Federal Energy Regulatory Commission
Office of Energy Projects
Washington, DC 20426

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
FOR THE
JORDAN COVE ENERGY PROJECT

Docket Nos. CP17-494-000 and CP17-495-000

FERC/DEIS-0292D

March 2019

Cooperating Agencies:

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

OFFICE OF ENERGY PROJECTS

In Reply Refer To:
OEP/DG2E/Gas Branch 3
Jordan Cove Energy Project, L.P.
Docket No. CP17-495-000
Pacific Connector Gas Pipeline, LP
Docket No. CP17-494-000
FERC/EIS-0292D

TO THE INTERESTED PARTIES:

The staff of the Federal Energy Regulatory Commission (FERC or Commission) with the participation of the cooperating agencies listed below, has prepared a draft environmental impact statement (EIS) for the Jordan Cove Liquefied Natural Gas Project proposed by Jordan Cove Energy Project L.P. (Jordan Cove) and the Pacific Connector Gas Pipeline Project proposed by Pacific Connector Gas Pipeline LP (Pacific Connector) (collectively referred to as the Jordan Cove Energy Project or Project). Under Section 3 of the Natural Gas Act (NGA), Jordan Cove requests authorization to liquefy at a terminal in Coos Bay, Oregon up to 1.04 billion cubic feet of natural gas per day for export for to overseas markets. Pacific Connector seeks a Certificate of Public Convenience and Necessity under Section 7 of the NGA to construct and operate an interstate natural gas transmission pipeline providing about 1.2 billion cubic feet per day of natural gas from the Malin hub to the Jordan Cove terminal, crossing portions of Klamath, Jackson, Douglas, and Coos Counties, Oregon.

The draft EIS assesses the potential environmental effects of the construction and operation of the Project in accordance with the requirements of the National Environmental Policy Act (NEPA). As described in the draft EIS, the FERC staff concludes that approval of the Project would result in a number of significant environmental impacts; however, the majority of impacts would be less than significant because of the impact avoidance, minimization, and mitigation measures proposed by Jordan Cove and Pacific Connector and those recommended by staff in the draft EIS.

The United States Department of the Interior Bureau of Land Management (BLM); U.S. Department of Agriculture Forest Service (Forest Service); Bureau of Reclamation (Reclamation); U.S. Department of Energy; U.S. Army Corps of Engineers; U.S. Environmental Protection Agency; U.S. Department of the Interior Fish and Wildlife Service; U.S. Department of Commerce National Oceanic and Atmospheric Administration's National Marine Fisheries Service; U.S. Department of Homeland

Security Coast Guard; the Coquille Indian Tribe; and the Pipeline and Hazardous Materials Safety Administration within the U.S. Department of Transportation participated as cooperating agencies in preparation of this EIS. Cooperating agencies have jurisdiction by law or special expertise with respect to resources potentially affected by the proposal and participate in the NEPA analysis. The cooperating agencies provided input into the conclusions and recommendations presented in the draft EIS. Following issuance of the final EIS, the cooperating agencies will issue subsequent decisions, determinations, permits or authorizations for the Project in accordance with each individual agency's regulatory requirements.

The BLM, with the concurrence of the Forest Service and Reclamation, would adopt and use the EIS to consider issuing a right-of-way grant for the portion of the Project on federal lands. Other cooperating agencies would use this EIS in their regulatory process, and to satisfy compliance with NEPA and other related federal environmental laws (e.g., the National Historic Preservation Act).

The BLM and the Forest Service would also use this EIS to evaluate proposed amendments to their District or National Forest land management plans that would make provision for the Pacific Connector pipeline. In order to consider the Pacific Connector right-of-way grant, the BLM must amend the affected Resource Management Plans (RMPs). The BLM therefore proposes to amend the RMPs to re-allocate all lands within the proposed temporary use area and right-of-way to a District-Designated Reserve, with management direction to manage the lands for the purposes of the Pacific Connector right-of-way. Approximately 885 acres would be re-allocated. District-Designated Reserve allocations establish specific management for a specific use or to protect specific values and resources. In accordance with Code of Federal Regulations (CFR) part 36 CFR 219.16, the Forest Service gives notice of its intent to consider amendments of Land and Resource Management Plans (LRMP) for the Umpqua, Rogue River and Winema National Forests. Proposed amendments of LRMPs include reallocation of matrix lands to Late Successional Reserves and site-specific exemptions from standards and guidelines and other LRMP requirements to allow construction of the Pacific Connector pipeline. Exemptions from standards and guidelines include requirements to protect known sites of Survey and Manage species, changes in visual quality objectives at specific locations, limitations on detrimental soil conditions, removal of effective shade at perennial stream crossings and the construction of utility corridors in riparian areas. Further information on Forest Service LRMP amendments is included below.

The Commission mailed a copy of the Notice of Availability of the draft EIS to federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; Indian Tribes; potentially affected landowners and other interested individuals and groups; and newspapers and libraries in the Project area. The draft EIS is only available in electronic format. It may be viewed and downloaded from the FERC's website (www.ferc.gov), on the Environmental Documents page (https://www.ferc.gov/industries/gas/enviro/eis.asp). In addition, the draft EIS may be accessed by using the eLibrary link on the FERC's website. Click on the eLibrary link (https://www.ferc.gov/docs-filing/elibrary.asp), click on General Search, and enter the docket number in the "Docket Number" field, excluding the last three digits (i.e., CP17-494 or CP17-495). Be sure you have selected an appropriate date range. For assistance, please contact FERC Online Support at FercOnlineSupport@ferc.gov or toll free at (866) 208-3676, or for TTY, contact (202) 502-8659.

Any person wishing to comment on the draft EIS may do so. Your comments should focus on the draft EIS's disclosure and discussion of potential environmental effects, reasonable alternatives, and measures to avoid or lessen environmental impacts. To ensure consideration of your comments on the proposal in the final EIS, it is important that the Commission receive your comments on or before 5:00 p.m. Eastern Time on **July 5, 2019.**

For your convenience, there are four methods you can use to submit your comments to the Commission.[1] The Commission will provide equal consideration to all comments received, whether filed in written form or provided verbally. The Commission encourages electronic filing of comments and has staff available to assist you at (866) 208-3676 or FercOnlineSupport@ferc.gov. Please carefully follow these instructions so that your comments are properly recorded.

1) You can file your comments electronically using the eComment feature on the Commission's website (www.ferc.gov) under the link to Documents and Filings. This is an easy method for submitting brief, text-only comments on a project;

2) You can file your comments electronically by using the eFiling feature on the Commission's website (www.ferc.gov) under the link to Documents and Filings. With eFiling, you can provide comments in a variety of formats by attaching them as a file with your submission. New eFiling users must first create an account by clicking on "eRegister." If you are filing a comment on a particular project, please select "Comment on a Filing" as the filing type; or

[1] The contents of your comment including your address, phone number, e-mail address, or other personal identifying information may be made available to the public. While you may request that your personal identifying information be withheld from public view, we cannot guarantee that we will be able to do so.

3) You can file a paper copy of your comments by mailing them to the following address. Be sure to reference the Project docket numbers (CP17-494-000 and CP17-495-000) with your submission: Kimberly D. Bose, Secretary, Federal Energy Regulatory Commission, 888 First Street NE, Room 1A, Washington, DC 20426

4) In lieu of sending written or electronic comments, the Commission invites you to attend a public comment session that will be held in the Project area to receive comments on the draft EIS. The dates, locations, and times of these sessions will be provided in a supplemental notice.

Any person seeking to become a party to the proceeding must file a motion to intervene pursuant to Rule 214 of the Commission's Rules of Practice and Procedures (18 CFR 385.214). Motions to intervene are more fully described at http://www.ferc.gov/resources/guides/how-to/intervene.asp. Only intervenors have the right to seek rehearing or judicial review of the Commission's decision. The Commission grants affected landowners and others with environmental concerns intervenor status upon showing good cause by stating that they have a clear and direct interest in this proceeding which no other party can adequately represent. **Simply filing environmental comments will not give you intervenor status, but you do not need intervenor status to have your comments considered.** Subsequent decisions, determination, permits, and authorization by the cooperating agencies are subject to the administrative procedures of each respective agency.

Questions?

Additional information about the Project is available from the Commission's Office of External Affairs, at **(866) 208-FERC**, or on the FERC website (www.ferc.gov) using the eLibrary link. The eLibrary link also provides access to the texts of all formal documents issued by the Commission, such as orders, notices, and rulemakings.

In addition, the Commission offers a free service called eSubscription that allows you to keep track of all formal issuances and submittals in specific dockets. This can reduce the amount of time you spend researching proceedings by automatically providing you with notification of these filings, document summaries, and direct links to the documents. Go to www.ferc.gov/docs-filing/esubscription.asp.

TABLE OF CONTENTS

1.0 INTRODUCTION 1-1
1.1 PROJECT SUMMARY 1-1
1.1.1 Previous Proposals 1-2
1.1.2 Proposed Action 1-3
1.2 APPLICANTS' PURPOSE AND NEED 1-6
1.3 FEDERAL AGENCY ROLES AND RESPONSIBILITIES 1-6
1.3.1 Federal Energy Regulatory Commission 1-7
1.3.2 U.S. Department of the Interior Bureau of Land Management 1-7
1.3.3 U.S. Department of Agriculture Forest Service 1-9
1.3.4 U.S. Department of the Interior Bureau of Reclamation 1-10
1.3.5 U.S. Department of Energy 1-10
1.3.6 U.S. Army Corps of Engineers 1-12
1.3.7 U.S. Environmental Protection Agency 1-12
1.3.8 U.S. Fish and Wildlife Service and National Marine Fisheries Service Review 1-13
1.3.9 U.S. Department of Homeland Security Coast Guard 1-13
1.3.10 U.S. Department of Transportation 1-14
1.3.11 Federal Aviation Administration (FAA) 1-15
1.4 PUBLIC REVIEW AND COMMENTS 1-15
1.5 PERMITS, APPROVALS, AND CONSULTATIONS 1-18
1.5.1 Federal Environmental Laws, Regulations, Permits, Approvals, and Consultations 1-18
1.5.2 State Agency Permits and Approvals 1-30

2.0 DESCRIPTION OF THE PROPOSED ACTION 2-1
2.1 PROJECT OPERATIONAL COMPONENTS 2-1
2.1.1 Jordan Cove LNG Project 2-1
2.1.2 Pacific Connector Pipeline and Associated Aboveground Facilities 2-19
2.1.3 BLM and Forest Service Land Management Plan Amendment Actions 2-22
2.1.4 Mitigation Actions Specific to the Right-of Way Grant on Federal Lands 2-32
2.1.5 Mitigation Plan Specific to NFS Lands 2-33
2.1.6 Right-of-Way Grant to Cross Federal Lands 2-35
2.1.7 Mitigation on Non-Federal Lands 2-36
2.2 NON-JURISDICTIONAL FACILITIES 2-36
2.2.1 LNG Carriers 2-37
2.2.2 Southwest Oregon Regional Safety Center 2-37
2.2.3 Fire Department 2-37
2.2.4 Trans-Pacific Parkway/U.S. 101 Intersection Widening 2-37
2.2.5 Utility Connections for the Pipeline Facilities 2-37
2.3 LAND REQUIREMENTS 2-38
2.3.1 Jordan Cove LNG Terminal Facilities 2-38
2.3.2 Pacific Connector Pipeline and Associated Aboveground Facilities 2-38

2.4 CONSTRUCTION PROCEDURES 2-45
2.4.1 Jordan Cove LNG Terminal 2-46
2.4.2 Pacific Connector Pipeline and Associated Aboveground Facilities 2-51
2.5 CONSTRUCTION SCHEDULE AND WORKFORCE 2-65
2.6 ENVIRONMENTAL Inspection, and COMPLIANCE MONITORING 2-66
2.6.1 Jordan Cove Environmental Inspection Program 2-66
2.6.2 FERC Environmental Compliance Monitoring 2-67
2.6.3 Monitoring by Land Managing Agencies on Federal Lands 2-67
2.7 OPERATION AND MAINTENANCE PROCEDURES 2-70
2.7.1 LNG Terminal Facilities 2-70
2.7.2 Pipeline and Associated Aboveground Facilities 2-71

3.0 ALTERNATIVES 3-1
3.1 NO ACTION ALTERNATIVE 3-3
3.2 SYSTEM ALTERNATIVES 3-4
3.3 LNG TERMINAL SITE ALTERNATIVES 3-8
3.3.1 LNG Terminal Site Alternatives in California 3-9
3.3.2 LNG Terminal Site Alternatives in Oregon and Washington (LNG Terminal Site Characteristics) 3-10
3.3.3 Coos Bay Terminal Alternatives 3-11
3.3.4 Inland (Non-Waterfront) Alternative 3-13
3.4 PIPELINE ROUTE ALTERNATIVES AND VARIATIONS 3-15
3.4.1 Major Route Alternatives 3-15
3.4.2 Pipeline Variations 3-16
3.5 CONCLUSION 3-45

4.0 SECTION 4 .... 4-I
4.1 GEOLOGICAL RESOURCES 4-3
4.1.1 Jordan Cove LNG Project 4-3
4.1.2 Pacific Connector Pipeline Project 4-4
4.1.3 Environmental Consequences on Federal Lands 4-33
4.1.4 Conclusion 4-40
4.2 SOILS AND SEDIMENTS 4-41
4.2.1 Jordan Cove LNG Project 4-41
4.2.2 Pacific Connector Pipeline Project 4-51
4.2.3 Environmental Consequences on Federal Lands 4-68
4.2.4 Conclusion 4-74
4.3 WATER RESOURCES AND WETLANDS 4-75
4.3.1 Groundwater 4-75
4.3.2 Surface Water 4-82
4.3.3 Wetlands 4-118
4.3.4 Environmental Consequences on Federal Lands 4-134
4.4 UPLAND VEGETATION 4-145
4.4.1 Jordan Cove LNG Project 4-145
4.4.2 Pacific Connector Pipeline Project 4-153
4.4.3 Environmental Consequences on Federal Lands 4-173
4.4.4 Conclusion 4-178

4.5 WILDLIFE AND AQUATIC RESOURCES....4-179
4.5.1 Terrestrial Wildlife....4-179
4.5.2 Aquatic Resources....4-229
4.6 THREATENED, ENDANGERED, AND OTHER SPECIAL STATUS SPECIES....4-309
4.6.1 Federally Listed Threatened and Endangered Species....4-310
4.6.2 State-Listed Threatened or Endangered Species....4-359
4.6.3 Other Special Status Species....4-368
4.6.4 Environmental Consequences on Federal Lands....4-371
4.7 LAND USE....4-400
4.7.1 Jordan Cove LNG Terminal....4-400
4.7.2 Pacific Connector Pipeline and Associated Facilities....4-414
4.7.3 Environmental Consequences on Federal Lands....4-425
4.7.4 Conclusion....4-532
4.8 RECREATION AND VISUAL RESOURCES....4-533
4.8.1 Recreation and Public Use Areas....4-533
4.8.2 Visual Resources....4-557
4.9 SOCIOECONOMICS....4-588
4.9.1 Jordan Cove LNG Project....4-588
4.9.2 Pacific Connector Pipeline Project....4-603
4.9.3 Environmental Consequences on Federal Lands....4-619
4.9.4 Conclusion....4-621
4.10 TRANSPORTATION....4-622
4.10.1 Jordan Cove LNG Project....4-622
4.10.2 Pacific Connector Pipeline Project....4-626
4.10.3 Environmental Consequences on Federal Lands....4-629
4.10.4 Conclusion....4-631
4.11 CULTURAL RESOURCES....4-632
4.11.1 Consultations....4-633
4.11.2 Area of Potential Effect....4-645
4.11.3 Results of Investigations....4-646
4.11.4 Unanticipated Discovery Plans....4-653
4.11.5 Compliance with the NHPA....4-654
4.11.6 Conclusion....4-655
4.12 AIR QUALITY AND NOISE....4-656
4.12.1 Air Quality....4-656
4.12.2 Noise and Vibration....4-678
4.13 RELIABILITY AND SAFETY....4-698
4.13.1 Jordan Cove LNG Project....4-698
4.13.2 Pacific Connector Pipeline Project....4-768
4.13.3 Conclusions....4-780
4.14 CUMULATIVE IMPACTS....4-782
4.14.1 Cumulative Effects....4-792
4.14.2 Cumulative Impact Conclusions....4-808

5.0 CONCLUSIONS AND RECOMMENDATIONS....5-1
5.1 CONCLUSIONS OF THE ENVIRONMENTAL ANALYSIS....5-1
5.1.1 Geology....5-1

5.1.2 Soils and Sediments 5-2
5.1.3 Water Resources and Wetlands 5-2
5.1.4 Vegetation 5-4
5.1.5 Wildlife and Aquatic Resources 5-4
5.1.6 Threatened, Endangered, and Other Special Status Species 5-5
5.1.7 Land Use 5-6
5.1.8 Recreation and Visual Resources 5-6
5.1.9 Socioeconomics 5-7
5.1.10 Transportation 5-8
5.1.11 Cultural Resources 5-8
5.1.12 Air Quality and Noise 5-9
5.1.13 Reliability and Safety 5-10
5.1.14 Cumulative Impacts 5-11
5.2 FERC STAFF'S RECOMMENDED MITIGATION 5-12

APPENDICES

Appendix A Distribution for Notice of Availability

Appendix B U.S. Coast Guard's Letter of Recommendation (LOR) for the Jordan Cove Energy LNG Project

Appendix C Pipeline Route and Work Area Maps

Appendix D Pipeline Facility Tables

Appendix E Pacific Connector's Proposed Modifications to FERC's Plan and Procedures

Appendix F BLM and Forest Service Supporting Documentation

F.1 Evaluation of Project Consistency with Federal Land Management Plans of the USDOI Bureau of Land Management and USDA Forest Service

F.2 Forest Service Proposed Amendments and CMP

F.3 Late Successional Reserves Crossed by the PCGP Project on National Forest System Lands

F.4 Aquatic Conservation Strategy Assessment

F.5 Survey and Manage Species Persistence Evaluation

F.6 Management Indicator Species Report

F.7 Biological Evaluation

F.8 Federal Lands Review

F.9 Blue Ridge Variation Comparison with Proposed Route

F.10 Plan of Development

Appendix G Soil and Geology Appendix

Appendix H Water and Wetlands Appendix

Appendix I Vegetation and Wildlife Appendix

Appendix J Site-Specific Residential Mitigation Plans

Appendix K Visual Resource Appendix

Appendix L Cultural Resources Appendix

Appendix M Air Quality/Noise Appendix

Appendix N Cumulative Effects

Appendix O List of Preparers

Appendix P References

LIST OF TABLES

Table 1.4-1	Environmental Issues Identified During the Pre-filing Public Scoping Process for the Jordan Cove and Pacific Connector Projects	1-16
Table 1.5.1-1	Major Permits, Approvals, and Consultations for the Jordan Cove & Pacific Connector Project	1-19
Table 2.1.1.8-1	Materials Excavated and Dredged During Construction of LNG Terminal Marine Facilities	72-16
Table 2.1.2.1-1	Pacific Connector Aboveground Facilities	2-19
Table 2.1.2.1-2	Proposed and Existing Gas Control Communication Towers	2-21
Table 2.1.3.2-1	Forest Service LRMP Amendments Associated with the Pacific Connector Pipeline Project that Apply to the Umpqua, Rogue River, and Winema National Forests	2-25
Table 2.1.3.3-1	LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Umpqua National Forest	2-26
Table 2.1.3.4-1	LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Rogue River National Forest	2-28
Table 2.1.3.5-1	LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Winema National Forest	2-30
Table 2.1.5-1	Mitigation Projects to Address LRMP Objectives on NFS Lands	2-34
Table 2.3.1-1	Land Requirements for the Jordan Cove LNG Project	2-38
Table 2.3.2-1	Land Requirements for the Pacific Connector Pipeline Project	2-39
Table 2.3.2.3-1	Federal Lands Affected by the Pacific Connector Pipeline Project	2-43
Table 2.3.2.3-2	BLM Federal Land Allocations – Miles Crossed by the Pacific Connector Pipeline	2-43
Table 2.3.2.3-3	Forest Service Federal Land Allocations – Miles Crossed by the Pacific Connector Pipeline	2-43
Table 2.3.2.3-4	U.S Bureau of Reclamation Administered Lands and Canals	2-44
Table 2.4.2.1-1	Permanent Slope Breaker Spacing from Pacific Connector's ECRP	2-58
Table 2.6.3-1	Pacific Connector's Plan of Development	2-68
Table 3.2-1	Proposed Canadian LNG Projects	3-7
Table 3.3.2-1	LNG Terminal Port Alternatives Comparison	3-11
Table 3.3.3-1	Comparison of Proposed and Jordan Point Alternative LNG Sites	3-13
Table 3.4.2.1-1	Comparison of Coos Bay Estuary Variations with Proposed Route	3-19
Table 3.4.2.2-1	Comparison of Blue Ridge Variation with the Proposed Route	3-23
Table 3.4.2.3-1	Comparison of Weaver Ridge Variations with the Proposed Route	3-27
Table 3.4.2.4-1	Comparison of Camas Valley Northern Variation with the Proposed Route	3-30
Table 3.4.2.5-1	Comparison of Umpqua National Forest Variations with the Proposed Route	3-33
Table 3.4.2.6-1	Comparison of Rogue River National Forest Variations with the Proposed Route	3-35
Table 3.4.2.8-1	East Fork Cow Creek Variation	3-41

Table 3.4.2.9-1 Comparison of the PCT Variation with the Proposed Route 3-44
Table 4.1.2.3-1 Historical Earthquakes within 100 Miles of the Proposed Pacific Connector Pipeline 4-11
Table 4.1.2.3-2 Summary of Potential Liquefaction and Lateral Spreading Hazards 4-17
Table 4.1.2.5-1 Rock Source and/or Permanent Disposal Sites 4-26
Table 4.1.2.6-1 Summary of Blasting Potential Along the Proposed Pacific Connector Pipeline 4-28
Table 4.2.1.1-1 Acres of Impacts at the Jordan Cove LNG Project, by Soil Type 4-42
Table 4.2.1.2-1 Summary of Applicable ODEQ and EPA Screening Levels Concentrations (in parts per million [ppm]) 4-47
Table 4.2.2.1-1 Acreages and Soil Characteristics Crossed by the Pacific Connector Pipeline 4-53
Table 4.2.2.2-1 Areas Where Topsoil Would be Salvaged Along the Pacific Connector Pipeline 4-56
Table 4.2.2.3-1 Summary of Soils Limitations – Pacific Connector Pipeline Aboveground Facilities 4-63
Table 4.2.2.3-2 Contractor and Pipe Storage Yards with Sensitive Soil Characteristics (Pastures, Fields and Vacant Lots) 4-67
Table 4.2.3.1-1 Thresholds for Detrimental Soil Conditions on NFS Lands 4-69
Table 4.2.3.1-2 Mitigation Projects to Address LMP Amendments on NFS Lands...........4-72
Table 4.2.3.2-1 Risk/Sensitivity Ratings by Administrative Unit by Watershed (Acres) 4-73
Table 4.3.1.1-1 Projected Water Usage for the Proposed Jordan Cove LNG Project......4-76
Table 4.3.1.2-1 Wellhead Protection Areas Crossed by the Pacific Connector Pipeline Project 4-79
Table 4.3.1.2-2 Private Wells Within 200 Feet of Construction Work Space for the Pacific Connector Pipeline Project..4-80
Table 4.3.2.2-1 Subbasins and Watersheds Crossed by Proposed Pacific Connector Pipeline 4-92
Table 4.3.2.2-2 FERC Designated Major Waterbodies Crossed by Pacific Connector Pipeline by County and Fifth-Field Watershed.......................................4-94
Table 4.3.2.2-3 Surface Water Public DWSAs Crossed by the Proposed Pacific Connector Pipeline 4-96
Table 4.3.2.2-4 Surface Water Intakes for Potable Drinking Water Supply......................4-97
Table 4.3.2.2-5 Points of Diversion within 150 feet of Pacific Connector Construction Work Area 4-98
Table 4.3.2.2-6 Streams Crossed by the Pacific Connector Pipeline Route That Have a High Potential for Scour or Migration.......................................4-108
Table 4.3.2.2-7 Potential Hydrostatic Test Water Quantity and Source Locations.........4-110
Table 4.3.2.2-8 Potential Dust Control Water Sources for the Pacific Connector Pipeline 4-112
Table 4.3.2.2-9 Predicted Modeled Temperatures at Selected Stream Crossings Along the Pacific Connector Pipeline Route 4-115
Table 4.3.3.1-1 Wetlands Impacts on the LNG Project Area 4-127

Table 4.3.3.2-1	Summary of Wetland Impacts along the Pacific Connector Pipeline	4-132
Table 4.3.4.2-1	Fifth-Field Watersheds Crossed by the Pacific Connector Pipeline on Forest Service Lands	4-137
Table 4.3.4.2-2	Key Watersheds Crossed by the Proposed Pacific Connector Pipeline	4-137
Table 4.4.1.5-1	Impacts on Vegetation Type from the Jordan Cove LNG Project	4-151
Table 4.4.1.6-1	Noxious Weeds and Invasive Aquatic Species Documented or with Potential to Occur in the Jordan Cove LNG Project Area	4-152
Table 4.4.2-1	Vegetation Types Crossed by the Pacific Connector Pipeline Project	4-154
Table 4.4.2.4-1	Construction Impacts on Vegetation by the Pacific Connector Pipeline Project (acres)	4-161
Table 4.4.2.4-2	Operation Impacts on Vegetation by the Pacific Connector Pipeline Project	4-163
Table 4.4.2.5-1	Oregon Target Weeds (List T) Suspected within or Near the Proposed Pacific Connector Pipeline Work Area	4-168
Table 4.4.2.5-2	Summary of Noxious Weeds found within the Vicinity of the Pacific Connector Pipeline Route during Surveys	4-169
Table 4.4.2.6-1	Summary of Known Infestations of Insect Parasites and Tree Diseases Along the Pacific Connector Pipeline Route	4-171
Table 4.4.2.7-1	Historic Average Fire Frequency and Extent of Acreage Burned in Watersheds Crossed by the Proposed Pacific Connector Pipeline	4-172
Table 4.5.1.1-1	Birds of Conservation Concern in the Project Area, Timing of Potential Occurrence, and Expected Habitat	4-182
Table 4.5.1.1-2	Acres of Wildlife Habitat Types Affected by Construction and Operation of the Jordan Cove LNG Project	4-185
Table 4.5.1.2-1	Wildlife Habitat Types Crossed by the Pacific Connector Pipeline and Wildlife Species Associated with Habitats	4-193
Table 4.5.1.2-2	Non-Special Status Bat Species and Associated Habitats Likely to Occur In the Project Area	4-196
Table 4.5.1.2-3	Birds of Conservation Concern in BCR-5 and BCR-9 that Have Been Observed on BBS Routes within 50 Miles of the Pacific Connector Pipeline Project with Regional and Local Population Trends, and Breeding Dates, if Known	4-198
Table 4.5.1.2-4	Designated Big Game Winter Range Crossed by the Pacific Connector Pipeline	4-202
Table 4.5.1.2-5	Summary of Construction-Related Effects on Habitat by the Pacific Connector Pipeline (acres a/)	4-204
Table 4.5.1.2-6	Summary of Operation-Related Effects on Habitat by the Pacific Connector Pipeline (acres a/)	4-206
Table 4.5.1.2-7	Common Sound Levels for Equipment/Activities Potentially Associated with the Pacific Connector Pipeline	4-211
Table 4.5.1.2-8	FWS Recommended Spatial Buffers Surrounding Raptor Nests of Species that May Occur in the Vicinity of the Pacific Connector Pipeline	4-219

Table 4.5.1.2-8	FWS Recommended Spatial Buffers Surrounding Raptor Nests of Species that May Occur in the Vicinity of the Pacific Connector Pipeline	4-220
Table 4.5.1.2-9	Acres of Habitat Types Affected in Big Game Winter Ranges by Construction and Operation of the Pacific Connector Pipeline by Landowner	4-222
Table 4.5.1.3-1	Acres of Construction-Related Disturbance to Wildlife Habitat Types by the Pacific Connector Pipeline on Federal Land, and Wildlife Species Associated with Johnson and O'Neil (2001) Habitats	4-225
Table 4.5.1.3-2	Snag Density Estimates on NFS Lands	4-228
Table 4.5.2.2-1	Taxa Groups Collected in Coos Bay Near the Jordan Cove Terminal During 2009–2011	4-239
Table 4.5.2.2-2	Estuarine Habitat Affected by Construction of the Jordan Cove LNG Project Facilities and Marine Waterway Modifications in the Federal Navigation Channel	4-241
Table 4.5.2.2-3	M-Weighted PTS Criteria and Functional Hearing Range for Marine Mammals	4-251
Table 4.5.2.2-4	Modeled Onset of Injury Distances of Unmitigated Metal Pile-Driving Sound Effects on Fish in Coos Bay during Construction	4-253
Table 4.5.2.2-5	Comparison of Relative Loss of Larval Invertebrates and Larval Fish from Entrainment to Natural Mortality During Cooling Water Intake for One LNG Vessel Docked at the Jordan Cove Terminal	4-258
Table 4.5.2.2-6	Selected Survival Values by Life Stage of Marine Species That May Be Entrained or Impinged	4-259
Table 4.5.2.3-1	Number of Waterbodies Crossed or Adjacent to the Pacific Connector Pipeline, by Fish Status Category and Fifth-Field Watershed	4-272
Table 4.5.2.3-2	Proposed Waterbody Crossing Methods for All Waterbody Crossings, by Subbasins and Fifth-Field Watersheds	4-274
Table 4.5.2.3-3	Estimates of Total Suspended Sediment Concentrations (TSS) Generated during In-stream Construction and Estimated Downstream Distance to Attenuate to Ambient TSS in Fish-bearing Watersheds that Would Be Crossed by the Pipeline	4-280
Table 4.5.2.3-4	Number of Streams Within Four Width Classed that Would be Crossed by Dry-Open Cuts and Estimated Duration (a/) of In-Stream Generating Actions	4-281
Table 4.5.2.3-5	Total Terrestrial Habitat (acres) Affected/Removed (a/) by Construction and within the 30-Foot-Wide Maintained Operation Corridor Riparian Zones (One Site-Potential Tree Height Wide) Adjacent to Perennial and Intermittent Waterbodies Crossed/Near the Pacific Connector Pipeline Project	4-290
Table 4.5.2.3-6	Hydrostatic Testing Water Requirements and Flow Impacts on Water Sources	4-300
Table 4.5.2.4-1	Number of Streams Crossed by the Pacific Connector Pipeline Route on Federal Lands by Fish Status Category within Each Fifth-Field Watershed Coinciding with the Pacific Connector Project	4-304

Table 4.6.1-1	Federally Listed and Proposed Species Potentially Occurring in the Project Area	4-310
Table 4.6.2-1	State-Listed Species Potentially Occurring in the Area Affected by the Proposed Project	4-359
Table 4.6.3.5-1	Numbers of Other Special Status Species Potentially Affected by the Project	4-371
Table 4.6.4.1-1	Numbers of BLM and Forest Service Sensitive Species within the Four BLM Districts and Three National Forests Crossed by the Proposed Pacific Connector Pipeline	4-373
Table 4.6.4.1-2	BLM and Forest Service Sensitive Species with the Potential to be Affected by the Project	4-373
Table 4.6.4.3-1	Regional Site Count of Fungi Species Potentially Affected by the Project	4-386
Table 4.6.4.3-2	Fungi Sites Potentially Affected by the Project	4-387
Table 4.6.4.3-3	Regional Site Count of Lichen Species Potentially Affected by the Project	4-390
Table 4.6.4.3-4	Lichen Sites Potentially Affected by the Project	4-391
Table 4.6.4.3-5	Affected Lichen Sites by National Forest	4-391
Table 4.6.4.3-6	Regional Site Count of Plant Species Potentially Affected by the Project	4-392
Table 4.6.4.3-7	Vascular Plant Sites Potentially Affected by Project	4-393
Table 4.6.4.3-8	Regional Site Count of Mollusk Species Potentially Affected by the Project	4-394
Table 4.6.4.3-9	Mollusk Sites Potentially Affected by the Project	4-395
Table 4.6.4.3-10	Affected Mollusk Sites by National Forest	4-396
Table 4.6.4.3-11	Regional Site Count of Vertebrate Species Potentially Affected by the Project	4-397
Table 4.6.4.3-12	Vertebrate Sites Potentially Affected by the Project	4-398
Table 4.6.4.3-13	Affected Vertebrate Sites by National Forest	4-398
Table 4.7.1.1-1	Land Ownership of the Jordan Cove Project Area Facilities	4-400
Table 4.7.1.1-2	Land Uses Affected by Construction and Operation of Aboveground Jordan Cove Project Area Facilities (in acres)	4-409
Table 4.7.2.1-1	Land Crossed by the Pacific Connector Pipeline by Ownership	4-414
Table 4.7.2.2-1	Land Uses Crossed by the Pacific Connector Pipeline ROW	4-415
Table 4.7.2.2-2	Acres of Land Affected by Construction and Operation of the Pacific Connector Pipeline Project	4-416
Table 4.7.2.2-3	Acres Affected by Operation of Pacific Connector Proposed Aboveground Facilities	4-418
Table 4.7.2.4-1	Residences within 50 Feet of the Construction ROW or Temporary Extra Work Areas	4-420
Table 4.7.2.5-1	Merchantable Timber to be Cleared for the Proposed Pacific Connector Pipeline, by Class and Age	4-422
Table 4.7.3.1-1	Federal Lands Affected by the Pacific Connector Pipeline Project	4-426

Table 4.7.3.1-3	Land Management and Land Use Activities That Would be Prohibited or Restricted on the Proposed Pacific Connector Pipeline Construction and Operational Rights-of-Way	4-429
Table 4.7.3.3-1	O&C Lands, Coos Bay Wagon Road Lands, and Reserved Public Domain Lands Crossed by the Pacific Connector Pipeline (miles)	4-434
Table 4.7.3.3-2	Forest Service NWFP Land Allocations – Acres Impacted by the Pipeline	4-437
Table 4.7.3.3-3	BLM RMP Land Allocations – Acres Impacted by the Pacific Connector Pipeline	4-441
Table 4.7.3.5-1	Provinces, River Basins and Watersheds on NFS Lands Subject to the ACS	4-487
Table 4.7.3.5-2	Summary of Riparian Reserves, Stream Channels and Wetlands Crossed by the Pacific Connector Pipeline on NFS Lands by Administrative Unit	4-493
Table 4.7.3.5-3	Vegetation Age Class Structure of Riparian Reserves Cleared in Construction Corridor and TEWAs by Administrative Unit, Forest Service	4-494
Table 4.7.3.5-4	Fifth-Field Watersheds and Land Allocations Crossed by the Pacific Connector Gas Pipeline Corridor ROW on NFS Lands	4-495
Table 4.7.3.5-5	Compliance of the Project with ACS Objectives, Days Creek–South Umpqua River Watershed	4-496
Table 4.7.3.5-6	Compliance of the Project with ACS Objectives, Elk Creek–South Umpqua River Watershed	4-498
Table 4.7.3.5-7	Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Upper Cow Creek Watershed	4-500
Table 4.7.3.5-9	Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Little Butte Creek	4-509
Table 4.7.3.5-10	Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Spencer Creek Watershed	4-513
Table 4.7.3.6-1	Direct Effects (a/) of the Proposed Project on Mapped LSRs (acres)	4-518
Table 4.3.7.6-2	Summary of Total LSR Acres Directly and Indirectly (a/) Affected by the Proposed Project	4-520
Table 4.7.3.6-3	Comparison of Total LSR Acres Cleared (a/) by the Project and the Acres of Matrix Reallocated to LSR	4-521
Table 4.7.3.6-4	Comparison of LSR 223 Acres Affected (a/) by the Project and Acres of Matrix Reallocated to LSR	4-526
Table 4.7.3.6-5	Comparison of Total LSR Acres Affected a/ by the Project and Acres of Matrix Reallocated to LSR	4-531
Table 4.8.2.3-1	Forest Service Crosswalk Between Visual Quality Objectives, Scenic Integrity Objectives, and Scenic Integrity Levels	4-581
Table 4.8.2.3-2	BLM Visual Resource Management Classes	4-582
Table 4.8.2.3-3	Sensitive Viewsheds on Federal Lands and Proposed Mitigation Measures	4-583
Table 4.9.1.1-1	Population by State, County, and Community	4-588
Table 4.9.1.4-1	Regional Economic Impacts of Construction of the Jordan Cove Project in Oregon	4-593

Table 4.9.1.9-1 Demographic Indicators 4-600
Table 4.9.2.1-1 Population by State and County 4-603
Table 4.9.2.2-1 Housing 4-605
Table 4.9.2.2-2 Estimated Housing Demand by Pacific Connector Construction Workers 4-606
Table 4.9.2.2-3 Estimated Housing Demand by Pacific Connector Construction Workers as a Share of Estimated Supply 4-606
Table 4.9.2.4-1 Employment and Labor Statistics for the Pacific Connector Pipeline Project Area 4-608
Table 4.9.2.4-2 Regional Economic Impacts of Construction of the Pacific Connector Pipeline Project in Oregon 4-609
Table 4.9.2.5-1 Revenues for the Counties Crossed by the Pacific Connector Pipeline, FY 2016 4-610
Table 4.9.2.6-1 Hospitals in the Counties Crossed by the Pacific Connector Pipeline ...4-612
Table 4.9.2.7-1 Estimated Construction Traffic Impacts on SH62 near Shady Cove and Trail 4-614
Table 4.9.2.7-2 Travel Spending, Earnings, and Employment, 2016 4-615
Table 4.9.2.9-1 Race and Ethnicity in Counties Crossed by the Pacific Connector Pipeline 4-617
Table 4.9.2.9-2 Demographic Indicators 4-618
Table 4.9.3.1-1 Financial Efficiency Analysis of the Pacific Connector Pipeline Project 4-620
Table 4.10.2.1-1 Proposed New Temporary and Permanent Construction Access Roads 4-627
Table 4.10.2.2-1 Estimated Peak Vehicle Round Trips per Day by Pipeline Spread 4-629
Table 4.11.3.2-1 Cultural Resources Surveys of Jordan Cove's Proposed LNG Terminal Facilities 4-647
Table 4.11.3.3-1 Cultural Resources Surveys Conducted for the Pacific Connector Project 4-650
Table 4.12.1.1-1 Estimated Construction PM_{10} Emissions in Klamath Falls PM_{10} Maintenance Area (tons) from the Pacific Connector Pipeline Project 4-658
Table 4.12.1.2-1 Existing Air Quality Concentrations for Criteria Air Pollutants Near the Jordan Cove LNG Project 4-665
Table 4.12.1.2-2 Existing Air Quality Near Proposed Klamath Compressor Station 4-667
Table 4.12.1.3-1 Estimated Emissions from Terminal Construction Activities, By Year (tons) 4-669
Table 4.12.1.3-2 Estimated Emissions During Operation of the Jordan Cove LNG Project (tons per year) 4-670
Table 4.12.1.3-3 Maximum Combined Impacts of Jordan Cove LNG Project, Marine Vessels, and Nearby Major Sources 4-672
Table 4.12.1.4-1 Estimated Emissions from Construction of the Klamath Compressor Station and Pacific Connector Pipeline (tons) 4-673
Table 4.12.1.4-2 Criteria Pollutant Emissions from Operation of Klamath Compressor Station and Pacific Connector Pipeline (tons per year) 4-675

Table 4.12.1.4-3	Screening-Level CO and NO_2 Impacts from Compressor Station Turbines	4-676
Table 4.12.1.5-1	Maximum Impacts of Jordan Cove LNG Project at Class I Areas	4-677
Table 4.12.2.1-1	Oregon Noise Limits For Industrial and Commercial Noise Sources	4-680
Table 4.12.2.1-2	Octave Band Noise Limits For Industrial and Commercial Noise Sources	4-680
Table 4.12.2.2-1	Ambient Noise Levels for the Jordan Cove LNG Terminal Measured at Nearby NSAs	4-682
Table 4.12.2.2-2	Ambient Noise Levels for the Klamath Compressor Station Measured at Nearby NSAs	4-683
Table 4.12.2.3-1	Predicted Construction Noise Levels at NSAs (dBA)	4-684
Table 4.12.2.3-2	Predicted Pile Driving Noise Levels at NSAs (dBA)	4-684
Table 4.12.2.3-3	Predicted Dredging Noise Levels at NSAs (dBA)	4-685
Table 4.12.2.3-4	Predicted Project Noise Emissions at NSAs compared to Regulatory Limits for Jordan Cove LNG Project (dBA)	4-686
Table 4.12.2.3-5	Predicted Process and Marine Flare Noise Levels at NSAs (dBA)	4-688
Table 4.12.2.4-1	Ambient Noise Levels for the Pacific Connector HDD Sites Measured at Nearby NSAs	4-690
Table 4.12.2.4-2	Summary of HDD Acoustic Modeling Results	4-692
Table 4.12.2.4-3	Predicted Operational Noise Levels of the Klamath Compressor Station	4-694
Table 4.12.2.4-4	Blowdown Valve Sound Pressure Level at Various Distances	4-695
Table 4.12.2.4-5	Summary of Blowdown Acoustic Modeling Results	4-696
Table 4.13.2.1-1	USDOT Class Locations for the Proposed Pacific Connector Pipeline	4-770
Table 4.13.2.1-2	USDOT Class 3 Locations and High Consequence Areas Crossed by and Adjacent to the Proposed Pacific Connector Pipeline	4-772
Table 4.13.2-3	Natural Gas Transmission Pipeline Significant Incidents by Cause (1996–2015)	4-776
Table 4.13.2.2-2	Outside Forces Significant Incidents by Cause (1996-2015)	4-777
Table 4.13.2.3-1	Injuries and Fatalities – Natural Gas Transmission Pipelines	4-779
Table 4.13.2.3-2	Accidental Deaths by Cause	4-780
Table 4.14-1	Geographic Scope, by Resource, for Cumulative Effects Analysis	4-786
Table 4.14-2	Past, Present, or Reasonably Foreseeable Actions that May Cumulatively Affect Resources	4-789
Table 4.14.1-1	Area Affected by Projects Included in Cumulative Effects Analysis, by Watershed	4-792

LIST OF FIGURES

Figure 1.1-1.	General Location	1-5
Figure 2.1-1	Jordan Cove LNG Project General Location	2-2
Figure 2.1-2	LNG Terminal Facilities	2-3
Figure 2.1-3	Jordan Cove LNG Project Detail	2-4
Figure 2.1-4.	Typical Full Containment LNG Storage Tank	2-6
Figure 2.1-5	Industrial Wastewater Pipeline, Water Pipelines Relocation, and Utility Tie-Ins	2-9
Figure 2.1-6	Proposed LNG Carrier Transit Route	2-11
Figure 2.1-7	Plot Plan of the Marine Facilities	2-13
Figure 2.1-8	Profile of Marine Berth	2-15
Figure 2.3-1.	Typical Pipeline Right-of-Way Cross Sections	2-40
Figure 2.4-1.	Typical Pipeline Construction Sequence	2-53
Figure 3.2-1.	System Alternatives	3-6
Figure 3.3-1.	Jordan Point Site Alternative	3-12
Figure 3.4-1.	Coos Bay Estuary Variations	3-18
Figure 3.4-2.	Blue Ridge Route Variations	3-22
Figure 3.4-3.	Weaver Ridge Variations	3-26
Figure 3.4-4.	Camas Valley Northern VariationE	3-29
Figure 3.4-5.	Umpqua National Forest Variations	3-32
Figure 3.4-6.	Rogue River National Forest Variations	3-36
Figure 3.4-7.	Survey and Manage Species Variation	3-38
Figure 3.4-8.	East Fork Cow Creek Variation	3-40
Figure 3.4-9.	Pacific Crest Trail Variation	3-43
Figure 4.3-1a.	Wetland Delineation of the Jordan Cove Project Area (LNG Terminal and APOC Sites)	4-120
Figure 4.3-1b.	Wetland Delineation of the Jordan Cove Project Area (Access Channel, MOF, and Pile Dike Rock Apron Estuarine Impacts)	4-121
Figure 4.3-1c.	Wetland Delineation of the Jordan Cove Project Area (Navigation Reliability Improvements [NRI] Dredge Areas and Temporary Dredge Line	4-122
Figure 4.3-1d.	Wetland Delineation of the Jordan Cove Project Area (Temporary Dredge Line to APCO Site 2 and Kentuck Temporary Dredge Transfer Line)	4-123
Figure 4.3-1e.	Wetland Delineation of the Jordan Cove Project Area (North Bank and Kentuck Project Sites)	4-124
Figure 4.3-1f.	Wetland Delineation of the Jordan Cove Project Area (Laydown and Park & Ride Sites)	4-125
Figure 4.4-1a.	Vegetation Associations	4-146
Figure 4.4-1b.	Vegetation Associations	4-147

Figure 4.5-1. Aquatic Analysis Areas Along the Waterway, including Essential Fish Habitat....4-230
Figure 4.5-2. Shrimp and Oyster Distributions and Shellfish Areas in Coos Bay....4-240
Figure 4.5-3. Submerged Aquatic Vegetation within the Slip and Navigation Channel....4-242
Figure 4.5-4. Effects of Pipeline Stream Crossing Suspended Sediment Concentrations on Salmonids....4-277
Figure 4.7-1a. Land Ownership....4-401
Figure 4.7-1b. Land Ownership....4-402
Figure 4.7-1c. Land Ownership....4-403
Figure 4.7-2a. Land Use Types within 0.25 Mile....4-406
Figure 4.7-2b. Land Use Types within 0.25 Mile....4-407
Figure 4.7-2c. Land Use Types within 0.25 Mile....4-408
Figure 4.7-3a. Structures Within 0.25 Mile of the Jordan Cove Site....4-411
Figure 4.7-3b. Structures Within 0.25 Mile of the Jordan Cove Site....4-412
Figure 4.7-3c. Structures Within 0.25 Mile of the Jordan Cove Site....4-413
Figure 4.7-4. Provinces, and Watersheds Crossed by the Pacific Connector Pipeline Project....4-490
Figure 4.7-5. Direct Effects of the Proposed Project on Mapped LSRs (acres)....4-518
Figure 4.7-6. Summary of Total LSR Acres Directly and Indirectly Affected....4-520
Figure 4.7-7. Comparison of Total LSR Acres Cleared by the Project and Total Acres of Matrix Reallocated to LSR....4-521
Figure 4.7-8. Map of Proposed Project and LSRs in the Umpqua National Forest....4-523
Figure 4.7-9. Proposed Off-Site Mitigation Actions in LSR 223....4-525
Figure 4.7-10. Comparison of Total LSR 223 Acres Affected by the Project and Acres of Matrix Reallocated to LSR....4-526
Figure 4.7-11. Map of Proposed Project and LSR in the Rogue River National Forest....4-528
Figure 4.7-12. Proposed Off-Site Mitigation Actions in the Rogue River National Forest....4-530
Figure 4.7-13. Comparison of Total LSR Acres Affected by the Project and Acres of Matrix Reallocated to LSR....4-531
Figure 4.8-1. Recreation Areas in the Vicinity of the Jordan Cove LNG Terminal....4-534
Figure 4.8-2. Key Observation Point (KOP) Locations....4-560
Figure 4.8-3. BLM VRM and Forest Service VQO Classes for the Project Area and Location of KOPs located between MP 0 and MP 85....4-569
Figure 4.8-4. BLM VRM and Forest Service VQO Classes for the Project Area and Location of KOPs located between MP 85 and MP 155....4-570
Figure 4.8-5. BLM VRM and Forest Service VQO Classes for the Project Area and Location of KOPs located between MP 155 and MP 228....4-571
Figure 4.9-1. 2010 Census Tracts in the Jordan Cove Project Area....4-602
Figure 4.13-1 Accidental Hazard Zones along LNG Marine Vessel Route....4-708
Figure 4.13-2. Intentional Hazard Zones along LNG Marine Vessel Route....4-709

Figure 4.14-1a. Watersheds and Counties Crossed by the Project 4-787
Figure 4.14-1b. Watersheds and Counties Crossed by the Project 4-788

TECHNICAL ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
μg/m^3	micrograms per cubic meter
μPa	microPascal
AADT	average annual daily traffic
AAQS	ambient air quality standards
AASHTO	American Association of State Highway Transportation Officials
ACDP	air contaminant discharge permit
ACEC	Area of Critical Environmental Concern
ACHP	Advisory Council on Historic Preservation
ACI	American Concrete Institute
AEGL	Acute Exposure Guideline Level
AIChE	American Institute of Chemical Engineers
AGPA	Alaska Gasline Port Authority
AKWA	Area of Known Wolf Activity
ALPEMA	Aluminum Plate-Fin Heat Exchanger Manufacturer’s Association
AMSL	above mean sea level
ANFO	Ammonium Nitrate and Fuel Oil
ANSI	American National Standards Institute
APDBA	applicant-prepared draft biological assessment
APCO	Al Pierce Company
APE	area of potential effect
API	American Petroleum Institute
Applicants	Jordan Cove Energy L.P. and Pacific Connector Gas Pipeline L.P.
AQCR	Air Quality Control Region
AQRV	Air Quality-Related Values
ARSC	Aquatic Resources of Special Concern
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASR	Annual Species Review
ATV	all-terrain vehicle
Authorization	Section 3 Authorization
BA	biological assessment
BAC	Byram Archaeological Consulting, LLC
BBS	breeding bird survey
B.C.	British Columbia
Bcf/d	billion cubic feet per day
BCC	Birds of Conservation Concern
BCR	Bird Conservation Region
BE	Biological Evaluation
Bgs	below ground surface
BIA	U.S. Department of the Interior Bureau of Indian Affairs
BLEVE	boiling-liquid-expanding-vapor explosion
BLM	U.S. Department of the Interior Bureau of Land Management
BMP	best management practice
BO	biological opinion

BOG	boil-off gas
BPA	Bonneville Power Administration
BPVC	Boiler and Pressure Vessel Code
BST	Baker-Strehlow-Tang
BTEX	benzene, toluene, ethylbenzene, and xylene
Btu	British thermal units
Btu/ft-hr-°F	British thermal units per foot per hour per degrees Fahrenheit
BWE	ballast water exchange
BWM	Ballast Water Management
CAA	Clean Air Act
CadnaA	computer aided noise abatement
CBC	Christmas Bird Count
CBNBWB	Coos Bay-North Bend Water Board
CCPS	Center for Chemical Process Safety
CCS	carbon capture and storage
CDI	Coastal Dependent Industry
CEP	Community Enhancement Plan
CEQ	Council on Environmental Quality
Certificate	Certificate of Public Convenience and Necessity
CFD	computational fluid dynamics
CFR	Code of Federal Regulations
CH_4	methane
CHE	Coast and Harbor Engineering
CHU	critical habitat unit
CIT	Coquille Indian Tribe
CMP	Compensatory Mitigation Plan
CMZ	Channel Migration Zone
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
Coast Guard	U.S. Department of Homeland Security Coast Guard
COE	U.S. Army Corps of Engineers
Commission	Federal Energy Regulatory Commission
Coos Tribes	Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians
COTP	Captain of the Port
Cow Creek Tribe	Cow Creek Band of Umpqua Tribe of Indians
CP	cathodic protection
CRPA	Cultural Resources Protection Agreement
CSZ	Cascadia subduction zone
CTCLUSI	Confederated Tribes of the Lower Umpqua, Coos, and Siuslaw Indians
CWA	Clean Water Act
CWD	coarse woody debris
Cy	cubic yard
CZMA	Coastal Zone Management Act
dB	decibel
dBA	A-weighted decibels
dBC	C-weight decibels
Dbh	diameter at breast height

dB_{RMS}	decibels root mean squared
DCS	distributed control system
DEA	David Evans & Associates, Inc.
DEGADIS	dense gas dispersion model
DEIS	draft environmental impact statement
DEM	digital elevation model
DHA	Department of Homeland Security
DMEF	Dredged Material Evaluation Framework
DMMU	Dredged Material Management Unit
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE/FE	U.S. Department of Energy, Office of Fossil Energy
DOGAMI	Oregon Department of Geology and Mineral Industries
DP	Direct Pipe
DPS	Distinct Population Segments
Dth/d	dekatherms per day
DWSA	drinking water source area
EA	Environmental Assessment
Eagle Act	Bald and Golden Eagle Protection Act of 1940, as amended
EAR	existing access road
ECA	Emissions Control Area
ECRP	Pacific Connector's *Erosion Control and Revegetation Plan*
ECSI	Environmental Cleanup Site Information
EDRR	Early Detection Rapid Response
EEZ	economic exclusion zone
EFCC	East Fork Cow Creek
EFH	essential fish habitat
EI	environmental inspector
EIS	Environmental Impact Statement
EJSCREEN	Environmental Justice Mapping and Screening Tool
EMD	electric motor driven
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPAct	Energy Policy Act of 2005
ERMA	Extensive Recreation Management Area
ERP	emergency response plan
ESA	Endangered Species Act
ESCP	Erosion and Sedimentation Control Plan
ESD	emergency shutdown
ESU	Evolutionarily Significant Units
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FDS	Fire Dynamics Simulator
FEED	front-end engineering design
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FGS	Fire and Gas Systems
FHWA	Federal Highway Administration
FLPMA	Federal Land and Policy Management Act of 1976

FOI	Forest Operations Inventory
Forest Service	U.S. Department of Agriculture Forest Service
Fort Chicago Holdings	Fort Chicago Holdings II US LLC
Fps	foot per second
FR	*Federal Register*
FSA	Facility Security Assessment
FSH	Forest Service Handbook
FSM	Forest Service Manual
FSP	Facility Security Plan
ft^3	cubic feet
FTA	free trade agreement
FTE	full-time equivalent
FWCA	Fish and Wildlife Coordination Act
FWS	U.S. Department of the Interior Fish and Wildlife Service
g/hp-hr	grams per horsepower per hour
GeoBOB	Geographic Biotic Observations
GHG	greenhouse gas
GIS	geographic information system
Gpm	gallons per minute
Grand Ronde Tribes	Confederated Tribes of the Grand Ronde Reservation
GRI	GRI Geotechnical and Environmental Consultants
GTN	Gas Transmission Northwest LLC
H_2S	hydrogen sulfide
HAP	Hazardous Air Pollutant
HAZID	Hazard Identification
HAZOP	hazard and operability review
HCA	high consequence area
HDD	horizontal directional drill
HEC-RAS	Hydrologic Engineering Center-River Analysis System
HF	high-frequency
HMA	Herd Management Area
HMT	highest measured tide
Hp	horsepower
HPMP	Historic Properties Management Plan
HRA	Historical Research Associates, Inc.
HUC	Hydrologic Unit Code
Hz	hertz
I-5	Interstate 5
IM	Instruction Memorandum
IMO	International Maritime Organization
IMPLAN	Impact Analysis for Planning
INGAA	Interstate Natural Gas Association of America
IRA	Inventoried Roadless Area
IRR	Integra Realty Resources
ISA	International Society for Automation
ISO	International Organization for Standardization
ISPS Code	International Ship and Port Facility Security Code
ITA	Incidental Take Authorization
IWWP	industrial wastewater pipeline

Jordan Cove	Jordan Cove Energy Project L.P.
Jordan Cove's *Plan*	Jordan Cove's *Upland Erosion Control, Revegetation, and Maintenance Plan*
Jordan Cove's *Procedures*	Jordan Cove's *Wetland and Waterbody Construction and Mitigation Procedures*
Kcal	kilocalories
Kentuck project	Kentuck Slough Wetland Mitigation project
KO	Knockout
KOAC	known owl activity center
Km	kilometer
KOP	key observation point
kPa	kilopascals
kW	kilowatt
kW/m^2	kilowatts per square meter
L_{dn}	day-night sound level
L_{eq}	equivalent sound level
L_{max}	maximum sound level
LLA	Likely to adversely affect
LDC	local distribution company
LF	low frequency
LFL	lower flammable limit
LiDAR	light detection and ranging
LMP	Land Management Plan
LNG	liquefied natural gas
LOD	Letter of Determination
LOI	Letter of Intent
LOPA	Layer of Protection Analysis
LOR	Letter of Recommendation
LOS	level of service
LPG	liquified petroleum gasoline
LRMP	Land and Resource Management Plan
LSOG	late-successional old-growth
LSR	Late Successional Reserve
LSRA	Late-Successional Reserve Assessment
LUCS	Land Use Compatibility Statement
LUST	leaking underground storage tank
LWD	large woody debris
m^2	square meter
m^3	cubic meters
m^3/hr	cubic meters per hour
MA	Management Area
MAMU	marbled murrelet
MAOP	maximum allowable operating pressure
MARSEC	Maritime Security
MBF	thousand board feet
MBTA	Migratory Bird Treaty Act
MCE	Maximum Considered Earthquake
Mcy	million cubic yards
MF	mid-frequency

mg/l	milligram per liter
mg/d	million gallons per day
mg/kg	milligram per kilogram
MHW	mean high water
MIS	management indicator species
MLA	Mineral Leasing Act
MLLW	mean lower low water
MLRA	Major Land Resource Area
MLV	mainline block valve
Mm	millimeter
MMBF	million board feet
MMBtu/hr	million British thermal units per hour
MMcf/d	million cubic feet per day
mmhos/cm	millimhos per centimeter
MMPA	Marine Mammal Protection Act
MMTPA	million metric tons per annum
MOA	Memorandum of Agreement
MOF	material offloading facility
MOU	Memorandum of Understanding
MP	milepost
Mph	miles per hour
MPRSA	Marine Protection, Research, and Sanctuary Act
MR	Mixed Refrigerant
MRL	Mixed Refrigerant liquid
Ms	
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	mean sea level
MTBM	micro-tunnel boring machine
mtpa	metric tonnes per annum
MTSA	Maritime Transportation Security Act
MUSY	Multiple Use, Sustained Yield Act of 1960
MVA	megavolt ampere
MW	megawatt
N	equivalent energy release ratio
na	Not applicable
NAAQS	National Ambient Air Quality Standards
NAS	Non-indigenous aquatic species
NAVD88	North American Vertical Datum of 1988
NCDC	National Climatic Data Center
NCM	navigation channel mile
NE	no effect
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NF	National Forest
NFMA	National Forest Management Act
NFPA	National Fire Protection Association
NFS	National Forest System
NGA	Natural Gas Act

NHPA	National Historic Preservation Act
NJ	Not likely to jeopardize the continued existence for proposed species
NLAA	not likely to adversely affect
NMFS	National Marine Fisheries Service
NNL	National Natural Landmark
NNSR	Nonattainment New Source Review
NO	nitrogen oxide
NO_2	nitrogen dioxide
NOAA	U.S. Department of Commerce National Oceanic and Atmospheric Administration
NOI	Notice of Intent
Northwest	Northwest Pipeline GP
NO_x	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NRF	nesting, roosting, and foraging
NRHP	National Register of Historic Places
NRIS	Natural Resource Information System
NSA	noise-sensitive area
NSHM	National Seismic Hazard Map
NSO	northern spotted owl
NSPS	New Source Performance Standards
NSR	New Source Review
NTU	nephelometric turbidity unit
NVIC	Navigation and Vessel Inspection Circular
NWFP	Northwest Forest Plan
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
NWS	National Weather Service
O_2	oxygen
O&C	Oregon and California Railroad
O&C Act	Oregon and California Revested Lands Sustained Yield Management Act of 1937
OAR	Oregon Administrative Rule
OBE	Operating Basis Earthquake
OCMP	Oregon Coastal Management Program
OCRM	National Oceanic and Atmospheric Administration Office of Coast and Ocean Resource Management
ODA	Oregon Department of Agriculture
ODE	Oregon Department of Energy
ODEQ	Oregon Department of Environmental Quality
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODLCD	Oregon Department of Land Conservation and Development
ODNRA	Oregon Dunes National Recreation Area
ODOT	Oregon Department of Transportation
ODSL	Oregon Department of State Lands

OEP	FERC's Office of Energy Projects
OHWM	ordinary high water mark
OHV	off-highway vehicle
OHWM	ordinary high water mark
OIMB	Oregon Institute of Marine Biology
OISC	Oregon Invasive Species Council
OPRD	Oregon Parks and Recreation Department
OPS	Office of Pipeline Safety
OPUC	Oregon Public Utilities Commission
ORBIC	Oregon Biodiversity Information Center
ORS	Oregon Revised Statute
OSHA	Occupational Safety and Health Administration
OSMB	Oregon State Marine Board
OSMRE	Office of Surface Mining Reclamation Enforcement
OSWB	Oregon State Weed Board
OWRD	Oregon Water Resources Department
Pacific Connector	Pacific Connector Gas Pipeline L.P.
PAG	plant association group
PAH	polynuclear aromatic hydrocarbon
PAR	permanent access road
PBF	physical or biological features
PCB	polychlorinated biphenyl
PCT	Pacific Crest Trail
Pembina	Pembina Pipeline Corporation
PES	PES Environmental, Inc.
PFMC	Pacific Fishery Management Council
PG&E	Pacific Gas and Electric Company
PGA	peak horizontal ground acceleration
PGAM	geometric mean peak ground acceleration
PHMSA	Pipeline and Hazardous Materials Safety Administration
PI	point of intersection
PILT	Payment In Lieu of Taxes
PLF	product loading facility
Plan	*Upland Erosion Control, Revegetation, and Maintenance Plan*
PM_{10}	particulate matter with a diameter of less than 10 microns
$PM_{2.5}$	particulate matter with a diameter of less than 2.5 microns
PMD	Power Driven Machinery
PnR	Park and Ride
POD	Plan of Development
Port	Oregon International Port of Coos Bay
ppm	parts per million
ppmvd	parts per million by volume, dry basis
ppmvd @ 15 percent O_2	Parts per million by volume, dry basis, corrected to 15 percent oxygen
PPV	peak particle velocity
PRICO®	Poly Refrigerant Integrated Cycle Operation
Procedures	*Wetland and Waterbody Construction and Mitigation Procedures*
Project	Jordan Cove LNG Project and Pacific Connector Gas Pipeline Project
PSD	Prevention of Significant Deterioration

PSE	Puget Sound Energy
PSEL	plant site emission limit
PSET	Portland Sediment Evaluation Team
Psi	pounds per square inch
psig	pounds per square inch gauge
PST	Pacific Standard Time
Psu	practical salinity unit
PTS	permanent threshold shift
PVC	polyvinyl chloride
PWA	Potential Wilderness Area
R.	Range
RBC	risk-based concentration
Reclamation	U.S. Department of the Interior Bureau of Reclamation
RFP	Roseburg Forest Products
RFPD	Rural Fire Protection District
RHA	Rivers and Harbors Act
RM	river mile
RMA	Recreation Management Area
RML	rapidly moving landslide
RMP	Resource Management Plan
RMS	Riparian Management Strategy
RNA	Research Natural Area
ROD	Record of Decision
RPT	rapid phase transition
Ruby	Ruby Pipeline LLC
RV	recreational vehicle
SAFE Port Act	Security and Accountability For Every Port Act
Sandia	Sandia National Laboratories
SAP	sampling and analysis plan
SAV	submerged aquatic vegetation
SBS	Siskiyou BioSurvey, LLC
SD	scaled distance factor
SDWA	Safe Drinking Water Act
SEL_{cum}	cumulative sound exposure level
SEP	surface emissive power
SER	Significant Emission Rate
SEV	severity of ill effect
SH	State Highway
SHN	SHN Consulting Engineers & Geologists, Inc.
SHPO	State Historic Preservation Officer
SIL	significant impact level
Siletz Tribes	Confederated Tribes of the Siletz Reservation
SIS	Safety Instrumentation Systems
SLR	sea level rise
SMPE	South Mist Pipeline Extension
SMR	single mixed refrigerant
SMU	Species Management Unit
SO_2	sulfur dioxide
SOLAS	Safety of Life at Sea

SONCC	Southern Oregon/Northern California Coast
SORSC	Southwest Oregon Regional Safety Center
SOULA	Southern Oregon University Laboratory of Anthropology
SPCC	Spill Prevention, Containment, and Countermeasures
SPL	sound pressure level
SPL_{peak}	peak sound pressure level
SRMA	Special Recreation Management Area
SSA	sole or principal source aquifer
SSE	Safe Shutdown Earthquake
SSTEMP	Stream Segment Temperature Model
SSURGO	Soil Survey Geographic (Database)
STATSGO	State Soil Geographic (Database)
SVID	Shasta View Irrigation District
SVOC	semivolatile organic compound
SWMP	Storm Water Management Plan
SWPCP	Storm Water Pollution Control Plan
T.	Township
T&E	Threatened and Endangered
TACT	Typically Achievable Control Technologies
TAR	temporary access road
TCP	Traditional Cultural Property
TEMA	Tubular Exchanger Manufacturers Association
TEWA	temporary extra work area
t/hr	metric ton per hour
TMBB	temporary material barge berth
TMDL	Total Maximum Daily Load
TMP	Transportation Management Plan
TPH	total petroleum hydrocarbon
TPY	tons per year
TSS	total suspended solids
Tuscarora	Tuscarora Gas Transmission Company
TVS	total volatile solids
TWIC	Transportation Worker Identification Credential
UCSA	uncleared storage area
UDP	Unanticipated Discovery Plan
UFL	upper flammable limit
U.S.	United States
U.S.C.	United States Code
USDA	United States Department of Agriculture
USDOI	U.S. Department of the Interior
USDOT	U.S. Department of Transportation
USGCRP	United States Global Change Research Program
USGS	U.S. Geological Survey
v/c	volume-to-capacity ratio
VGP	General Permit for Discharges Incidental to the Normal Operation of Vessels
VOC	volatile organic compound
VQO	Visual Quality Objective
VRM	visual resource management

WA	Watershed Analyses
WBD	Watershed Boundary Dataset
WHPA	wellhead protection area
WNF	Winema National Forest
WRCC	Western Regional Climatic Center
WRP	Wetland Reserve Program
WSA	Waterway Suitability Assessment
WSR	Waterway Suitability Report

EXECUTIVE SUMMARY

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared this draft environmental impact statement (EIS) to assess the impacts of constructing and operating the Jordan Cove Liquefied Natural Gas (LNG) Project proposed by Jordan Cove Energy Project LP (Jordan Cove) and the Pacific Connector Gas Pipeline Project proposed by Pacific Connector Gas Pipeline L.P. (Pacific Connector). The purpose and need of the Jordan Cove LNG Project is to export natural gas supplies derived from existing interstate natural gas transmission systems to overseas markets. The purpose and need of the Pacific Connector Gas Pipeline Project is to connect the existing interstate natural gas transmission systems of Gas Transmission Northwest, LLC and Ruby Pipeline, LLC with the proposed LNG export terminal. Collectively, Jordan Cove and Pacific Connector are referred to as the applicants, and the projects are referred to collectively as the Project.

The purpose of this draft EIS is to inform the FERC decision-makers, the public, and the permitting agencies about the potential adverse and beneficial environmental impacts of the proposed Project and recommend mitigation measures that would reduce adverse impacts to the extent practicable. We[1] prepared this analysis based on information provided by the applicants; our independent review of this information; in consultation with federal cooperating agencies (see below); and in consideration of comments provided by state and local agencies, Indian Tribes, and individual members of the public. This draft EIS was prepared in accordance with the requirements of the National Environmental Policy Act of 1969 (NEPA) and the Commission's implementing regulations under Title 18 of the Code of Federal Regulations, Part 380 (18 CFR 380).

The FERC is the federal agency responsible for authorizing onshore LNG facilities, and is responsible for regulating the siting and construction of interstate natural gas transmission pipelines. FERC is the lead federal agency responsible for the preparation of this draft EIS. The U.S. Department of the Interior Bureau of Land Management (BLM); U.S. Department of Agriculture Forest Service (Forest Service); Bureau of Reclamation; U.S. Department of Energy; U.S. Army Corps of Engineers (COE); U.S. Environmental Protection Agency; U.S. Department of the Interior Fish and Wildlife Service; U.S. Department of Commerce National Oceanic and Atmospheric Administration's National Marine Fisheries Service; U.S. Department of Homeland Security Coast Guard (Coast Guard); the Coquille Indian Tribe; and the Pipeline and Hazardous Materials Safety Administration within the U.S. Department of Transportation are cooperating agencies for the development of this draft EIS consistent with 40 CFR 1501.6(b). A cooperating agency has jurisdiction by law or has special expertise with respect to the environment potentially affected by the Project. The cooperating agencies provided input to the conclusions and recommendations presented in the draft EIS. Following issuance of the final EIS, the cooperating agencies will issue subsequent decisions, determinations, permits or authorizations for the Project in accordance with each individual agency's regulatory requirements.

PROPOSED ACTION

On September 21, 2017, the applicants, in Docket Nos. CP17-494-000 and CP17-495-000, filed applications with the FERC pursuant to Sections 3 and 7 of the Natural Gas Act (NGA) seeking an Authorization and a Certificate of Public Convenience and Necessity to construct and operate

[1] "We," "us," and "our" refer to the environmental and engineering staff of the FERC's Office of Energy Projects.

an LNG export terminal and an interstate natural gas transmission pipeline. The LNG terminal would be located in Coos County, Oregon on the North Spit of Coos Bay and would be capable of liquefying up to 1.04 billion cubic feet of natural gas per day for export. The 200-acre LNG terminal site would include:

- an access channel from the existing Coos Bay Federal Navigation Channel to the LNG terminal;
- modifications to the existing Federal Navigation Channel;
- a marine slip containing two berths (one Production Loading Berth and one Emergency Lay Berth), a dock for tug and escort boats, and a material offloading facility (MOF);
- LNG loading platform and transfer line;
- two full-containment LNG storage tanks and associated equipment;
- five natural gas liquefaction trains;
- a pipeline gas conditioning facility;
- a temporary workforce housing facility;
- the non-jurisdictional Southwest Oregon Regional Security Center and Fire Department building; and
- other security and control facilities, administrative buildings, and other support structures.

As proposed, the LNG terminal would be called upon by about 120 LNG carriers per year.

The pipeline would originate at interconnections with existing pipeline systems in Klamath County, Oregon, and would span parts of Klamath, Jackson, Douglas, and Coos Counties, Oregon, before connecting with the LNG terminal. The approximately 229-mile-long, 36-inch-diameter pipeline would be capable of transporting up to 1.2 billion cubic feet of natural gas per day. Operating the pipeline would require the use of one compressor station (i.e., the Klamath Compressor Station) and other associated facilities including mainline block valves, pig[2] launchers and receivers, communication systems, and meter stations.

PUBLIC INVOLVEMENT

The applicants began participating in the Commission's Pre-filing Process in early 2017 (Docket No. PF17-4-000). The FERC's Pre-filing Process encourages the early involvement of interested stakeholders and responsible regulatory agencies to identify and resolve environmental issues before an application is filed with the FERC. During the Pre-filing Process, the applicants held Open Houses in Coos Bay and along the pipeline route in March of 2017 to provide the public with information about the Project and to solicit its concerns about the Project.

In June 2017, the FERC issued a *Notice of Intent to Prepare an Environmental Impact Statement for the Planned Jordan Cove LNG Terminal and Pacific Connector Pipeline Projects, Request for Comments on Environmental Issues, and Notice of Public Scoping Sessions* (NOI). The NOI was sent to affected landowners; federal, state, and local government agencies; elected officials; environmental and public interest groups; interested Indian tribes; and local libraries and newspapers. The NOI also began a 30-day scoping period. During the scoping period, the FERC along with the BLM and Forest Service, held joint public scoping sessions in Coos Bay and along the pipeline route to receive comments about the Project. Each session was attended by at least

[2] A pig is a remotely operated pipe inspection and cleaning tool.

150 people, and some sessions were attended by substantially more. During scoping, we also met with several federally recognized Indian Tribes in person and via teleconference meeting to discuss their concerns about the Project.

To date, we have received more than 9,000 comments on the Project. Most comments concern property rights, land use, purpose and need, safety and security, potential geological hazards (tsunamis and mountainous terrain), and the FERC's approach to the NEPA process. Comments from Indian Tribes expressed concern about meaningful consultation, cultural resources, environmental resources including fish (salmon) and vegetation, impacts on traditional use(s) of the land, environmental justice, cumulative impacts, and documentation of concerns in the EIS. All comments received prior to the issuance of this EIS were considered and addressed as appropriate in our analysis. Additionally, many comments raised concerns that are outside the scope of this EIS. Examples include comments concerning the public benefit or need to export LNG, unconventional natural gas production ("fracking"), induced production of natural gas, "life-cycle" cumulative environmental impacts associated with the LNG export process, and downstream greenhouse gas emissions resulting from the combustion of exported natural gas.

PROJECT IMPACTS

Constructing and operating the Project would impact geological resources, soils and sediments, water resources, wetlands, vegetation, wildlife, aquatic resources, threatened and endangered species, and other species of concern, land use, recreation, visual resources, socioeconomics, transportation, cultural resources, air quality, and noise. Our analysis also evaluates the potential for cumulative impacts on these resources.

Constructing and operating the LNG terminal would permanently impact about 200 acres of land, resulting in the loss of about 22 acres of wetlands. Coos Bay would temporarily experience increased turbidity and sedimentation due to the construction of the marine facilities. Wildlife in the vicinity of the LNG terminal, especially those species who are sensitive to noise and light would experience increased rates of stress, injury, and mortality. Areas adjacent to the Coos Bay Federal Navigation Channel would be modified, but it is suitable to support the LNG carriers that would call on the terminal. LNG carriers transiting the Federal Navigation Channel would likely cause minor delays for other marine traffic in the waterway. Vehicle traffic and associated commute times near the LNG terminal site would also increase. Permanent and temporary structures at the LNG terminal as well as LNG carrier operations in the Federal Navigation Channel would exceed FAA obstruction standards and there is a potential significant impact to the safe air operations of the Southwest Oregon Regional Airport if a resolution cannot be settled between Jordan Cove and FAA. Constructing the LNG terminal would temporarily impact the Coos Bay area short-term housing market. The LNG terminal would permanently impact the visual character of Coos Bay. The LNG terminal design accounts for possible tsunamis and includes safeguards and protections to ensure facility integrity and public safety.

Constructing the pipeline would require the temporary use of more than 4,000 acres of land. Operating the pipeline would permanently impact about 1,400 acres of land; however, many land uses including livestock grazing would not be permanently affected. The pipeline would be located across steep terrain through the Cascade Mountains, but Pacific Connector has planned accordingly for potential landslides and erosion. The pipeline would also cross over 300 waterbodies including the Coos, Rogue, and Klamath Rivers. These larger rivers would be crossed using horizontal directional drills to minimize impacts. The pipeline would also impact over 2,000 acres of forest including over 750 acres of late stage old-growth forest that provides habitat to marbled murrelet, northern spotted owl, and other federally-listed threatened and endangered species. Recreation areas crossed by the pipeline would be temporarily disturbed and use of these areas would likely find construction to be an annoyance and an inconvenience. Vehicle traffic on area roads would increase as well as demand for local services and business, but these increases would be temporary. Following construction, the primary impact of the Project would be the visible nature of the permanent pipeline easement. The visual impact of the easement would be similar to that of other utilities and roadways in the region.

ALTERNATIVES CONSIDERED

As required by NEPA and in consultation with the cooperating agencies, we identified and considered reasonable alternatives to the Project to determine if the implementation of an alternative would be preferable to the proposed action. An alternative is considered reasonable if it meets the stated purpose of the Project and is technically and economically feasible and practical. A preferable alternative would offer a significant environmental advantage over the proposed action.

In our alternatives analysis we considered the no action alternative, system alternatives, LNG terminal site alternatives, and pipeline route alternatives. The EIS evaluates all alternatives developed by staff, developed by the applicants, or suggested by stakeholders that were able to meet the Project's purpose and were feasible or practical.

Under the No Action alternative, the environmental impacts associated with constructing and operating the Project would not occur; however, equal or greater impacts could occur at other location(s) in the region as a result of another LNG export project seeking to meet the demand identified by the applicants.

The systems alternatives we considered include existing and proposed LNG terminals in Alaska, Canada, and Mexico; an LNG project currently under construction in Tacoma, Washington; an existing interstate natural gas transmission pipeline system in Oregon; and a non-jurisdictional intrastate pipeline in Coos County. Existing and proposed LNG terminals in Alaska, Canada, and Mexico are too far removed (700 to 3,000 miles) from the interconnections in Klamath County to offer a significant environmental advantage over the proposed action. The Tacoma LNG Project is designed to serve local customers and provide marine vessel fuel; it would not meet the Project's stated purpose for export. Additionally, the Tacoma LNG Project is being built on a 30-acre site and there is insufficient land available for expansion. The Northwest Pipeline interstate system and the intrastate Coos County Pipeline have insufficient capacities to replace the capacity that would be provided by the proposed pipeline. Modifications to these systems to create such capacity would result in equal or greater environmental impacts and would not offer a significant environmental advantage over the proposed action.

The LNG terminal site alternatives we considered include a site in Humboldt Bay, California; sites in Oregon and Washington; another site in Coos Bay; and an inland site east of Coos Bay. The impacts of constructing an LNG terminal and pipeline to Humboldt Bay would be comparable to that of the proposed Project. Alternative sites in Oregon and Washington would result in greater impacts on the environment. Therefore, alternative LNG terminal sites in California, Oregon, and

Washington would not offer a significant environmental advantage over the proposed action. The Coos Bay site alternative would also not offer a significant environmental advantage over the proposed action. The inland site alternative would be located at least 5 miles east of Coos Bay and would require the construction of an LNG cryogenic pipeline to the proposed marine loading facilities. Our analysis indicates that the relocation of the terminal site would reduce, but not eliminate impacts on wetlands; it would also still result in impacts on Coos Bay, and would likely increase overall impacts on the environment due to the need for an LNG cryogenic pipeline. Therefore, an inland alternative would not offer a significant environmental advantage over the proposed action.

Pipeline route alternatives considered include three major route alternatives and nine pipeline route variations. Based on our analysis as described in the draft EIS, we conclude that four route variations would be preferable to the corresponding proposed action. We are recommending that Pacific Connector incorporate the Blue Ridge Variation, the Survey and Manage Species Variation, the East Fork Cow Creek Variation, and the Pacific Crest Trail Variation into its proposed route for the Project. We have concluded that these variations would offer a significant environmental advantage over the proposed action.

CONCLUSIONS

We conclude that constructing and operating the Project would result in temporary, long-term, and permanent impacts on the environment. Many of these impacts would not be significant or would be reduced to less than significant levels with the implementation of proposed and/or recommended impact avoidance, minimization, and mitigation measures. However, some of these impacts would be adverse and significant. Specifically, we conclude that constructing the Project would temporarily but significantly impact housing in Coos Bay and that constructing and operating the Project would permanently and significantly impact the visual character of Coos Bay. Furthermore, constructing and operating the Project is likely to adversely affect 13 federally-listed threatened and endangered species including the marbled murrelet, northern spotted owl, and coho salmon. Our conclusions are based wholly or in part on the following factors:

- the Project would be constructed in compliance with all applicable federal laws, regulations, permits, and authorizations;
- the applicants would implement all best management practices, the measures described in their *Erosion Control and Revegetation Plan, Wetland and Waterbody Construction and Mitigation Procedures* and *Upland Erosion Control, Revegetation, and Maintenance Plans*, and other impact avoidance, minimization, and mitigation measures;
- the applicants' *Compensatory Wetland Mitigation Plan* would satisfy the COE's regulatory requirements to mitigate unavoidable impacts on wetlands and waters of the U.S.;
- the BLM and Forest Service's plan amendments would provide for the crossing of federal lands;
- compliance with the Endangered Species Act and the National Historic Preservation Act would be complete prior to construction;
- the LNG terminal was designed consistent with maximum tsunami run-up elevations and considered tsunami wave heights and inundation elevations;

- the LNG terminal would include protections and safeguards that ensure facility integrity and public safety;
- the Coast Guard issued a Letter of Recommendation indicating the Coos Bay Federal Navigation Channel would be considered suitable for the LNG marine traffic associated with the Project; and
- FERC’s environmental and LNG engineering construction inspection programs would ensure compliance with the applicants’ commitments, and the conditions of any FERC Authorization and Certificate.

In addition, we recommend that the Project-specific impact avoidance, minimization, and mitigation measures that we have developed (included in this EIS as recommendations) be attached as conditions to any Authorization and Certificate of Public Convenience and Necessity issued by the Commission for the Project.

1.0 INTRODUCTION

1.1 PROJECT SUMMARY

The staff of the Federal Energy Regulatory Commission (FERC or Commission) prepared this draft Environmental Impact Statement (EIS) to describe our assessment of the potential environmental impacts that may occur from constructing and operating the Jordan Cove Liquefied Natural Gas (LNG) Project and Pacific Connector Gas Pipeline Project.

On September 21, 2017 Jordan Cove Energy Project, L.P. (Jordan Cove) and Pacific Connector Gas Pipeline, L.P. (Pacific Connector)1 filed applications with the FERC pursuant to Sections 3 and 7 of the Natural Gas Act (NGA) to construct and operate an LNG terminal and associated pipeline facilities. A Notice of Application for the Jordan Cove and Pacific Connector Projects2 was issued by the FERC on October 5, 2017.

In FERC Docket No. CP17-495-000, Jordan Cove seeks an NGA Section 3 Authorization (Authorization) to construct and operate an LNG export terminal in Coos County, Oregon. The terminal would be capable of receiving, processing, and liquefying natural gas3 into LNG, then storing and loading the LNG onto LNG carriers. The Jordan Cove facilities could receive a maximum of 1.2 billion cubic feet per day (Bcf/d) of natural gas from the Pacific Connector pipeline and produce a maximum of 7.8 million metric tons per annum (MMTPA) of LNG.

In FERC Docket No. CP17-494-000, Pacific Connector seeks a Certificate of Public Convenience and Necessity (Certificate), under NGA Section 7, to construct and operate an approximately 229-mile-long, 36-inch-diameter natural gas transmission pipeline, crossing through Klamath, Jackson, Douglas, and Coos Counties, Oregon.4 The pipeline would transport about 1.2 Bcf/d of natural gas from interconnections with the existing Ruby Pipeline LLC (Ruby) and Gas Transmission Northwest LLC (GTN) systems5 near Malin, Oregon to the Jordan Cove terminal.

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[1] Jordan Cove and Pacific Connector are both subsidiaries of Pembina Pipeline Corporation (Pembina) of Calgary, Alberta, Canada. They are also referred to in this EIS as the applicants.

[2] Individually, the Jordan Cove proposal may be referred to in this EIS as the Jordan Cove Liquefaction Project, Jordan Cove LNG Project, LNG Project, Jordan Cove facilities, or the JCEP Project; the Pacific Connector proposal may be referenced similarly, as the Pacific Connector Pipeline Project, Pacific Connector pipeline, pipeline Project, or PCGP Project. Both proposals combined are often called the Project.

[3] Natural gas is a fossil fuel, consisting primarily of methane (CH_4), that is used for a variety of purposes, including electrical generation, home heating and cooking, fuel for motor vehicles, and other industrial/commercial applications. Natural gas is obtained from underground wells and transported from places of production to consumers mainly by way of pipelines. LNG is natural gas that has been cooled to about -260 degrees Fahrenheit (°F). As a liquid, LNG is about 600 times more dense than natural gas in a vapor state and can be stored and transported much more efficiently than the equivalent amount of gas. There are specially designed vessels (referred to as LNG carriers) that can transport LNG overseas from points of origin to customers. Exported LNG can be vaporized at receipt terminals, returned to natural gas, and then transported by pipelines to end-users.

[4] Pacific Connector also requested a blanket certificate to allow for future construction, operation, and abandonment activities under Subpart F of Title 18 Code of Federal Regulations (CFR) Part 157 of the Commission's regulations and requested a blanket certificate to provide open-access transportation services under its tariff in accordance with Subpart G of Part 284.

[5] GTN is owned by TransCanada, while Ruby is owned by Pembina.

As specified by the NGA and the Energy Policy Act of 2005 (EPAct), the FERC is responsible for authorizing onshore LNG terminals and interstate natural gas transmission facilities. EPAct also establishes the FERC as the lead federal agency responsible for coordinating applicable federal authorizations and complying with the requirements of the National Environmental Policy Act (NEPA). The FERC's regulations for implementing the elements of NEPA are at Title 18 Code of Federal Regulations (CFR) Part 380.

Consistent with federal regulations, applicable guidance, and other agreements,[6] the United States (U.S.) Department of the Interior Bureau of Land Management (BLM) Oregon State Office; U.S. Department of Agriculture Forest Service (Forest Service) Pacific Northwest Region; Bureau of Reclamation (Reclamation) Klamath Basin Area Office; U.S. Department of Energy (DOE); U.S. Army Corps of Engineers (COE) Portland District; U.S. Environmental Protection Agency (EPA) Region 10; U.S. Department of the Interior Fish and Wildlife Service (FWS) Oregon Fish and Wildlife Office; U.S. Department of Commerce National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) Oregon Coast Branch; U.S. Department of Homeland Security Coast Guard (Coast Guard) Portland (Sector Columbia River); the Coquille Indian Tribe[7]; and the Pipeline and Hazardous Materials Safety Administration (PHMSA) within the U.S. Department of Transportation (USDOT) are cooperating agencies in the development of this EIS. Cooperating agencies have jurisdiction by law or special expertise with respect to any environmental impacts involved in a proposal. The responsibilities of cooperating agencies are summarized in 40 CFR 1501.6, the Council of Environmental Quality (CEQ) regulations for implementing NEPA.

1.1.1 Previous Proposals

Beginning in 2006, Jordan Cove and Pacific Connector sought to import LNG into a terminal at Coos Bay, Oregon, and transport natural gas through a sendout pipeline to interconnections with existing pipeline systems at the Malin hub.[8] The import terminal and associated sendout pipeline

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[6] May 2002 "*Interagency Agreement on Early Coordination of Required Environmental and Historic Preservation Reviews Conducted in Conjunction With the Issuance of Authorizations to Construct and Operate Interstate Natural Gas Pipelines Certificated by the Federal Energy Regulatory Commission*", signed by the FERC, Advisory Council on Historic Preservation, CEQ, EPA, Department of the Army, Department of Agriculture, Department of Commerce, DOE, Department of the Interior, and USDOT. February 2004 "*Interagency Agreement Among the Federal Energy Regulatory Commission, United States Coast Guard, and Research and Special Programs Administration for the Safety and Security Review of Waterfront Import/Export Liquefied Natural Gas Facilities*." June 2005 "*Memorandum of Understanding Between the United States Army Corps of Engineers and the Federal Energy Regulatory Commission Supplementing the Interagency Agreement on Early Coordination of Required Environmental and Historic Preservation Reviews Conducted in Conjunction with the Issuance of Authorizations to Construct and Operate Interstate Natural Gas Pipelines Certificated by the Federal Energy Regulatory Commission*," executed 30 June 2005.

[7] The Project would be located across ancestral territory of the Coquille Indian Tribe (CIT). Due to their continued presence in the area, their modern and historic interest throughout their five-county fee-to-trust / service area, their concern for the land, and their special expertise regarding the natural environment, the CIT are participating as a cooperating agency. The CIT manages over 10,000 acres of land, primarily as sustainable forest; and provides education assistance, health care, elder services, and housing assistance to its members. The CIT have provided a unique and invaluable perspective to the development of this EIS.

[8] The originally proposed Pacific Connector sendout pipeline (in Docket No. CP07-441-000) would have connected with the existing GTN, Pacific Gas and Electric Company, and Tuscarora pipelines near Malin, Oregon. The original Jordan Cove LNG import project was authorized by the Commission in an "Order Granting Authorizations Under Section 3 and Issuing Certificates" issued on December 17, 2009 in Docket No. CP07-444-000.

applications were authorized by the Commission with conditions; however, due to changes in the natural gas industry, the facilities were never constructed, and the Commission withdrew its previous approval for the Project.9 Although the facilities required for the import of LNG are different than those required to export LNG, the original terminal location and footprint and the pipeline route are similar to the current Project proposed in Docket Nos. CP17-494-000 and CP17-495-000.

In 2012, Jordan Cove and Pacific Connector sought to export LNG from a terminal at Coos Bay, Oregon, with an associated feeder pipeline proposed to transport natural gas from existing pipeline systems near Malin.10 In response to those applications, the Commission issued an Order Denying Applications for Certificate and Section 3 Authorization on March 11, 2016 for Docket Nos. CP13-483-000 and CP13-492-000, and upheld its decision in its Order Denying Rehearing issued December 9, 2016. However, because the denial was without prejudice, Jordan Cove and Pacific Connector were able to file new applications in Docket Nos. CP17-494-000 and CP17-495-000.

1.1.2 Proposed Action

The facilities addressed in this EIS and described further in chapter 2 are the proposed LNG and pipeline facilities identified by Jordan Cove and Pacific Connector in their respective applications, and are summarized as follows:

LNG Project Facilities:

- an access channel from the existing Coos Bay Federal Navigation Channel to the LNG terminal;
- Modifications to the marine waterway, including four dredge locations located adjacent to the Federal Navigation Channel;
- a terminal marine slip containing two berths (one Production Loading Berth and one Emergency Lay Berth), and a dock for tug and escort boats, and a material offloading facility (MOF);
- LNG loading platform and transfer line;
- LNG storage system, consisting of two full-containment storage tanks;
- five natural gas liquefaction trains;
- a pipeline gas conditioning facility;
- the workforce housing facility located at the South Dunes Site;
- Southwest Oregon Regional Security Center (SORSC); and Fire Department building; and
- other security and control facilities, administrative buildings, meteorological station, and other support structures associated with the terminal.

Pipeline Project Facilities:

- a 229-mile-long, 36-inch-diameter welded steel underground pipeline, extending between interconnections near Malin in Klamath County and the Jordan Cove LNG terminal in Coos County, Oregon;
- the Klamath Compressor Station, at the eastern end of the pipeline; and

[9] On April 16, 2012, the Commission issued an "Order Granting Rehearing in Part, Dismissing Request for Stay, and Vacating Certificate and Section 3 Authorizations" in Docket Nos. CP07-441-000 and CP07-444-000.
[10] Like the current Project, the first LNG export and feeder pipeline proposal had the Pacific Connector pipeline connecting with the existing GTN and Ruby pipelines near Malin, Oregon.

- other associated facilities (e.g., meters stations, mainline block valves, pig launchers, and communication systems).

The general location of LNG terminal and pipeline facilities are depicted in figure 1.1-1 and chapter 2.

The primary differences between the previously proposed LNG terminal facilities (in Docket No. CP13-483-000) from the currently proposed Project are as follows:

- The South Dunes Power Plant has been eliminated from the current proposal.
- The locations of the workforce housing facility, the SORSC, and the project related Fire Department have been relocated.
- New staging areas have been added at Oregon International Port of Coos Bay (Port) Laydown and Boxcar Hill sites.
- The Al Pierce Company (APCO) sites (APCO 1 and 2) would be used for some Project related dredge disposal.
- The number of LNG carriers that would visit the terminal has increased to 110 to 120 vessels per year.
- The proposal now includes the excavation of four submerged areas (removing about 700,000 cubic yards of material) lying adjacent to the existing federally-authorized Federal Navigation Channel, and dredge slurry pipelines in Coos Bay; and
- The habitat mitigation areas at West Jordan Cove and West Bridge locations have been eliminated.

The primary differences between the previously proposed pipeline Project (Docket No. CP13-492-000) from the currently proposed project are as follows:

- Multiple horizontal directional drill (HDD) crossings have been newly proposed, including an approximately 5,200-foot-long HDD crossing under Coos Bay from about mileposts (MP) 0.12[11] to 1.11.
- Multiple route modifications have been made based on detailed civil survey, project design enhancements, and landowner or land-management agency input.
- Increased compression at the Klamath Compressor Station from 41,000 horsepower (hp) to 93,300 hp.
- Elimination of the Clark's Branch Meter Station.

[11] Notice that the MPs for the current version of the Pacific Connector pipeline in Docket No. CP17-494-000 are reversed from the actual direction of natural gas. Although the natural gas would flow east (from Malin) to west (to Coos Bay) in the current Project, the MPs are numbered from west (0.0. at the Jordan Cove Meter Station) to east (MP 228.8 at the Klamath Compressor Station). The letter "R" is used with some MPs to denote re-routes adopted after the original 2007 proposed pipeline route design.

Figure 1.1-1
General Location
Mileposts
Proposed PCGP Route
USBR Klamath Basin Project
BLM District Boundaries
National Forest Boundaries
Federal Lands
BLM
USFS
N
0 4 8 16
Miles
Jordan Cove Meter Station at MP 0.00
Harness Mtn. Comm Tower
Blue Ridge Comm Tower
Signal Tree Comm Tower
Sheep Hill MW
Starveout Creek Comm Tower
Flounce Rock Comm Tower
Robinson Butte Comm Tower
USBR Klamath Basin Project
Stukel Mtn. Comm Tower
Klamath Compressor Station, Klamath-Eagle Meter Station, and Klamath-Beaver Meter Station at MP 228.81
Coos Bay BLM District
Roseburg BLM District
Medford BLM District
Lakeview BLM District
Deschutes National Forest
Willamette National Forest
Umpqua National Forest
Winema National Forest
Rogue River National Forest
Siskiyou National Forest

1.2 APPLICANTS' PURPOSE AND NEED

The FERC does not plan, design, build, or operate natural gas infrastructure. As an independent regulatory commission, the FERC reviews proposals developed by other entities. Accordingly, the project proponent is the source for identifying the purpose for developing and constructing a project.

In its application, Jordan Cove states the purpose of its project is to export natural gas supplies derived from existing interstate natural gas transmission systems (linked to the Rocky Mountain region and Western Canada) to overseas markets, particularly Asia.12 According to Jordan Cove, the project is a market-driven response to increasing natural gas supplies in the U.S. Rocky Mountain and Western Canada production areas, and the growth of international demand, particularly in Asia.

In its application, Pacific Connector states that the purpose of its project is to connect the existing interstate natural gas transmission systems of GTN and Ruby with the proposed Jordan Cove LNG terminal.

1.3 FEDERAL AGENCY ROLES AND RESPONSIBILITIES

NEPA requires all federal agencies to consider the environmental consequences of federal actions or undertakings. The Commission's environmental staff, in partnership with the aforementioned cooperating agencies, has prepared this EIS to comply with the requirements of NEPA. This EIS discloses and assesses the potential environmental effects that are likely to result from the construction and operation of the Project. In addition to complying with NEPA, our purposes for preparing this EIS include:

- identify and assess potential impacts on the human environment that would result from the implementation of the proposed action;
- identify and assess reasonable alternatives to the proposed action that would avoid or minimize adverse impacts on the human environment;
- identify and recommend specific mitigation measures to minimize environmental impacts; and
- facilitate public involvement in identifying significant environmental impacts on specific resources.

The information and analyses presented in this EIS are intended to support subsequent conclusions and decisions made by the Commission and the cooperating agencies. For example, the BLM would use this EIS in its assessments of amendments to the Resource Management Plan (RMP) for the Coos Bay, Roseburg, Medford, and Lakeview Districts, and the Forest Service would use this EIS in its assessments of amendments to the Land and Resource Management Plan (LRMP) for the Umpqua, Rogue River, and Winema National Forests (see figure 1.1-1). In addition, the BLM would use this EIS when considering the issuance of a Right-of-Way (ROW) Grant to Pacific Connector for a pipeline easement over federal lands, with concurrence from the Forest Service and Reclamation (as further discussed below in sections 1.3.2, 1.3.3, and 4.7). The NMFS would

[12] Note that the Commission will consider as part of its decision whether or not to authorize natural gas facilities, all factors bearing on the public interest, including the project's purpose and need. Additional information regarding the Commission's process and considerations in regard to the project's purpose and need are provided in section 1.3.1.

use this EIS when considering the issuance of an authorization pursuant to the Marine Mammal Protection Act of 1972, as amended (MMPA) section 101(a)(5) for the take of marine mammals incidental to the proposed action (as further discussed in section 1.5.1.3).

1.3.1 Federal Energy Regulatory Commission

Sections 3 and 7 of the NGA provide the Commission with the authority to regulate the siting, construction, and operation of onshore LNG terminals, and pipelines engaged in the interstate transportation of natural gas. The Commission would consider the findings in this EIS during its review of Jordan Cove's and Pacific Connector's applications. The identification of environmental impacts related to Project construction and operation, and the mitigation of those impacts, as disclosed in this EIS, would be components of the Commission's decision-making process. The Commission would issue its decision in an Order. The Commission may accept the application in whole or in part, and can attach engineering and environmental conditions to the Order that would be enforceable actions to assure that the proper mitigation measures are implemented.

Specifically, regarding whether to authorize the siting of an LNG terminal under NGA Section 3, the Commission would approve the proposal unless it finds the proposed facilities would not be consistent with the public interest. In considering whether or not to issue a Certificate to a natural gas pipeline under NGA Section 7, the Commission would balance public benefits against potential adverse consequences,13 as documented in the Order. The Commission bases its decision on technical competence, financing, rates, market demand, gas supply, environmental effects, long-term feasibility, and other issues concerning a proposed project.

1.3.2 U.S. Department of the Interior Bureau of Land Management

The Pacific Connector pipeline would cross portions of four BLM Districts: Coos Bay District (of which about 17 miles would be crossed), Roseburg District (crossing about 13 miles), Medford District (crossing about 15 miles), and Lakeview District (Klamath Falls Resource Area; crossing about 1 mile). The BLM anticipates adopting this EIS pursuant to 40 CFR 1506.3(c). The EIS will address potential impacts resulting from the pipeline route crossing BLM land, and potential impacts resulting from BLM District Plan amendment that allow the pipeline.

BLM land use planning requirements were established in Sections 201 and 202 of the Federal Land Policy and Management Act of 1976 (FLPMA, 43 United States Code [U.S.C.] 1711-1712) and the regulations in 43 CFR 1600. These laws and regulations require a unit-specific Land Management Plan (LMP) for each BLM administrative management unit (also known as Resource Management Plan [RMP]). All projects or activities on BLM land must be consistent with the governing RMP.

Representatives of the BLM have worked cooperatively with the FERC staff and Pacific Connector during pipeline route selection over BLM lands and incorporation of best management practices (BMP) to minimize environmental consequences. The BLM has determined that the Pacific Connector Pipeline Project would not be consistent with certain requirements of the RMPs of the

[13] The Commission developed a "Certificate Policy Statement" (see *Certification of New Interstate Natural Gas Pipeline Facilities*, 88 FERC ¶ 61,227 (1999), clarified in 90 FERC ¶ 61,128, and further clarified in 92 ¶ 61,094 (2000)), that established criteria for determining whether there is a need for a proposed project.

BLM Districts crossed. To address these inconsistencies, the BLM proposes to amend the RMPs of the respective BLM Districts to make provision for the Project.

For the BLM, the primary purpose of this EIS is to consider and disclose the environmental consequences of construction and operation of the Pacific Connector pipeline on BLM lands and to evaluate proposed RMP amendments. The need for this EIS arises from the BLM's obligation to respond to the application for a ROW Grant submitted by Pacific Connector. The BLM will utilize this EIS to consider Pacific Connector's ROW application and decide, with concurrence from the Forest Service and Reclamation, to grant, grant with conditions, or deny the Temporary Use Permit and the ROW Grant. The BLM is also using this EIS process to identify specific stipulations (including project design features and mitigation measures) related to resources within its respective jurisdiction for inclusion in the ROW Grant.

The BLM has identified suites of "Project Design Features" or "Project Requirements" that are deemed necessary to accomplish the management objectives and direction in the respective RMPs.14 The project design features or requirements specific to the pipeline crossing of BLM lands are included as attachments to Pacific Connector's Plan of Development (POD). There are 28 attachments to the POD; these include draft monitoring elements as needed to ensure that the wide array of actions are implemented and to assess the effectiveness of the actions relative to the management objectives and direction in the respective RMPs. Collectively, the POD is incorporated into the Project's description.

In the 2015 EIS that evaluated the Pacific Connector Project, the BLM had required a compensatory mitigation plan to offset the unavoidable adverse impacts of the Project. This offsite mitigation plan would have been included in the ROW Grant, had the grant been approved. The BLM issued new policy and agency guidance regarding the imposition of offsite compensatory mitigation on July 24, 2018 in Instruction Memorandum (IM) No. 2018-093. The policy states; "Except where the law specifically requires, the BLM must not require compensatory mitigation from public land users. While the BLM, under limited circumstances, will consider voluntary proposals for compensatory mitigation, the BLM will not accept any monetary payment to mitigate the impacts of a proposed action." The policy does not affect compensatory mitigation required under federal laws other than the FLPMA, or the ability of any state government, or other non-federal party, to require and enforce mandatory compensatory mitigation as authorized under state law. This new policy addresses compensatory mitigation and does not affect the project design features and project requirements that are contained in the POD.

The BLM will continue to coordinate with the applicant on any voluntary compensatory mitigation they may propose, and with other federal and state agencies that identify compensatory mitigation as a matter of law on lands managed by the BLM. Any compensatory mitigation that is developed as a result of this coordination would be attached to the POD and included in the ROW Grant if the grant is approved.

[14] The BLM, Forest Service, and Reclamation use the term "Project Design Features" or "Project Requirements" rather than "mitigation" to describe elements of a plan that occur within a project area and are standard requirements of a project. The BLM and Forest Service reserve the term "mitigation" to describe measures taken to reduce or compensate for otherwise unavoidable impacts. The term "mitigation" as used elsewhere in this EIS refers to the full range of activities designed to reduce adverse effects of the Project.

The BLM Oregon State Director is the authorized officer for decisions related to amendments of the respective BLM RMPs, issuance of the Temporary Use Permit, and issuance of a ROW Grant, if authorized.

1.3.3 U.S. Department of Agriculture Forest Service

The Pacific Connector pipeline route would cross portions of the Umpqua, Rogue River, and Winema National Forests (see figure 1.1-1). As a cooperating agency, the Forest Service anticipates adopting this EIS pursuant to 40 CFR 1506.3(c).

Forest Service land use planning requirements were established by the National Forest Management Act (NFMA) and the regulations in 36 CFR 219. These laws and regulations require a unit-specific LMP for each National Forest (LRMPs). All projects or activities within a National Forest must be consistent with the governing LRMP.

On December 15, 2016, the Department of Agriculture Under Secretary for Natural Resources and Environment issued a final rule that amended the 36 CFR 219 regulations pertaining to National Forest System Land Management Planning (the planning rule) (81 Federal Register [FR] 90723, 90737). The amendment to the 219 planning rule clarified the Department's direction for amending LRMPs. The Department of Agriculture Under Secretary of Natural Resources and Environment also added a requirement for amending a plan for the responsible official to consider "which substantive requirements of §§ 219.8 through 219.11 are likely to be directly related to the amendment" (36 CFR 219.13(b)(2), 81 FR at 90738). Whether a rule provision is directly related to an amendment is determined by any one of the following: the purpose for the amendment, a beneficial effect of the amendment, a substantial adverse effect of the amendment, or a lessening of plan protections by the amendment.

Representatives of the Forest Service have worked cooperatively with the FERC staff and Pacific Connector during pipeline route selection over Forest Service lands and incorporation of BMPs to minimize environmental consequences. The Forest Service has determined that the linear nature of the Pacific Connector Pipeline Project would not be consistent with certain requirements of the LRMPs of the National Forests crossed. To address these inconsistencies, the Forest Service proposes to amend the LRMPs of the respective National Forests to make provision for the Project.

For the Forest Service, the primary purpose of this EIS is to consider and disclose the environmental consequences of construction and operation of the Pacific Connector pipeline on National Forest System (NFS) lands and to evaluate proposed LRMP amendments. The Forest Service will use this EIS to assess which, if any, substantive requirements of the planning rule are likely to be directly related to the amendment. The Forest Service is also using this EIS process to identify specific stipulations (including project design features and mitigation measures) related to resources within their jurisdiction for inclusion in the ROW Grant.

The Forest Service has identified suites of "Project Design Features" or "Project Requirements" that are deemed necessary to accomplish goals and objectives of the respective LRMPs. The project design features or requirements specific to the pipeline crossing Forest Service lands are included as attachments to Pacific Connector's POD. There are 28 attachments to the POD; each of these includes draft monitoring elements to ensure that the wide array of actions are implemented and assess the effectiveness of the actions relative to the goals and objectives of the respective LRMPs. Collectively, the POD is incorporated into the project's description. The

Forest Service would require a Compensatory Mitigation Plan (CMP) be developed for implementation on lands they manage and would require that this CMP be attached to the POD. This CMP would focus on off-site actions such as reallocation of land from the Matrix land allocation to the Late Successional Reserve (LSR) land allocation, placement of large woody debris (LWD), snag creation, stand density/fuels reduction, road resurfacing and decommissioning, culvert replacement, stream crossing repairs, invasive weed control, pre-commercial thinning, fire suppression facilities development, and meadow restoration.

Although these compensatory mitigation actions required by the Forest Service (which are summarized in section 2.1.5 of this EIS and described in appendix F of this EIS) are specific in terms of activity and location, this EIS addresses them in a programmatic fashion. Many of these mitigation actions may require additional analyses and surveys to comply with NEPA and ensure consistency with LRMPs. The Forest Service anticipates that this EIS would provide the basis for tiering subsequent site-specific NEPA analyses, in accordance with the CEQ regulations at 40 CFR 1508.28(b). The Forest Service would conduct any needed supplemental environmental analysis and consultation efforts with various federal, state, and local entities, as well as tribal governments, prior to authorizing future site-specific mitigation actions described in the CMP. Environmental compliance for these mitigation actions could be concurrent with authorized project actions.

The Forest Supervisor for the Umpqua National Forest is the authorized officer for decisions related to amendments of Forest Service LRMPs and issuance of a concurrence letter for a ROW grant to BLM, if warranted.

1.3.4 U.S. Department of the Interior Bureau of Reclamation

The Pacific Connector pipeline route would cross a portion of Reclamation's Klamath Basin Project area (see figure 1.1-1). As a cooperating agency, Reclamation anticipates adopting this EIS pursuant to 40 CFR 1506.3(c). Although Reclamation's Klamath Basin Area is not subject to an LMP, the agency has also worked closely with the FERC staff and Pacific Connector to address issues related to the siting, construction, and operation of the pipeline where it would cross Reclamation lands and facilities that are part of Reclamation's Klamath Irrigation Project. These procedures are outlined in the POD, including Pacific Connector's *Klamath Project Facilities Crossing Plan* (Attachment O of the POD) and its *Winter Construction Plan for the Klamath Basin* (Appendix E.1 attached to Resource Report 1 of Pacific Connector's application to the FERC).

Reclamation and Pacific Connector have not identified specific mitigation projects at this time; therefore, Reclamation may conduct additional environmental compliance activities to meet their responsibilities under NEPA and other federal laws and regulations prior to implementation of any mitigation requirements specific to Reclamation jurisdiction. The Responsible Official for Reclamation regarding issuance of a concurrence letter for a ROW grant to the BLM, if warranted, is the Area Manager of Reclamation's Mid-Pacific Region Klamath Basin Area Office.

1.3.5 U.S. Department of Energy

The DOE's Office of Fossil Energy (DOE/FE) may adopt this EIS to consider the environmental effects associated with its decision whether to authorize the export of LNG, as proposed by Jordan Cove, to countries with which the United States does not have a free trade agreement (FTA) requiring national treatment for trade in natural gas. The purpose and need for the DOE/FE action is to respond to the application filed by Jordan Cove with the DOE/FE to export LNG to non-FTA countries. The DOE/FE must meet its obligations under Section 3 of the NGA, to authorize the import and export of natural gas, including LNG, unless it finds that the proposed import or export would not be consistent with the public interest. The DOE/FE's authority to regulate the export of the natural gas commodity arises from Section 3 of the NGA. By law, under Section 3(c) of the NGA, applications to export natural gas to countries with which the United States has FTAs that require national treatment for trade in natural gas are deemed to be consistent with the public interest and the Secretary of the DOE must grant authorization without modification or delay. In the case of applications to export LNG to non-FTA nations, NGA Section 3(a) requires the DOE/FE to conduct a public interest review and to grant the applications unless the DOE/FE finds that the proposed exports will not be consistent with the public interest. Additionally, DOE/FE must consider the environmental effects of its decisions regarding applications to export natural gas to non-FTA nations.

On September 22, 2011, Jordan Cove filed an application with the DOE/FE seeking authorization to export up to 1.2 Bcf/d of natural gas converted to LNG from its proposed terminal at Coos Bay, Oregon to FTA nations. The DOE/FE issued its *Order Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Jordan Cove LNG Terminal to Free Trade Agreement Nations* on December 7, 2011, in DOE/FE Docket No. 11-127-LNG (DOE/FE Order No. 3041).

On March 23, 2012, Jordan Cove filed an application with the DOE/FE, in DOE/FE Docket No. 12-32-LNG, seeking authorization to export LNG to non-FTA nations. The DOE/FE issued its *Order Conditionally Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Jordan Cove LNG Terminal in Coos Bay, Oregon to Non-Free Trade Agreement Nations* (DOE/FE Order No. 3413) on March 24, 2014. This Order would allow Jordan Cove to export up to the equivalent of 438 Bcf/year of natural gas, in the form of LNG, for 30 years after either the first shipment or 10 years after the date of the Order. The LNG may be exported to any country with which the United States does not have an FTA, which currently has or in the future could develop the capacity to import LNG, and with whom trade is not prohibited by United States law or policy. The authorization was conditioned on the satisfactory completion of the environmental review process in FERC Docket Nos. CP13-483-000 and CP13-492-000, to comply with NEPA, and on issuance by DOE/FE of findings of no significant impact or a record of decision pursuant to NEPA. Jordan Cove would have to also comply with all preventive and mitigation measures required by federal and state agencies for the Project. Under that conditional authorization, Jordan Cove must also file with the DOE/FE copies of executed long-term contracts for both natural gas supply and the export of LNG.

Jordan Cove submitted an amendment to its FTA application and non-FTA application on February 6, 2018 to reflect the new export capacity of the LNG terminal under the current proposal. The DOE/FE authorized Jordan Cove's amended request for export to FTA countries on July 20, 2018, reflecting a new authorized export volume of approximately 395 Bcf/year over a 30-year term, beginning on the earlier of the date of first export or 10 years from the date of the amended authorization. The DOE/FE is currently reviewing this amendment in regard to exports to non-FTA countries. If export to non-FTA countries is approved, this authorization would be considered a new authorization that supersedes the previous conditional authorization.

Because the Project may involve actions in floodplains, in accordance with 10 CFR Part 1022, *Compliance with Floodplain and Wetland Environmental Review Requirements*, this EIS includes a floodplain assessment. A floodplain statement of findings would be included in any DOE/FE determinations. Section 4.3 of this EIS discusses elements of the Project that may be within floodplains, so that the FERC, as lead federal agency, can document compliance with Executive Order (EO) 11988.[15]

1.3.6 U.S. Army Corps of Engineers

The COE exerts regulatory authorities over waters of the United States pursuant to Sections 9, 10, and 14 (i.e., Section 408) of the Rivers and Harbors Act of 1899 (RHA), Sections 404 of the Clean Water Act (CWA), and Section 103 of the Marine Protection Research and Sanctuaries Act of 1972 (MPRSA). The laws and regulations underpinning the COE's actions are further discussed below in section 1.5 and table 1.5.1-1. The agency's purpose for participating in the development of the EIS is to streamline the COE's review of the applicant's Regulatory and Section 408 application evaluation processes by working with the FERC to eliminate duplication of efforts. The EIS can reduce duplications of efforts in COE permit and permission reviews for the Project by allowing the FERC to be the lead federal agency and fulfill obligations for compliance with a variety of federal environmental laws. The COE may adopt the EIS for the purposes of exercising its regulatory authorities.

Approval from the COE is required for alterations to, or to temporarily or permanently occupy or use, any COE federally authorized civil works project pursuant to Section 408 of the RHA. Proposed alterations must not be injurious to the public interest or affect the COE project's ability to meet its authorized purpose. The Project as currently proposed may affect multiple COE civil works projects including the Coos Bay Federal Navigation Channel or other designated navigation channels (e.g., the Coos River where a proposed HDD would occur), the federal pike structure west of the proposed slip (where a rock apron is currently proposed to minimize impacts to this structure), and a 40-acre multi-use COE real estate easement located partially within the proposed LNG terminal tank site. The COE is currently reviewing the current applicant proposal to determine if these Project-related effects to the civil works projects would constitute an injury to the public interest or affect the COE project's ability to meet its authorized purpose or impair its usefulness.

The COE is currently evaluating a permit application from Jordan Cove and Pacific Connector to conduct work and/or construct structures in navigable waters of the U.S. pursuant to Section 10 of the RHA and to discharge dredged and fill material into waters of the U.S. pursuant to Section 404 of the CWA. The COE's involvement in the EIS process may assist the COE in complying with NEPA, informing the COE's public interest determination, and informing the COE's evaluation of the applicant's proposal pursuant to the CWA 404(b)(1) Guidelines.

1.3.7 U.S. Environmental Protection Agency

The EPA has responsibilities under the Clean Air Act (CAA), CWA, and MPRSA (see section 1.5.1 of this EIS for more details). The EPA shares responsibility for administering and enforcing Section 404 of the CWA with the COE and has authority to veto COE permit decisions.

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[15] EO 11988, *Floodplain Management*, requires federal agencies to avoid adverse impacts associated with the occupancy and modification of floodplains, and to avoid floodplain development wherever there is a practicable alternative. The objectives of the EO include the minimization of impacts from floods resulting from agency actions, and the preservation of floodplains where possible. While the FERC, as an independent commission, is not subject to EOs, the other federal permitting agencies must confirm compliance.

In addition, Section 309 of the CAA directs the EPA to review and comment in writing on the environmental effects associated with all major federal actions. This obligation is independent of its role as a cooperating agency under NEPA regulations. Consistent with this direction, the EPA evaluates all federally issued EISs for adequacy in meeting the procedural and public disclosure requirements of NEPA.

1.3.8 U.S. Fish and Wildlife Service and National Marine Fisheries Service Review

The FWS and NMFS are charged with the protection of federally-listed threatened and endangered species as described in the Endangered Species Act (ESA) of 1973, as amended. As requested, the FWS and NMFS will consult with the lead federal agency (i.e., the FERC) for actions that may affect ESA-listed species and/or critical habitats. The FWS and NMFS also have the authority under the Fish and Wildlife Coordination Act of 1934, as amended (FWCA) to review applications for CWA Section 404 and Section 401 permits. The FWS has authority under the Bald and Golden Eagle Protection Act of 1940, as amended (Eagle Act), to protect bald and golden eagles, and to issue permits for actions that would negatively affect eagles or their nests. The FWS also has authority under the Migratory Bird Treaty Act of 1918, as amended (MBTA) to conserve migratory birds; EO 13186 encourages federal agencies to consider conservation actions for birds in the course of their operations, documented in Memoranda of Understanding (MOU). The NMFS has the authority under the Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended (MSA) and MMPA to review a project's effects on essential fish habitats (EFH) and to protect marine mammals, respectively. The process for review and potential subsequent authorizations under each law are described further in section 1.5.1.

1.3.9 U.S. Department of Homeland Security Coast Guard

The Coast Guard serves as a subject matter expert for and providing recommendations on the maritime safety and security aspects of the Project. The Coast Guard does not issue a permit, license, order, or record of decision in this context, but is responsible for assessing the suitability of the waterway and issuing a Letter of Recommendation (LOR).

The Coast Guard exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under EO 10173; the Magnuson Act; the Ports and Waterways Safety Act of 1972, as amended; and the Maritime Transportation Security Act of 2002. The Coast Guard is responsible for matters related to navigation safety, vessel engineering and safety standards, and all matters pertaining to the safety of the facilities or equipment located in or adjacent to navigable waters up to the last valve immediately before the LNG storage tanks. The Coast Guard also has authority for LNG facility security plan review, approval, and compliance verification, and siting as it pertains to the management of vessel traffic in and around the LNG facility. As required by its regulations, the Coast Guard is responsible for issuing an LOR as to the suitability of the waterway for LNG marine traffic.

On June 14, 2005, the Coast Guard issued a Navigation and Vessel Inspection Circular (NVIC), *Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic* (NVIC 05-05). The purpose of the NVIC 05-05 is to provide Coast Guard Captains of the Port (COTPs)/Federal Maritime Security Coordinators, members of the LNG industry, and port stakeholders with guidance on assessing the suitability of a waterway for LNG marine traffic that takes into account conventional navigation safety/waterway management issues contemplated by the existing Letter of Intent (LOI)/LOR process. In addition, maritime security implications were also considered. In accordance with this guidance, each LNG project applicant is to submit a Waterway Suitability Assessment (WSA) to the cognizant COTP. On December 22, 2008, the Coast Guard published a second NVIC, *Guidance Related to Waterfront Liquefied Natural Gas (LNG) Facilities* (NVIC 05-08; Coast Guard 2008). The purpose of NVIC 05-08 was to revise the format of the LOR to conform to its intended effect of being a recommendation of the waterway suitability to the FERC. NVIC 05-08 is further discussed in section 4.13. On January 24, 2011, the Coast Guard published a third NVIC: *Guidance Related to Waterfront Liquefied Natural Gas (LNG) Facilities* (NVIC 01-2011). The purpose of NVIC 01-2011 was to revise the format of the LOR to conform to its intended effect of being a recommendation to the FERC as to the suitability of the waterway. In this NVIC, the Coast Guard has added guidance on release of the LOR and message management and provided an updated template for the LOR analysis.

The WSR for the Jordan Cove LNG Project was issued pursuant to NVIC 05-05. The final review and LOR were issued pursuant to NVIC 05-08, which replaced NVIC 05-05. NVIC 05-08 eliminated the term WSR and replaced it with "Letter of Recommendation (LOR) Analysis." For the purpose of clarity, the WSR is equivalent to the LOR Analysis. Section 813 of the Coast Guard Authorization Act of 2010 requires the Coast Guard to consider recommendations made by the States prior to making a recommendation to the FERC on the suitability of the waterway for marine traffic associated with an LNG facility. Although this law was effective after the WSR and LOR were issued, the Oregon Department of Energy (ODE) (as lead State agency) was an active participant in the WSA validation committee and concurred with the verbiage of the WSR and LOR.

On January 13, 2014, Jordan Cove forwarded its most recent annual review of the WSA to the Coast Guard, who responded on February 14, 2014, with the following statement: "we have no objection to your conclusion that the minor changes do not change the risk associated with the waterway or the facility as originally evaluated in your 2007 WSA." On February 27, 2014, the Coast Guard accepted the annual review of the WSA for the Jordan Cove LNG Project. On January 23, 2017, the Coast Guard accepted the Project's existing WSA as it relates to the new proposed project and stated that a new "Follow-On" WSA is not required.[16] On May 10, 2018, a revised LOR was issued, in which the Coast Guard stated that "the Coos Bay Channel be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this project."

1.3.10 U.S. Department of Transportation

The USDOT has prescribed the minimum federal safety standards for LNG facilities in compliance with 49 U.S.C. 60101. Those standards are codified in 49 CFR 193 and apply to the siting, design, construction, operation, maintenance, and security of LNG facilities. The National Fire Protection Association (NFPA) Standard 59A, Standard for the Production, Storage, and Handling of Liquefied Natural Gas (2001 ed.), is incorporated into these requirements by reference, with regulatory preemption in the event of conflict. In accordance with the 2004 Interagency Agreement, the USDOT participates as a cooperating agency on the safety and security review of waterfront import/export LNG facilities. The USDOT does not issue a permit or license but, as a cooperating agency, assists FERC staff in evaluating whether an applicant's proposed siting criteria meets the USDOT requirements in Part 193, Subpart B. On August 31, 2018, the USDOT

[16] The WSA is considered Sensitive Security Information and is therefore not publicly releasable. Public documents related to the Coast Guard's determination can be found in appendix B of this EIS.

and FERC signed a new MOU to improve coordination throughout the LNG permit application process for FERC jurisdictional LNG facilities. Under the 2018 MOU, the USDOT will issue a Letter of Determination (LOD), determining whether a proposed LNG facility will be capable of complying with Part 193, Subpart B, Siting (see section 4.13 of this EIS). The LOD is provided to the Commission for consideration in its decision on the Project application. The USDOT also has the authority to enforce safety regulations and standards related to the design, construction and operation of natural gas pipelines, under the Natural Gas Pipeline Safety Act. The USDOT would also monitor the construction and operation of the natural gas facilities to determine compliance with its design and safety standards.

1.3.11 Federal Aviation Administration (FAA)

The FAA is a federal agency under the USDOT, which has the authority to regulate all aspects of civil aviation. The FAA is responsible for enforcing the elements of 14 CFR 77 (i.e., Objects Affecting Navigable Airspace), which would include an assessment of whether the proposed project could represent a hazard to aircraft at the Southwest Oregon Regional Airport.

1.4 PUBLIC REVIEW AND COMMENTS

On January 23, 2017 Jordan Cove and Pacific Connector filed a request to implement the Commission's Pre-filing Process for the Jordan Cove liquefaction and LNG export proposal, and the associated Pacific Connector supply pipeline. The FERC established the Pre-filing Process to encourage early involvement of interested stakeholders, facilitate interagency cooperation, and identify and resolve environmental issues before an application is filed with the FERC and facility locations are formally proposed. The FERC granted this request to use the Pre-filing Process on February 10, 2017 and established pre-filing Docket Nos. PF17-4-000 for the Projects.

Prior to and during the Pre-filing Process, Jordan Cove and Pacific Connector (Applicants) contacted federal, state, and local agencies to inform them about their respective projects and discuss project-specific issues and concerns. The applicants initiated contact with potentially affected landowners prior to entering the FERC Pre-filing Process. These initial contacts were in the form of a letter describing each applicant's project and seeking permission to conduct environmental and cultural resource surveys on landowner property. Jordan Cove held an Open House meeting in North Bend on March 21, 2017. Pacific Connector held additional Open House meetings in Canyonville, Medford, and Klamath Falls during the week of March 22, 2017. These Open House meetings were advertised to the public through notices published in local newspapers. The FERC staff attended these Open House meetings and were available to answer questions from the public regarding the FERC and NEPA process.

On June 9, 2017, the FERC issued a *Notice of Intent to Prepare an Environmental Impact Statement for the Planned Jordan Cove LNG Terminal and Pacific Connector Pipeline Projects, Request for Comments on Environmental Issues, and Notice of Public Scoping Sessions* (Notice of Intent, or NOI). The NOI was sent to affected landowners; federal, state, and local government agencies; elected officials; environmental and public interest groups; interested Indian tribes; and local libraries and newspapers. The NOI described the Project; listed currently identified environmental issues; outlined the proposed actions of the DOE, BLM, and Forest Service; discussed the scoping and environmental review process; announced the date, location, and time of four public scoping meetings; and explained how the public could participate and comment.

During the week of June 27, 2017, the FERC, BLM, and Forest Service held joint public scoping sessions in Coos Bay, Roseburg, and Klamath Falls to receive comments about the Project, which were recorded by a court reporter.[17]

Throughout the Pre-filing Review Process, we received comments on a wide variety of environmental issues. Between February 10, 2017 (when pre-filing was initiated) and July 10, 2017 (i.e., the end of the announced scoping period), we received more than 5,100 comments. These comments were provided via 1,174 discrete comment letters/documents; this included 1,028 letters from individuals, 55 letters from non-governmental organizations, 1 letter from a federal agency, 16 letters from state and local agencies, 64 letters from private companies, 2 letters from members of the U.S. Congress, and 8 letters from federally recognized Tribes. We also received 462 form letters during this time. In addition, between July 10, 2017, and issuance of this EIS, the FERC received more than 3,700 additional comments contained within over 700 discrete documents, and an additional 14 form letters. All comments received prior to the writing of this EIS were considered. The analysis in this EIS addresses all relevant environmental topics raised during scoping.

Table 1.4-1 categorizes the relevant environmental issues raised in letters to the FERC and considered in this EIS. The table does not account for the out-of-scope issues (as discussed below) and general environmental concerns or non-specific comments. The most frequently expressed comments concerned property rights, land use, purpose and need, safety and security; potential geological/topographical hazards, and the FERC's approach to the NEPA process (e.g., length of scoping periods, number of public meetings, etc.).

TABLE 1.4-1

Environmental Issues Identified During the Pre-filing Public Scoping Process for the Jordan Cove and Pacific Connector Projects

Specific Issue/Comment	EIS Section Where Comments are Addressed
Purpose and Need, and FERC Process/NEPA Process/State Process .	1.0
Comments about scoping period and meeting locations.	
Project Description	**2.0**
Life of Project, decommissioning	
Concerns over temporary work areas (TEWAs), uncleared storage areas	
BLM, Forest Service, and FERC process	
Alternatives	**3.0**
Comments urging that investments be redirected towards renewable, domestic energy sources such as wind, solar and wave power.	
Request rigorous analysis of pipeline route alternatives (evaluate more than action/no-action)	
Geologic Hazards	**4.1**
Regional seismic activity (earthquake and/or tsunami) on the export terminal or pipeline.	
Soils and Minerals	**4.2**
Concerns over erosion of sensitive soils.	
Sedimentation of streams as a result of soil disruption	
Soil and slope stability along the pipeline route.	

17 Transcripts of all of the public scoping meetings for this Project were placed into the FERC public record for the proceedings.

TABLE 1.4-1 (continued)

Environmental Issues Identified During the Pre-filing Public Scoping Process for the Jordan Cove and Pacific Connector Projects

Specific Issue/Comment	EIS Section Where Comments are Addressed
Water Resources	**4.3**
Effects of construction and operation of the project elements, including export terminal facilities and pipeline crossings, on surface water and groundwater, including drinking water and salmon spawning habitat, and especially that of the Rogue River.	
Concerns over horizontal directional drilling under streams and rivers along the pipeline route.	
Concerns over hydrostatic testing of the pipeline.	
Wetlands and Riparian Areas	**4.3**
Effects on sensitive wetlands in the vicinity of the export terminal and pipeline.	
Biological Resources	**4.4, 4.5, and 4.6**
Effects on threatened and endangered species.	
Effects on fisheries and EFH.	
Effects on wildlife habitat, including connectivity.	
Effects on pipeline construction on forestlands, including sensitive forest types.	
Introduction and propagation of noxious weeds in the pipeline ROW.	
Land Use and Recreation	**4.7 and 4.8**
Location of access roads, hydrostatic test locations, uncleared storage areas, cleared areas.	
Effects on recreational opportunities, recreation-based tourism.	
Comments supporting and opposing the use of federal lands for the pipeline corridor.	
Comments making specific pipeline alignment adjustments (generally to avoid private properties, also to avoid resources.	
Concerns over BLM and Forest Service LMP revisions.	
BLM and Forest Service Plan Revisions, and associated mitigation/restoration requirements	
Visual Resources	**4.8**
Concerns over specific views, typically from private properties.	
Socioeconomics	**4.9**
Opposition to use of eminent domain to acquire pipeline easements, especially when some land uses would not be allowed or practicable once the pipeline is installed.	
Comments supporting and opposing the creation of local jobs; reconcile with environmental effects and safety risks involved.	
Effects on the local economy, including anticipated drop in tourism (fishing, birding).	
Concerns over application of eminent domain.	
Concerns over decreased property values.	
Transportation	**4.10**
Effects and risks of proximity to the Southwest Oregon Regional Airport.	
Cultural Resources	**4.11**
Effects on tribal lands and lands traditionally used by tribal members, especially fishing.	
Request outreach to the tribes.	
Air Quality and Noise	**4.12**
Effects on climate change.	
Concerns over operations emissions of the LNG carriers and terminal on local communities (respiratory health).	
Safety and Security/Public Health/Monitoring and Accountability/Siting	**4.13**
Risk of catastrophic events, either accidental, intentional (terrorism) or as a result of a natural disaster on the export terminal, LNG carriers or the pipeline.	

TABLE 1.4-1 (continued) **Environmental Issues Identified During the Pre-filing Public Scoping Process for the Jordan Cove and Pacific Connector Projects**	
Specific Issue/Comment	**EIS Section Where Comments are Addressed**
Availability and readiness of emergency response personnel in the event of a catastrophic incident, especially in remote areas.	
Concerns over the health effects of spilled or leaked gas on nearby communities.	
Emergency response planning (tsunami, earthquake).	
Concerns over pipeline weakness, potential for leak or explosion leading to wildfire.	
Concerns over rural pipeline safety, including non-odorized gas and construction standards.	
Monitoring and mitigation; accountability and responsibility.	
Cumulative Impacts	**4.14**
Effects of increased marine traffic.	
Effects from other energy projects.	

The BLM and Forest Service also reviewed the results of scoping to identify any concerns specific to their proposed plan amendments and mitigation actions. Comments were received that addressed concerns about the Forest Service planning regulations that govern amending LRMPs as well as the need for further detail on proposed BLM plan amendments. Comments were also received that identified concerns regarding the proposed mitigation actions of the BLM and Forest Service and the need for additional alternatives that would avoid impacts to areas such as LSRs and riparian areas. These issues are addressed in more detail in a scoping report prepared by the BLM and Forest Service in appendix F.8 (Federal Lands Review) of this EIS.

Numerous citizens and organizations raised issues that are outside the scope of this EIS. Examples of out-of-scope issues include comments regarding the public benefit or need to export LNG; horizontal hydraulic drilling through shale formations during exploration for natural gas (often referred to as "fracking"); induced production of natural gas; "life-cycle" cumulative environmental impacts associated with the entire LNG export process; downstream greenhouse gas emissions resulting from the combustion of exported gas; the concept of a "programmatic" EIS to cover LNG export terminals throughout the United States; and administrative information technology system operations at the FERC. These issues are not addressed in this EIS.

1.5 PERMITS, APPROVALS, AND CONSULTATIONS

1.5.1 Federal Environmental Laws, Regulations, Permits, Approvals, and Consultations

In addition to the NGA, EPAct, and NEPA, the FERC and cooperating agencies are required to comply with other federal laws and regulations that involve consideration of the Project's potential effect on a range of environmental resources (see table 1.5.1-1). This includes, but is not limited to, compliance with the CAA, CWA, Coastal Zone Management Act (CZMA), ESA, MSA, MMPA, MBTA, and the National Historic Preservation Act (NHPA).

As the lead federal agency for the Project, the FERC has taken on the lead role for consultation under these statutes for itself and in collaboration with the cooperating agencies. The BLM will make its determinations in accordance with the FLPMA, NFMA, and Mineral Leasing Act (MLA), as it relates to the Pacific Connector's ROW Grant application to cross federal lands, with concurrence necessary from the Forest Service and Reclamation (see section 1.3). Some federal permits or approvals, such as Section 401 of the CWA, the CAA, and the CZMA, have been delegated to state agencies, as discussed below.

In accordance with Section 313(d) of the EPAct, the FERC is required to keep a complete consolidated record of all actions or decisions made by agencies undertaking federal authorizations. On October 19, 2006, in Order No. 687, the FERC issued implementing regulations regarding the maintenance of a consolidated record.

Table 1.5.1-1 lists the major federal, state, and local permits, approvals, and consultations identified for the Project.

TABLE 1.5.1-1

Major Permits, Approvals, and Consultations for the Jordan Cove & Pacific Connector Project

Agency	Authority/Regulation/ Permit	Agency Action	Initiation of Consultations and Permit Status
FEDERAL			
FERC	Sections 3 and 7 of the NGA Section 311 of the EPAct	Order Granting Section 3 Authorization and Issuing Certificate of Public Convenience and Necessity.	Jordan Cove and Pacific Connector filed applications with the FERC on September 21, 2017. In September 2017, Pacific Connector filed an application with the FERC under Section 7 of the NGA. The FERC's decision is pending.
Forest Service	MLA	Concur with ROW Grant.	Pending. The Forest Service letter on concurrence of the ROW grant is pending until after issuance of the FEIS and preparation of a Record of Decision (ROD).
	36 CFR 219 Subpart B 36 CFR 218 Subpart A and B	Amend Land and Resource Management Plans (LRMP).	Pending. The Forest Service proposed decision(s) on plan level amendments of LRMPs are subject to Administrative Review Regulations at 36 CFR 219 Subpart B. Decisions by the Forest Service to approve project-specific plan amendments are subject to the Administrative Review Process of 36 CFR 218 Subpart A and B. A final decision will follow consideration and resolution of any administrative reviews.
BLM	Section 28 of MLA	Issue ROW Grant for crossing federal lands.	Pending. The BLM decision on the ROW grant will follow BLM and Forest Service decisions on LRMP amendments and receipt of Letters of Concurrence from the Forest Service and Reclamation.

TABLE 1.5.1-1 (continued)

Major Permits, Approvals, and Consultations for the Jordan Cove & Pacific Connector Project

Agency	**Authority/Regulation/ Permit**	**Agency Action**	**Initiation of Consultations and Permit Status**
	Federal Land Policy and Management Act of 1976, as amended	Resource Management Plan (RMP) Amendments.	Pending. BLM's proposed decision(s) on amendments of RMPs are subject to Protest following completion of the FEIS. A final decision will follow consideration and resolution of any Protests.
Bureau of Reclamation	MLA	Concur with issuance of the ROW Grant	Pending.
DOE	Section 3 of the NGA	Long-Term authority to export LNG to Free Trade Agreement (FTA) Nations	FTA authorization granted December 7, 2011 (DOE/FE Order No. 3041). DOE authorized amendment to FTA authorization on July 20, 2018 (DOE/FE Order No. 3041-A).
	Section 3 of the NGA	Long-Term conditional authority to export LNG to Non-FTA Nations.	Conditional non-FTA authorization issued on March 24, 2014; subject to satisfactory completion of NEPA review and related conditions. DOE is currently reviewing the amendment request with respect to the non-FTA application.
COE	Section 10 and 408 of the RHA	Process permit applications for structures or work in or affecting navigable waters of the United States. Approval of requests to alter COE civil works projects.	Pending. The applicants requested COE initiate the project's review per the RHA and have submitted both regulatory and Section 408 applications to the COE. The applicants are continuing to work with the COE to provide supplemental information regarding the RHA review.
	Section 404 of the CWA	Process permit application for the discharge of dredged or fill material into waters of the United States.	Pending. The applicants requested the COE initiate the Project's review per the CWA and have submitted a regulatory application to the COE. The applicants are continuing to work with the COE to provide supplemental information regarding the CWA review
EPA	Section 404 of the CWA	Co-administers CWA 404 program with the COE. EPA retains veto authority for wetland permits issued by the COE.	Pending.
	Section 309 of the CAA	Reviews and evaluates EIS for adequacy in meeting the procedural and public disclosure requirements of NEPA.	Pending.
FWS	Section 7 of the ESA		Pending. The FERC is preparing a biological assessment (BA) that will be submitted to the FWS and NMFS.
	FWCA	Provide comments to prevent loss of and damage to wildlife resources.	Pending. FWS generally addresses FWCA issues via comments on the FERC NEPA and COE 404 permit processes.

TABLE 1.5.1-1 (continued)

Major Permits, Approvals, and Consultations for the Jordan Cove & Pacific Connector Project

Agency	**Authority/Regulation/ Permit**	**Agency Action**	**Initiation of Consultations and Permit Status**
	MBTA Executive Order 13186	Consultation regarding compliance with the MBTA.	Pending. The applicants are currently consulting with the FWS regarding the projects requirements under the MBTA.
	Eagle Act	Coordination regarding compliance with the Eagle Act	Pending. The applicants will consult with the FWS regarding the project's requirements under the Eagle Act. Jordan Cove and Pacific Connector would apply for an Eagle Act permit if needed.
NMFS	Section 7 of the ESA	Provide a BO if the Project is likely to adversely affect federally listed threatened or endangered aquatic species or their habitat.	Pending. The FERC is preparing a BA that will be submitted to the FWS and NMFS.
	MMPA	Authorize, upon request, take of marine mammals incidental to otherwise lawful activities, subject to mitigation monitoring and reporting requirements.	Pending. The applicants have indicated that a MMPA Incidental Take Authorization (ITA) request will be filed with the NMFS.
	MSA	Provide conservation recommendations if the Project would adversely impact EFH.	Pending. EFH will be addressed in the FERC BA.
Coast Guard	Ports and Waterway Safety Act	Captain of the Port (COTP) issues a Letter of Recommendation (LOR) recommending the suitability of the waterway for LNG marine traffic.	Jordan Cove submitted LOI on January 9, 2017. Coast Guard issued LOR on May 10, 2018.
		Review Emergency Manual.	Pending. Must be completed prior to receiving first LNG carrier.
		Review Operations Manual.	Pending. Must be completed prior to receiving first LNG carrier.
		Establish safety and security zones for LNG vessels in transit and while docked.	Pending.
	Maritime Transportation Security Act	Review and Approve Facility Security Plan.	Pending. Must be completed 60 days prior to receiving first LNG carrier at the facility
	Navigation and Vessel Inspection Circular – Guidance related to Waterfront LNG Facilities	Develop LNG Vessel Transit Management Plan.	Pending. Must be completed prior to receiving first LNG carrier.
		Validate WSA and produce LOR and LOR Analysis.	Issued LOR and LOR Analysis on May 10, 2018.
USDOT; PHMSA	Natural Gas Pipeline Safety Act	Administer national regulatory program to ensure the safe transportation of natural gas and issue LOD on the project's compliance with the siting requirements of 49 CFR 193.	Pending. Applicants met with PHMSA in November 2017 to review their technical design package. In June 2018, PHSMA determined that the Project's design spill determination methodology meets the requirements of 49 CFR 193. LOD is pending. Anticipated prior to FEIS.

TABLE 1.5.1-1 (continued)

Major Permits, Approvals, and Consultations for the Jordan Cove & Pacific Connector Project

Agency	Authority/Regulation/ Permit	Agency Action	Initiation of Consultations and Permit Status
U.S. Department of Defense (DOD)	Section 311(f) of the EPAct and Section 3 of the NGA Memorandum of Understanding (MOU) between the FERC and DOD	Consult with the Secretary of Defense to determine whether an LNG facility would affect the training or activities of an active military installation.	In November 2012, the DOD indicated that the previously proposed project would have minimal impacts on military operations in the area. In December 2017, the DOD indicated that because it had previously reviewed the last proposal, it has "no issues" concerning the current Project.
DOE, Bonneville Power Administration (BPA)	Land Use Agreement for electric transmission line crossings	Permit review.	Pending.
USDOT, FAA	18 CFR Subchapter E Federal Aviation Regulations (FAR) Part 77 IAW FAA Order 7400.2G, 6-1-6	Aeronautical Study of Objects Affecting Navigable Airspace. Feasibility Study for Hazard Determination.	Pending. The FAA has issues a Notice of Presumed Hazard. Jordan Cove is currently consulting with the FAA regarding the potential for aeronautical operations to be impacted by the LNG terminal.
ACHP	Section 106 of the NHPA	Opportunity to comment on the undertaking.	Pending.
Federal Communication Commission	License for fixed microwave stations and service	Review proposals for new or additions to existing communication towers.	Pending.
U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS)	Farmland Protection Policy Act	Determine if the Project would result in the permanent conversion of prime farmland.	Pending.
U.S. Department of the Treasury, Bureau of Alcohol, Tobacco, and Firearms	Explosives User Permit	Issue permit to purchase, store, and use explosives during project construction.	Pending. Permits to be obtained by Jordan Cove and Pacific Connector, as necessary, before construction.
STATE – OREGON			
Oregon Department of Geology and Mineral Industries (DOGAMI)	Building Code Section 1802.1 Oregon Revised Statute (ORS) 455.446	Review of structural designs in tsunami zones. Review of geotechnical investigations for geological hazards.	Pending.
Oregon Department of Agriculture (ODA)	Oregon Endangered Species Act Oregon Senate Bill 533 and ORS 564	Consult on Oregon listed plant species, and ODA would review botanical survey reports covering non-federal public lands prior to ground-disturbing activities where state listed botanical species are likely to occur.	Pending.
Oregon Department of Consumer and Business Services – Building Code Division	ORS 455.446	Site-specific exemption approval under the state building code,	Pending.

TABLE 1.5.1-1 (continued)

Major Permits, Approvals, and Consultations for the Jordan Cove & Pacific Connector Project

Agency	Authority/Regulation/ Permit	Agency Action	Initiation of Consultations and Permit Status
ODE	State Authorities under Section 311 of the EPAct	Furnish an advisory report on state safety and security issues to the FERC regarding the Jordan Cove LNG terminal proposal and conduct operational safety inspections if the facility is approved and built.	Pending.
Oregon Department of Environmental Quality (ODEQ)	Water Quality Certification Section 401 of the CWA	Issue a license or permit to achieve compliance with state water quality standards.	Applicants submitted their CWA Section 401 application package to the ODEQ on April 6, 2018. On September 25, 2018, the applicants requested that the 401 application be withdrawn and resubmitted to allow ODEQ additional time to consider the request. Processing of the permit is pending.
	Section 402 of CWA	Issue National Pollutant Discharge Elimination System (NPDES) permits for discharge of stormwater.	NPDES permit for storm water issued in July 2015 and expires in June 2020
	Ballast Water Management	Review liabilities and offences connected to shipping and navigation.	Pending.
	CAA – Title V	Issue Title V Air Quality Operating permit. Issue Title V Acid Rain permit. Enforce Greenhouse Gas (GHG) Reporting Requirements.	Permit application to be filed by Pacific Connector one year after beginning operations of the Klamath Compressor Station.
	Prevention of Significant Deterioration CAA	Review Best Available Control Technologies to minimize discharges from new major sources, and review air quality analyses to ensure compliance with National Ambient Air Quality Standards.	Pending.
	Hazardous Waste Activity ORS 466 Oregon Administrative Rule (OAR) 340-102	Review plans for storage and management of hazardous waste	Pending.
Oregon Department of Fish and Wildlife (ODFW)	Fish and Wildlife Coordination Act and the Oregon Endangered Species Act under ORS 496, 506, and 509 OAR 635	Consult on sensitive species and habitats that may be affected by the Project and, in general, regarding conservation of fish and wildlife resources.	Pending.
	Fish and Wildlife OAR 345-22 & 60	Consult on and approve fish and wildlife mitigation plan.	Pending.
	Oregon Fish Passage Law ORS 509.-585 OAR 635-412-5 to 40	Review stream crossing plans for consistency with Oregon Fish Passage Law and screening criteria.	Pending.
	In-Water Blasting ORS 509-140, et al. OAR 635-425 to 50	Consider issuance of in-water blasting permits.	Pending.

TABLE 1.5.1-1 (continued)

Major Permits, Approvals, and Consultations for the Jordan Cove & Pacific Connector Project

Agency	Authority/Regulation/ Permit	Agency Action	Initiation of Consultations and Permit Status
Oregon Department of Forestry (ODF)	Easement on State lands Oregon Forest Practices Act OAR 629 ORS 477 ORS 527	Management of State Forest lands for Greatest Permanent Value, develops Forest Management Plans, stewardship under State's Land Management Classification System, monitors harvests of timber on private lands, and protects non-federal public and private lands from wildfires.	Pending.
Oregon Department of Land Conservation and Development (ODLCD)	CZMA 15 CFR Part 930 ORS 196.435	Determine consistency with CZMA program policies.	Pending.
Oregon Department of Transportation (ODOT)	Section 303(c) DOT Act 49 CFR 303 OAR 734-030(4) OAR 734-051-4020	Review and approve traffic management plans	Pending. A draft traffic impact analysis was provided to ODOT, Coos County, and City of North Bend on December 4, 2017 by the applicants. ODOT and North Bend provided comments on December 21, 2017. The applicants continue to work with ODOT.
	State Highway ROW ORS 374-305 OAR 734- 55	Permits to be issued from each ODOT District Office to allow construction within State Highway ROW and use of State Highways for Project access, and where utilities would cross over, under, or run parallel to ODOT ROWs.	Pending. Applications for ODOT Approach and Utility Permits to be submitted with enough advance notice (which could be up to 12 months or more depending on individual District requirements) prior to construction activities to ensure adequate time to review the specific proposals.
Oregon Department of State Lands (ODSL)	Submerged and Submersible Land Easement OAR 141-122	Grant submerged land easements.	Pending.
	Lease and Registrations OAR 141-082	Issue wharf registrations	Pending.
	Sand and Gravel Lease/License OAR 141-014	Issue licenses or leases for removal of state-owned materials.	Pending.
	Joint Removal-Fill Law ORS 196-795-990 OAR 141-85	Approve removal or fill of material in waters of the state.	Pending.
	Special Use Permits OSAR 141-125	Allow work within state-owned lands	Pending.
	Compensatory Wetland Mitigation Rules OAR 141-85-121	Review and approve wetland mitigation plans.	Pending.
Oregon Water Resources Department (OWRD)	New Water Rights ORS 537 OAR 690-310	Issue permits to appropriate surface water and groundwater.	Pending.
	Temporary Water Use ORS 537 OAR 690-340	Issue limited licenses for temporary use of surface waters.	Pending.

TABLE 1.5.1-1 (continued)

Major Permits, Approvals, and Consultations for the Jordan Cove & Pacific Connector Project

Agency	Authority/Regulation/ Permit	Agency Action	Initiation of Consultations and Permit Status
Oregon Public Utilities Commission (OPUC)	OAR 860-031	Authorize intrastate electric transmission lines. Inspect the natural gas facilities for safety.	Pending Pacific Connector's submittal of appropriate applications to OPUC.
State Historic Preservation Office (SHPO)	Section 106 of the NHPA 36 CFR 800 ORS 338-920	Review cultural resources reports and comments on recommendations for National Register of Historic Places eligibility and project effects. Issue permits for excavation of archaeological sites on non-federal lands.	Pending. SHPO wrote letters to the FERC on June 21, 2017, January 18 and September 24, 2018, commenting on reports submitted by the applicants.
LOCAL – COUNTIES and CITIES			
Various County Permits	Coos County Zoning and Land Development Ordinance, Coos County Comprehensive Plan, and Coos Bay Estuary Management Plan (CBEMP) Douglas County Comprehensive Plan and Douglas County Land Use and Development Ordinance Jackson County Comprehensive Plan and Jackson County Land Development Ordinance Jackson County Comprehensive Plan and Jackson County Land Development Ordinance Klamath County Land Development Code Various Road Crossing; Grading; and Solid Waste Disposal North Bend Comprehensive Plan North Bend City Code	Issue Conditional Use Permits. Zoning Changes and Verifications. Issue Land Use Compatibility Statement under Statewide Planning Goals.	Pending.

1.5.1.1 Endangered Species Act

Section 7 of the ESA, as amended, states that "Federal agencies shall, in consultation with and with the assistance of the Secretary, utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species listed pursuant to Section 4 of this Act," and any project authorized, funded, or conducted by a federal agency should not "jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined...to be critical". The lead federal agency, or the applicant as a non-federal party, is required to consult with the FWS and the NMFS to determine whether any federally listed or proposed endangered or threatened species or their designated critical habitat occur in the vicinity of the Project. If, upon review of existing data, or data provided by the applicant, one (or both) of the Services find that any federally listed species or critical habitats may be affected by the Project, the FERC is required to prepare a biological assessment (BA) to identify the nature and extent of adverse effects, and to recommend measures that would avoid, reduce, or mitigate effects on habitats and/or species. The FERC's request for consultation with the BA begins the consultation process. The consultation process concludes with the issuance of a biological opinion(s) as to whether or not the proposed action may result in jeopardy to the species or adverse modification to critical habitat. If the determination is no jeopardy/adverse modification, an incidental take statement is included when needed. An incidental take statement would contain reasonable and prudent measures necessary or appropriate to minimize the proposed action's impact and terms and conditions that must be complied with by the federal agency(s) and applicants. See section 4.6 of this EIS, as well as the pending BA, for further information regarding the Project's effects on federally listed species and protected habitats.

1.5.1.2 Magnuson-Stevens Fishery Conservation and Management Act

The MSA, as amended by the Sustainable Fisheries Act of 1996, established procedures designed to identify, conserve, and enhance EFH for those species regulated under a federal fisheries management plan. The MSA requires federal agencies to consult with the NMFS on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH. Although absolute criteria have not been established for conducting EFH consultations, the NMFS recommends consolidated EFH consultations with interagency coordination procedures required by other statutes, such as NEPA, the Fish and Wildlife Coordination Act, or the ESA to reduce duplication and improve efficiency.

See sections 4.5 and 4.6 of this EIS for further information regarding the Project's effects on EFH.

1.5.1.3 Marine Mammal Protection Act

All marine mammals are protected under the MMPA. This act was amended by the U.S. Congress in 1994. Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 et seq.) direct the Secretary of Commerce (as delegated to the NMFS) to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review (note that the FWS has jurisdiction over some species of marine mammals, but none within Oregon).

An authorization for incidental takings shall be granted if the NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. The NMFS has defined "negligible impact" in 50 CFR 216.103 as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.

The MMPA states that the term "take" means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal. Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

The NMFS may use relevant portions of this EIS during its review and may adopt measures to protect marine mammals outlined in this EIS. It may also require additional mitigation, monitoring, and reporting measures to ensure that the taking results in the least practicable adverse impact on affected marine mammal species or stocks. The public would have an opportunity to comment to the NMFS in response to its publication of a notice of proposed Incidental Take Authorization (ITA), or in response to its publication of a notice of proposed rule.

See sections 4.5 and 4.6 of this EIS for further information regarding the Project's effects on marine mammals.

1.5.1.4 National Historic Preservation Act

Section 101(d)(6) of the NHPA states that properties of traditional religious and cultural importance to Indian tribes[18] may be determined eligible for the National Register of Historic Places (NRHP). In carrying out our responsibilities under Section 106 of the NHPA, the FERC consulted on a government-to-government basis with Indian tribes that may attach religious and cultural importance to properties in the area of potential effect (APE), in accordance with the implementing regulations at 36 CFR 800.2(c)(2)(ii). Those consultations with tribes are detailed in section 4.11.1.2 of this EIS. The BLM and Forest Service are proposing to amend their respective LMPs to make provision for the pipeline, Reclamation must concur with the BLM ROW Grant to allow the pipeline to cross lands and facilities related to the Klamath Project, and the COE is considering issuing permits under the RHA and CWA, and these other federal agencies may consult separately, under their responsibilities, with affected Indian tribes on those actions.

Section 106 of the NHPA requires that federal agencies take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment. Historic properties include prehistoric or historic sites, districts, buildings, structures, objects, landscapes, or properties of traditional religious or cultural importance listed on or eligible for listing on the National Register of Historic Places (NRHP). Jordan Cove and Pacific Connector, as non-federal parties, can provide cultural resources data, analyses, and recommendations to the FERC, as allowed by the regulations for implementing Section 106. However, the FERC remains responsible for all findings and determinations.

The FERC is responsible under Section 106 and its implementing regulations, to consult with the Oregon State Historic Preservation Office (SHPO), identify historic properties within the APE, and make determinations of NRHP eligibility and project effects, on behalf of all the federal

[18] Indian tribes are defined in 36 CFR 800.16(m) as: "an Indian tribe, band, nation, or other organized group or community, including a Native village, Regional Corporation, or Village Corporation, as those terms are defined in Section 3 of the Alaska Native Claims Settlement Act (43 U.S.C. 1602), which is recognized as eligible for the special programs and services provided by the United States to Indians because of their special status as Indians."

cooperating agencies. Section 4.11 of this EIS summarizes the status of our compliance with the NHPA.

1.5.1.5 Rivers and Harbors Act

Section 10 of the RHA prohibits the unauthorized obstruction or alteration of any navigable water of the United States. This section provides that the construction of any structure in or over any navigable water of the United States, or the accomplishment of any other work affecting the course, location, condition, or physical capacity of such waters is unlawful unless the work has been authorized by the COE.

1.5.1.6 Clean Water Act

The CWA establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. Section 404 of the CWA outlines procedures by which the COE can issue permits (after notice and opportunity for public hearings) for the discharge of dredged or fill material into waters of the United States at specified disposal sites.[19] The EPA has the authority to review and veto COE decisions on Section 404 permits. The FWS and NMFS use their Fish and Wildlife Coordination Act authorities to review and comment during the 404 permitting process. The authority to issue Water Quality Certifications pursuant to Section 401 of the CWA and National Pollutant Discharge Elimination System (NPDES) permits pursuant to Section 402 of the CWA has been delegated to the ODEQ (see section 1.5.2.4).

See section 4.3 of this EIS for further information regarding water quality issues.

1.5.1.7 Clean Air Act

The primary objective of the CAA as amended, is to establish federal standards for various pollutants from both stationary and mobile sources, and to provide for the regulation of polluting emissions via state implementation plans. In addition, the CAA was established to prevent significant deterioration in certain areas where air pollutants exceed national standards and to provide for improved air quality in areas that do not meet federal standards (non-attainment areas).

The EPA has regulatory authority under the CAA. Section 309 of the CAA directs the EPA to review and comment in writing on environmental effects associated with all major federal actions. The EPA has delegated permitting authority under the CAA to the ODEQ. Emissions from all phases of construction and operation of the proposed LNG terminal and pipeline would be subject to applicable federal and state air regulations.

See section 4.12.1 of this EIS for further information regarding air quality issues.

[19] For activities involving CWA Section 404 discharges, a permit will be denied by the COE if the associated discharge does not comply with the EPA's 404(b) (1) Guidelines. The Guidelines are binding regulations and provide substantive environmental standards by which all Section 404 permit applications are evaluated. The Guidelines specifically require that "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse effects." The burden of proving no practicable alternative exists is the sole responsibility of the applicant.

1.5.1.8 Coastal Zone Management Act

In 1972, Congress passed the CZMA to "preserve, protect, develop, and where possible, to restore or enhance, the resources of the nation's coastal zone for this and succeeding generations" and to "encourage and assist the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone".

Section 307 (c)(3)(A) of the CZMA states that "any applicant for a required federal license or permit to conduct an activity, in or outside the coastal zone, affecting any land or water use or natural resource of the coastal zone of that state shall provide a certification that the proposed activity complies with the enforceable policies of the state's approved program and that such activity will be conducted in a manner consistent with the program." In order to participate in the coastal zone management program, a state is required to prepare a program management plan for approval by the NOAA Office of Coast and Ocean Resource Management (OCRM). Once the OCRM has approved a plan and its enforceable program policies, a state program gains "federal consistency" jurisdiction. This means that any action requiring a federally issued licenses or permits that takes place within a state's coastal zone must be found to be consistent with state coastal policies before the action authorized by the federal license or permit can occur.

All components of the Project from MP 0.0 to approximately MP 53.2 are within the designated Oregon coastal zone and are subject to federal CZMA review. The ODLCD is the state's designated coastal management agency and has established the Oregon Coastal Management Program (OCMP). The program's mission is to work in partnership with coastal local governments, state and federal agencies, and other stakeholders to ensure that Oregon's coastal and ocean resources are managed, conserved, and developed consistent with statewide planning goals. To accomplish this mission, the program combines various state statutes for managing coastal lands and waters into a single, coordinated package. These include: (1) the 19 Statewide Planning Goals, which are Oregon's standards for comprehensive land use planning; (2) city and county comprehensive land use plans; and (3) state agencies and natural resource laws such as the Oregon Beach Bill and the Removal-Fill Law. Under the provisions of the CZMA, Jordan Cove and Pacific Connector must provide a certification to the FERC, COE, and the ODLCD that their projects comply with and would be conducted in a manner consistent with the state's approved management program (15 CFR 930.50 Subpart D).

See section 4.7 of this EIS for further information regarding the FERC's compliance with the CZMA.

1.5.1.10 Migratory Bird Treaty Act

The MBTA protects 1,027 species (50 CFR §10.13). Intentional destruction or disturbance of active migratory bird nests, or any eggs or young contained within it, without authorization, is a violation of the MBTA.

EO 13186 encourages federal agencies to find ways to conserve birds protected under MBTA, especially those of greatest conservation concern, in the course of conducting agency activities. On March 30, 2011 the FERC and FWS entered into an MOU that focuses on migratory birds and strengthening conservation through enhanced collaboration between the agencies. This voluntary MOU does not waive legal requirements under the MBTA, Eagle Act, ESA, or any other statutes, and does not authorize the take of migratory birds. Under the MOU, the FERC would promote the applicants' use of BMPs to avoid and minimize impacts on birds to the extent practicable during project implementation.

See sections 4.5 and 4.6 of this EIS for further information regarding the migratory bird species that inhabit the Project area, as well as measures the applicants would implement to avoid, reduce, or mitigate effects on migratory birds.

1.5.1.11 Bald and Golden Eagle Protection Act (Eagle Act)

The Eagle Act prohibits the "take" of bald and golden eagles, including their parts, nests, or eggs, without a permit. "Take" is defined as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb."

Activities that may affect an eagle's ability to forage, nest, roost, breed, or raise young, constitute 'disturbance' and require a permit; habitat manipulation in this project might result in disturbance and require a permit. The FWS can issue permits for non-purposeful take under the Eagle Act and encourages applicants to coordinate early to avoid and minimize impacts to bald and golden eagles that may be in the vicinity of the project.

See section 4.6 of this EIS for further information regarding bald and golden eagles that inhabit the Project area, as well as measures the applicants would implement to avoid, reduce, or mitigate effects on bald and golden eagles as required by the Eagle Act.

1.5.2 State Agency Permits and Approvals

In addition to the federal permitting authorities that have been delegated to the states, as discussed above, various Oregon laws pertain to the Project. Permits, authorizations, and consultations with state agencies relevant to the Project are listed in table 1.5.1-1.

The FERC encourages cooperation between applicants and state and local authorities, but this does not mean that state and local agencies (through application of state and local laws) may prohibit or unreasonably delay the construction or operation of facilities approved by the FERC. Any state or local permits issued with respect to FERC regulated facilities must be consistent with the conditions of any Certificate the FERC may issue.[20]

1.5.2.1 Oregon Department of Geology and Mineral Industries (DOGAMI)

The mission of the DOGAMI is to provide earth science information for the citizens of Oregon. DOGAMI identifies and quantifies natural hazards, and works to minimize potential effects of earthquakes, landslides, and tsunamis. Its administrative rule at OAR 632 includes the identification of Tsunami Inundation Zones under Division 5. The agency is also the steward of Oregon's mineral resources, and it regulates mining activities, and oil and gas exploration and production on non-federal lands.

[20] *See* 15 U.S.C. § 717r(d) (state or federal agency's failure to act on a permit considered to be inconsistent with Federal law); *see also Schneidewind v. ANR Pipeline Co.*, 485 U.S. 293, 310 (1988) (state regulation that interferes with FERC's regulatory authority over the transportation of natural gas is preempted) and *Dominion Transmission, Inc. v. Summers,* 723 F.3d 238, 245 (D.C. Cir. 2013) (noting that state and local regulation is preempted by the NGA to the extent it conflicts with federal regulation, or would delay the construction and operation of facilities approved by the Commission).

1.5.2.2 Oregon Department of Agriculture (ODA)

The ODA maintains the state list of endangered and threatened plant species, in accordance with Oregon Administrative Rule (OAR) Chapter 603, Division 73, and reviews reports of botanical surveys under Oregon Senate Bill 533 and its corresponding Oregon Revised Statute (ORS) 564. These state laws and regulations require surveys for state listed species on non-federal public lands prior to ground-disturbing activities, unless habitat for the species does not exist in the Project area. Furthermore, the ODA Noxious Weed Control Program and the Oregon State Weed Board maintain the State Noxious Weed List for the State of Oregon.

1.5.2.3 Oregon Department of Energy (ODE)

According to the EPAct, the Governor of a state in which an LNG terminal is proposed is to designate an appropriate state agency to consult with the Commission. That state agency should provide the FERC with an advisory report on state and local safety concerns, within 30 days of the FERC's notice of an application for an LNG terminal, for the Commission to consider prior to making a decision. The ODE has been designated by the Governor of Oregon as the state agency to coordinate the review of proposed LNG projects by other state agencies and consult with the FERC.

1.5.2.4 Oregon Department of Environmental Quality (ODEQ)

The ODEQ is responsible for protecting and enhancing Oregon's water and air quality, managing the proper disposal of hazardous and solid waste, overseeing clean-ups of spills or releases of hazardous materials, and enforcing Oregon's environmental laws and regulations. The agency's duties to regulate sewage treatment and disposal systems are found in ORS Chapter 454, for solid waste management in Chapter 459, hazardous materials in Chapters 465 and 466, air and water quality in Chapter 468, and ballast water in Chapter 783. The EPA has delegated authority to the ODEQ under both the CWA and CAA.

Under its delegated responsibilities required by the CAA, the ODEQ administers the Title V Air Permit program and the acid rain program, and issues air contaminant discharge permits (ACDP). The agency is also responsible for enforcing greenhouse gas (GHG) reporting requirements, and collecting data on GHG emissions for certain facilities that hold Title V or ACDP operating permits. In addition, ODEQ makes determinations about the Prevention of Significant Deterioration (PSD) of air quality from new major sources or major modifications at existing sources, and reviews air quality analyses completed to comply with National Ambient Air Quality Standards (NAAQS).

1.5.2.5 Oregon Department of Fish and Wildlife (ODFW)

The OODFW is responsible for keeping the state sensitive fish and wildlife list and developing the state's Wildlife Diversity Plan. The purpose of the Fish and Wildlife Habitat Mitigation Policy (OAR 345-22-60) developed by the ODFW is to apply consistent goals and standards to mitigate effects on fish and wildlife habitat caused by land and water development actions. The policy provides goals and standards for general application to individual development actions, and for the development of more detailed policies for specific classes of development actions or habitat types. In implementing this policy, the ODFW will recommend or require mitigation for losses of fish and wildlife habitat resulting from development actions; priority is given to native species.

ORS 509.585 (Oregon Fish Passage Law) applies to all project components that cross waters of the state where native migratory fish species are or were historically present. The ODFW would also review fish screening at water intakes under ORS 498-306. Under ORS 509 and OAR 635, the ODFW has responsibilities for review of stream crossing plans to provide for passage of native migratory fish.

OAR 635-425-000 through 635-425-0050 requires in-water blasting permits to be issued by ODFW for locations where explosives may be used to cross streams. While, in general, in-water blasting is discouraged, unless it is the only practicable method for accomplishing project goals, the ODFW may issue a permit if it contains conditions for preventing injury to fish and wildlife and their habitats.

1.5.2.6 Oregon Department of Forestry (ODF)

The ODF manages State Forests for the Greatest Permanent Value. The ODF has created a Forest Management Plan to provide strategic direction and guide management activities. Part of the plan is to identify multi-purpose objectives, and protect sensitive resources according to the state's Land Management Classification System. The ODF also monitors the commercial harvest of forest products from private timber lands, according to the Oregon Forest Practices Act. The ODF is responsible for protection of non-federal and private forest lands from wildfires.

Pacific Connector would be required to submit a Notification to the ODF. The Notification serves three purposes: notification of a forest operation, a request for a Permit to Use Fire or Power Driven Machinery, and notice to the Department of Revenue of timber harvest. A separate notification should be filed for each county and timber owner affected by the Project. All notifications require a 15-day waiting period before activity may begin unless a waiver is requested. Also, any action that would result in the conversion of forestland to other land uses or practices not in statute or rule would require the submission of a Plan for Alternate Practice and written approval from the State Forester.

1.5.2.7 Oregon Department of Land, Conservation, and Development (ODLCD)

The ODLCD assists communities and citizens in improving the built and natural environment. Under Oregon's statewide land use planning program, the ODLCD provides protection for farm and forest lands, conservation of natural resources, plans for orderly development, and coordinates among local governments. Comprehensive land use planning coordination is required under ORS 197. All cities and counties in Oregon have adopted plans that meet state standards and adhere to 19 Statewide Planning Goals and Guidelines.

In addition, NOAA has delegated to the state of Oregon the finding of consistency with the CZMA. In accordance with ORS 196.435, the ODLCD's Ocean and Coastal Services Division has been designated the state's coastal zone management agency and administers the CZMA federal consistency review program. Applicants for certification of CZMA consistency are encouraged by the ODLCD to obtain state and local permits and other authorizations required by enforceable policies. The requirements of the CZMA are applicable to NPDES permits and must be included in the NPDES permit for the Jordan Cove industrial wastewater treatment facility.

1.5.2.7 Oregon Department of Transportation (ODOT)

The ODOT has the responsibility to preserve the operational safety, integrity, and function of the state's highway facilities. The ODOT must also ensure that improvements to the highway system can be accomplished without undue effects or damage to utilities within the highway ROW. Construction that may affect the state ROW is subject to ORS 374.305, under which no person, firm, or corporation may place, build, or construct on any state highway ROW, approach road, structure, pipeline, ditch, cable or wire, or any other facility, thing, or appurtenance without first obtaining written permission from the ODOT. A permit from the ODOT is required for any work on a highway that is part of the state highway system, including but not limited to interstate highways, other highways on the National Highway System, and routes on the federal-aid highway system.

1.5.2.8 Oregon Department of State Lands (ODSL)

Under Oregon's Removal-Fill Law, permits are issued by the ODSL for projects requiring the removal or fill of 50 cubic yards or more of material in waters of the state; the removal or fill of any material regardless of the number of cubic yards affected in a stream designated as essential salmon habitat; and the removal or fill of any material from the bed and banks of scenic waterways regardless of the number of cubic yards affected.

An application to the ODSL should demonstrate independent utility, identify best use of waters, and outline measures to minimize effects on water resources. To meet the requirements of OAR Division 85, compensatory mitigation should be offered to replace all lost functions and values of wetlands and waterbodies effected by a project.

1.5.2.9 Oregon Water Resources Department (OWRD)

The mission of the OWRD is to address the state's water supply needs through the restoration and protection of stream flows and watersheds. The OWRD is charged with administering state laws and regulations governing surface and groundwater resources, such as the Ground Water Act under ORS 537-505. Its core functions include collecting water resources data and enforcing water rights, under OAR Chapter 690. All water is publicly owned in Oregon, and users must obtain a permit or water right from OWRD, including water withdrawals from underground wells, streams, or lakes. OWRD also maintains a database of water well locations, and a database for stream flows and lake levels. The applicants utilized the OWRD database for their application to the FERC.

1.5.2.8 Oregon State Historic Preservation Office (SHPO)

The FERC, as the lead federal agency, on behalf of the federal cooperating agencies, is consulting with the Oregon SHPO regarding the identification of historic properties and determination of Project-related effects, in accordance with 36 CFR 800, in order to comply with Section 106 of the NHPA. The SHPO also has authorities under ORS 358-920 to issue permits for cultural resources surveys on non-federal public land, and for the excavation of archaeological sites on non-federal lands. Jordan Cove and Pacific Connector would obtain applicable permits from the SHPO prior to conducting other archaeological work related to the Project.

2.0 DESCRIPTION OF THE PROPOSED ACTION

As described herein, Jordan Cove proposes to construct and operate an LNG production, storage, and export facility in Coos County, Oregon. Pacific Connector also proposes to construct and operate an interstate natural gas transmission pipeline and associated facilities in Coos, Douglas, Jackson, and Klamath Counties, Oregon. The proposed action also includes amendments to BLM and Forest Service LMPs. The proposed amendments and associated mitigation actions are described in sections 2.1.3, 2.1.4, and 2.1.5 below.

2.1 PROJECT OPERATIONAL COMPONENTS

2.1.1 Jordan Cove LNG Project

The Jordan Cove LNG export terminal would be located on the bay side of the North Spit of Coos Bay, Oregon. The general location of the terminal and associated temporary construction work areas including marine facilities and mitigation sites is shown on figure 2.1-1. The primary components of the LNG terminal include five liquefaction trains[21], two full-containment LNG storage tanks, vessel loading facilities, a vessel slip, and a marine access channel. The terminal site would also include a connection to the Pacific Connector pipeline and a gas conditioning facility. Jordan Cove is proposing five mitigation sites (i.e., the Kentuck project; the Eelgrass Mitigation site; and the Lagoon, Panhandle, and North Bank upland wildlife habitat mitigation sites). As shown on figure 2.1-2, portions of the terminal site are referred to as Ingram Yard which would contain the main terminal facilities; South Dunes, which would contain the SORSC, administration building, and temporary workforce housing and laydown areas; and an access and utility corridor between the Ingram Yard and South Dunes. Components that make up the proposed LNG terminal are described below, and the location of specific components are shown on figure 2.1-3.

The proposed LNG terminal site is within a potential tsunami inundation zone, and Jordan Cove has incorporated measures into the proposed facility design to account for potential tsunami inundation. Measures include elevating some site components and protecting some site components with berms or wall. Details are discussed as appropriate within this EIS.

2.1.1.1 Gas Conditioning

Natural gas would require conditioning prior to liquefaction to remove components that could freeze out and clog the liquefaction equipment or would otherwise be incompatible with the liquefaction process such as mercury, hydrogen sulfide, carbon dioxide (CO_2), water, and heavy hydrocarbons that would freeze during the liquefaction process. Heavy hydrocarbons removed would be blended into the fuel gas stream, so no on-site storage or disposal would be required.

[21] A liquefaction train consists of all components of the liquefaction process arranged in a linear relationship.

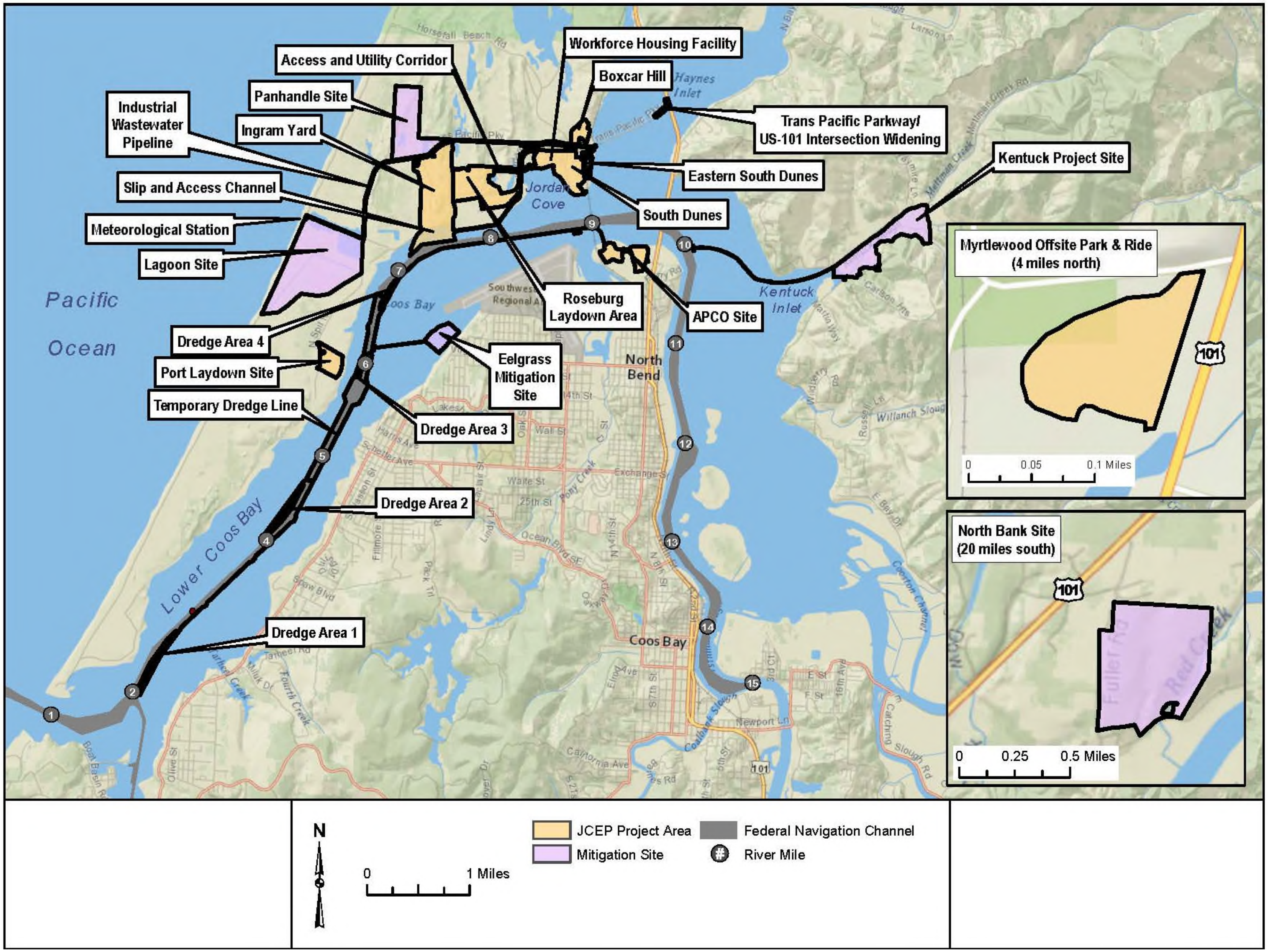

Figure 2.1-1
Jordan Cove LNG Project General Location

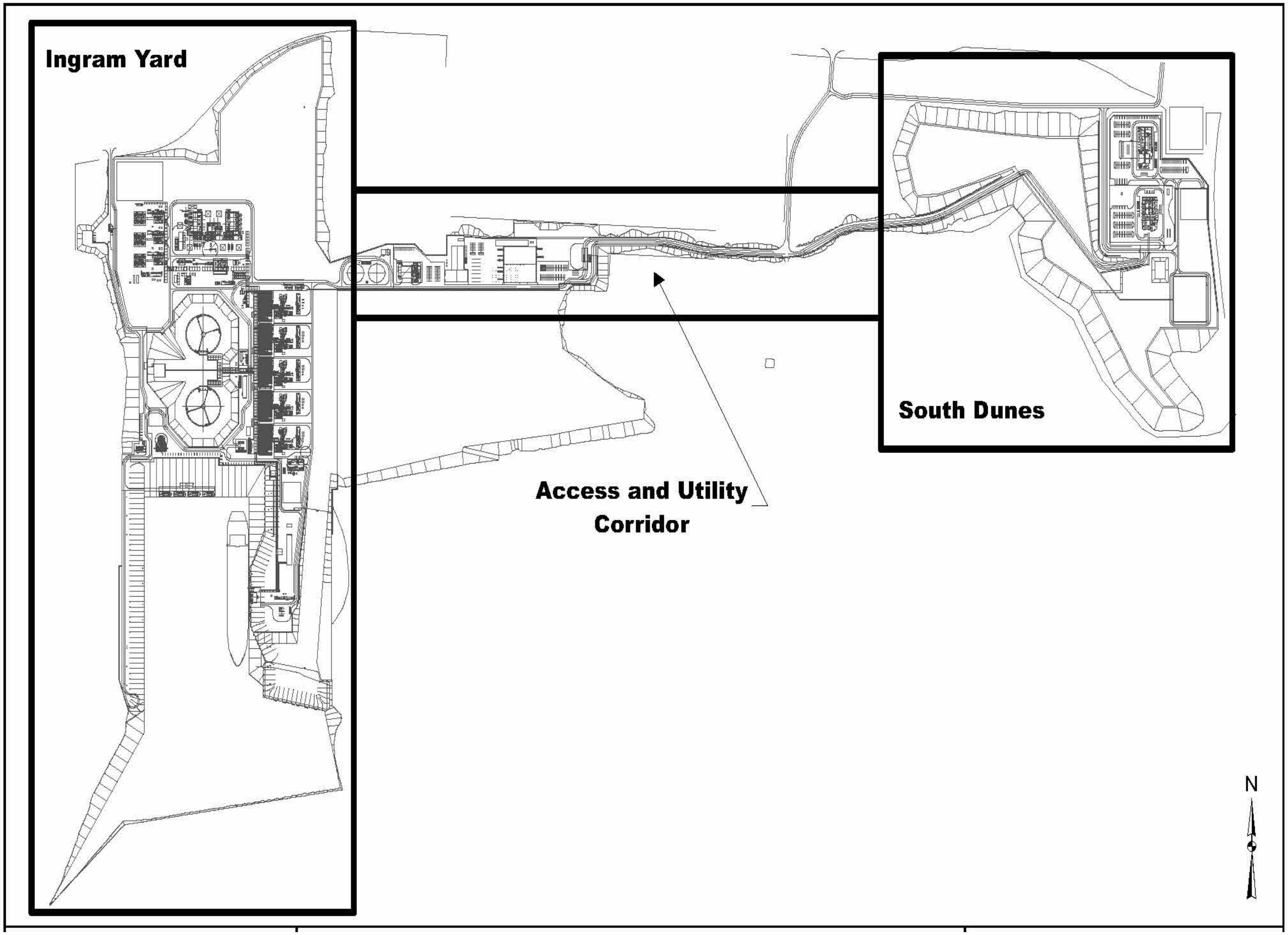

Figure 2.1-2
LNG Terminal Facilities

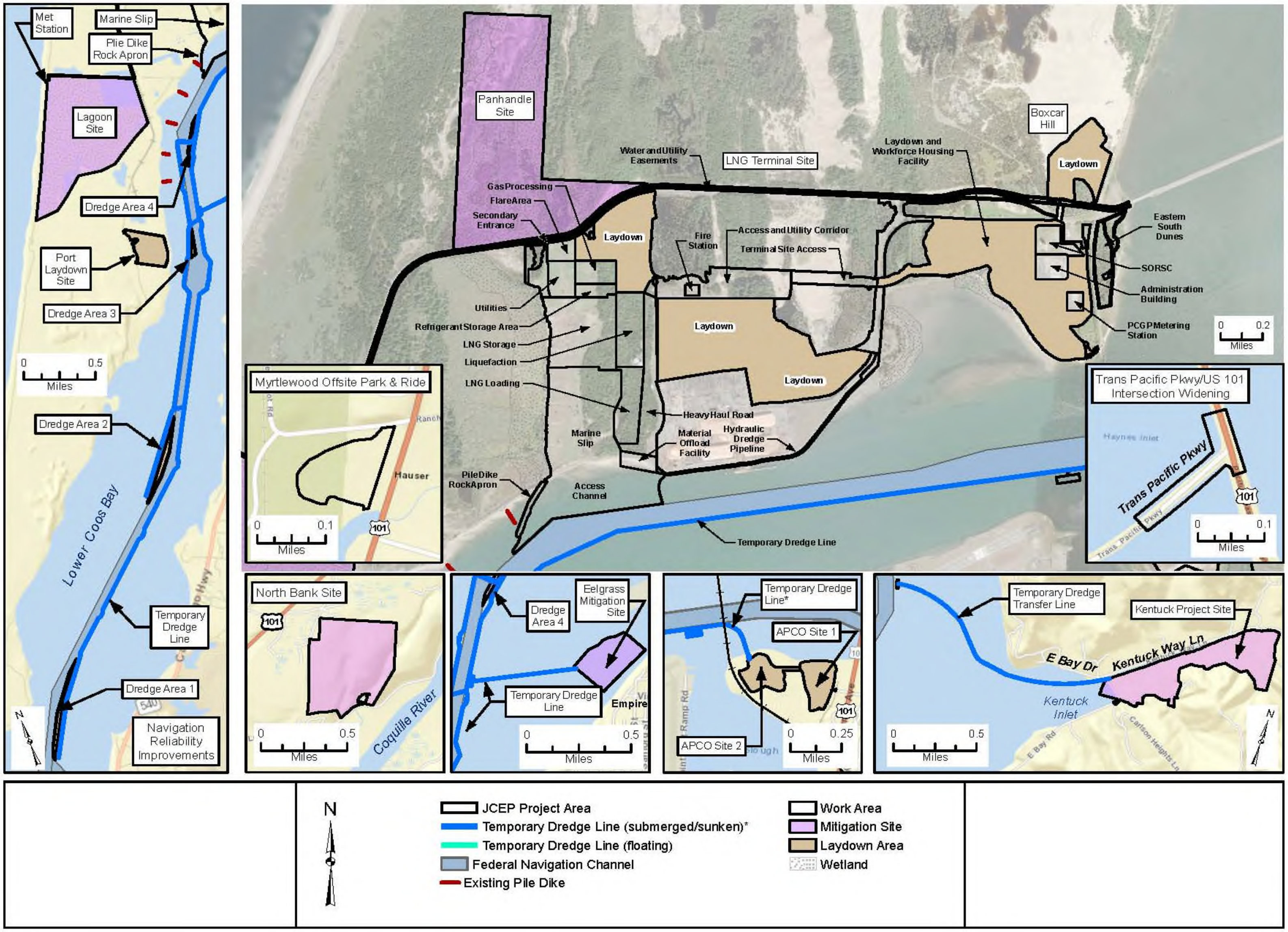

Figure 2.1-3
Jordan Cove LNG Project Detail

2.1.1.2 Liquefaction

The liquefaction trains would use Black & Veatch proprietary Poly Refrigerant Integrated Cycle Operation (PRICO®) LNG technology, each with a maximum annual capacity of 1.56 metric tonnes per annum (mtpa), for a total annual capacity of 7.8 mtpa for export. Gas delivered from the conditioning units would be divided equally among the five liquefaction trains where it would be turned into liquid by cooling to approximately -260°F. Upon leaving the LNG trains the produced LNG would be conveyed to the LNG storage tanks.

2.1.1.3 LNG Storage Tanks

The terminal would include two full-containment storage tanks, each designed to store 160,000 cubic meters (m^3) (1,006,000 barrels) of LNG at an approximate temperature of -260 degrees Fahrenheit (°F) at atmospheric pressure. Each storage tank would consist of a nine percent nickel inner steel container and a secondary concrete outer container wall with a steel vapor barrier, and would be designed so that both the primary inner container and the secondary outer concrete shell are capable of independently containing the entire volume of stored LNG.

The base elevation of the LNG storage tanks would be at about +27 feet above mean sea level (MSL). The top of the tanks (dome) would be about 180 feet above grade, and the diameter of the outer tank would be about 267 feet wide. Jordan Cove proposes to enclose the LNG storage tanks within an earthen berm that would be about +46 feet high. The berm would be designed to contain the contents of one 160,000 m^3 storage tank.

Each LNG storage tank would be built on a shallow mat foundation. Cellular glass insulation would be incorporated into the foundation and a glass wool blanket would be installed on the inner tank. The remainder of the annular space between the outer tank and inner tank would be filled with expanded perlite to keep the stored LNG at a temperature of approximately -260°F while maintaining the outer container at near ambient temperature. The LNG storage tanks would have top connections only with piping that would allow top and bottom filling. Top filling would be done via a spray device or a splash plate while bottom loading would be achieved via a standpipe to allow mixing of incoming LNG as it combines with the LNG inventory within the LNG storage tanks. A conceptual design drawing of a typical full containment LNG storage tank is illustrated in figure 2.1-4.

2.1.1.4 Terminal Access, Utility Corridor, and Parking

The feed gas supply pipeline and other utilities including power, water supply, and communications would be located in an approximately one-mile-long corridor connecting the South Dunes and Ingram Yard. The corridor would also provide temporary and permanent access to the LNG terminal site. Paved access between the South Dunes portion of the site and the western portion of the access and utility corridor would be via the existing Jordan Cove Road. A two-lane access road would be installed to the northwest of Ingram Yard to provide emergency, marine terminal, and occasional maintenance access from the Trans-Pacific Parkway.

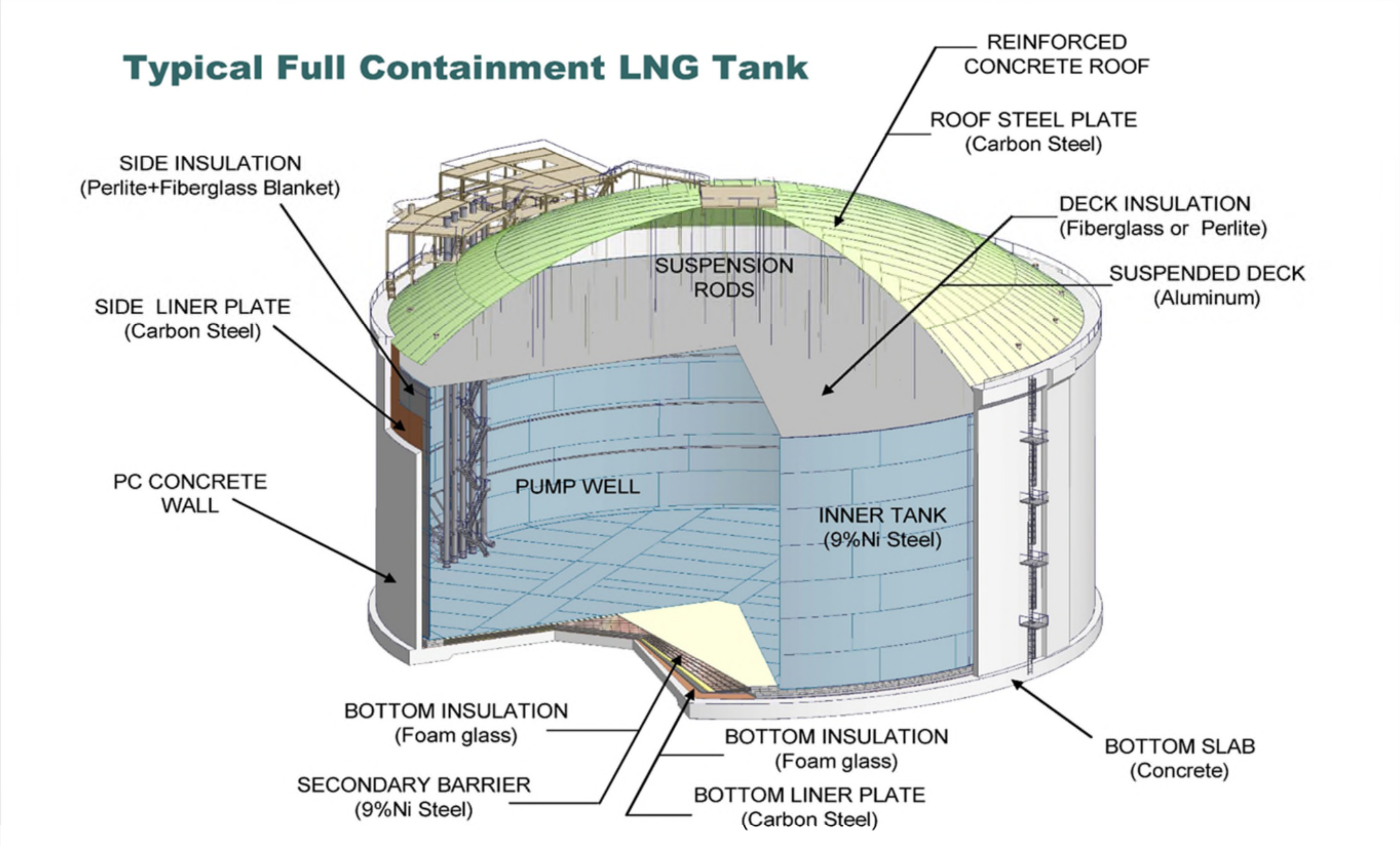

Figure 2.1-4

Typical Full Containment LNG Storage Tank

2.1.1.5 Other Terminal Support Systems

The LNG terminal operation would require installation of several other systems within the LNG terminal site, as described below.

Vapor Handling System

The liquefaction and vessel loading processes would result in the creation of miscellaneous LNG vapors, which would be recovered and directed into a vapor handling system and recycled into the liquefaction process.

Ground Flares

The LNG terminal would have three separate flare systems for occasional pressure relief or plant protection conditions: one flare system for warm (or wet) reliefs, one for cold cryogenic (or dry) reliefs, and one for low-pressure cryogenic reliefs from the marine loading system. The warm and cold flares would both be combined within a shared multi-point ground flare, while the marine flare would be within an enclosed cylindrical ground flare. The multi-point ground flare systems would be located at the northern end of the LNG terminal site and the enclosed ground flare would be located north of the marine vessel slip. The flare systems would only be used during plant-protection situations, maintenance activities, cases of purging and gassing-up an LNG carrier, and initial commissioning/start-up.

During initial commissioning and startup flaring would occur for approximately 1 week, at 10 to 20 percent of the flare design capacity. For dryout and cooldown, flaring would occur for approximately 2 weeks at less than about 20 percent of the flare design capacity. When each subsequent liquefaction train is started, flaring may occur for approximately 2 hours, and each train would be staggered by about 1 month between startups. Flaring during other commissioning activities would occur intermittently but would consist of individual pieces of equipment being isolated with very small volumes flared compared to the flare design capacity until the system is depressurized.

Instrumentation and Process Control System

The facility would be operated through a distributed control system (DCS) that would include control panels and numerous field-mounted instruments connected to remote input/output cabinets that would interface with the central control room. In addition, independent Safety Instrumented Systems (SIS) and Fire and Gas Systems (FGS) would monitor hazardous conditions and provide emergency shutdown capability.

Electrical Systems

Electrical power to the LNG terminal would be supplied via two 30-megawatt (MW) steam turbine generators and one spare 30 MW steam turbine generator, with the steam generated by heat recovery from gas turbine operation. A black-start auxiliary boiler would be used to generate steam for power when gas turbines are not in operation. The system would also include two standby diesel generators for the LNG facility and two for the SORSC.

Lighting System

Twenty-four-hour facility lighting would be required for security and personnel safety during operation of the LNG terminal. A final lighting plan, including lighting of the LNG storage tanks, would be developed during detailed LNG terminal design; however, Jordan Cove states that only lighting required for operation and maintenance, safety, security, and meeting FAA requirements would be used on the LNG storage tanks.

Water Systems

Jordan Cove would design and construct a stormwater management system to gather runoff from impervious surfaces within the terminal and direct the flow to designated areas for disposal. Stormwater collected in areas that are potentially contaminated with oil or grease would be pumped or would flow to oily water collection sumps before discharging to the industrial wastewater pipeline. No untreated stormwater would be allowed to enter federal or state waters.

Sanitary waste would either be directed to a holding tank and disposed of by a sanitary waste contractor as necessary or would be treated by a packaged treatment system and directed to an existing industrial wastewater pipeline (IWWP).

During construction of the Jordan Cove LNG Project, an existing industrial wastewater pipeline would be abandoned, replaced, and relocated. The new replacement pipeline would consist of 16-inch-diameter slip joint polyvinyl chloride (PVC). It would run for about two miles from the South Dunes portion of the site along the shoulder of the Trans-Pacific Parkway within an easement owned by the Port to connect with the existing outfall pipe west of the Weyerhaeuser lagoon on the North Spit (see figure 2.1-5).

Jordan Cove proposes to use raw water from the existing Coos Bay North Bend Water Board (CBNBWB) raw water pipeline for construction water needs, including hydrostatic testing of the LNG storage tanks. Following testing and ODEQ approval, the water would be locally discharged to the stormwater system for infiltration or discharged into the IWWP according to the applicable NPDES permit requirements.

An interconnect to the CBNBWB potable water pipeline would be used for all normal operational water needs in the LNG terminal, which includes fire water makeup, utility water used for such items as equipment and area cleaning, and potable water required to supply buildings and eyewash/safety shower stations. In addition, the raw water pipeline tap at the LNG terminal site would remain connected after construction, but there are no normal operational uses anticipated for this raw water supply. The water pipelines and proposed taps are shown on figure 2.1-5.

During construction of the terminal, Jordan Cove would use approximately 595.5 million gallons of water for various activities, including hydrostatic testing. During terminal operations, about 71.5 million gallons of water would be consumed annually. Water usage and impacts are more fully discussed in section 4.3 of this EIS.

The LNG terminal would include a fire suppression system with the main fire water supply for the system provided by two aboveground firewater storage tanks located in the access and utility corridor. Water supply for the two tanks would be potable water obtained from CBNBWB. Each tank would hold a minimum usable capacity of 3,240,000 gallons. This would supply approximately 4 hours of firefighting water. The fire water systems would also include stationary fire water pumps, fire hydrant mains, fixed water spray systems, automatic sprinkler extinguishing systems, high expansion foam system, and remotely controlled monitored spray systems. The fire water supply would also be used to provide water for on-site firefighting trucks.

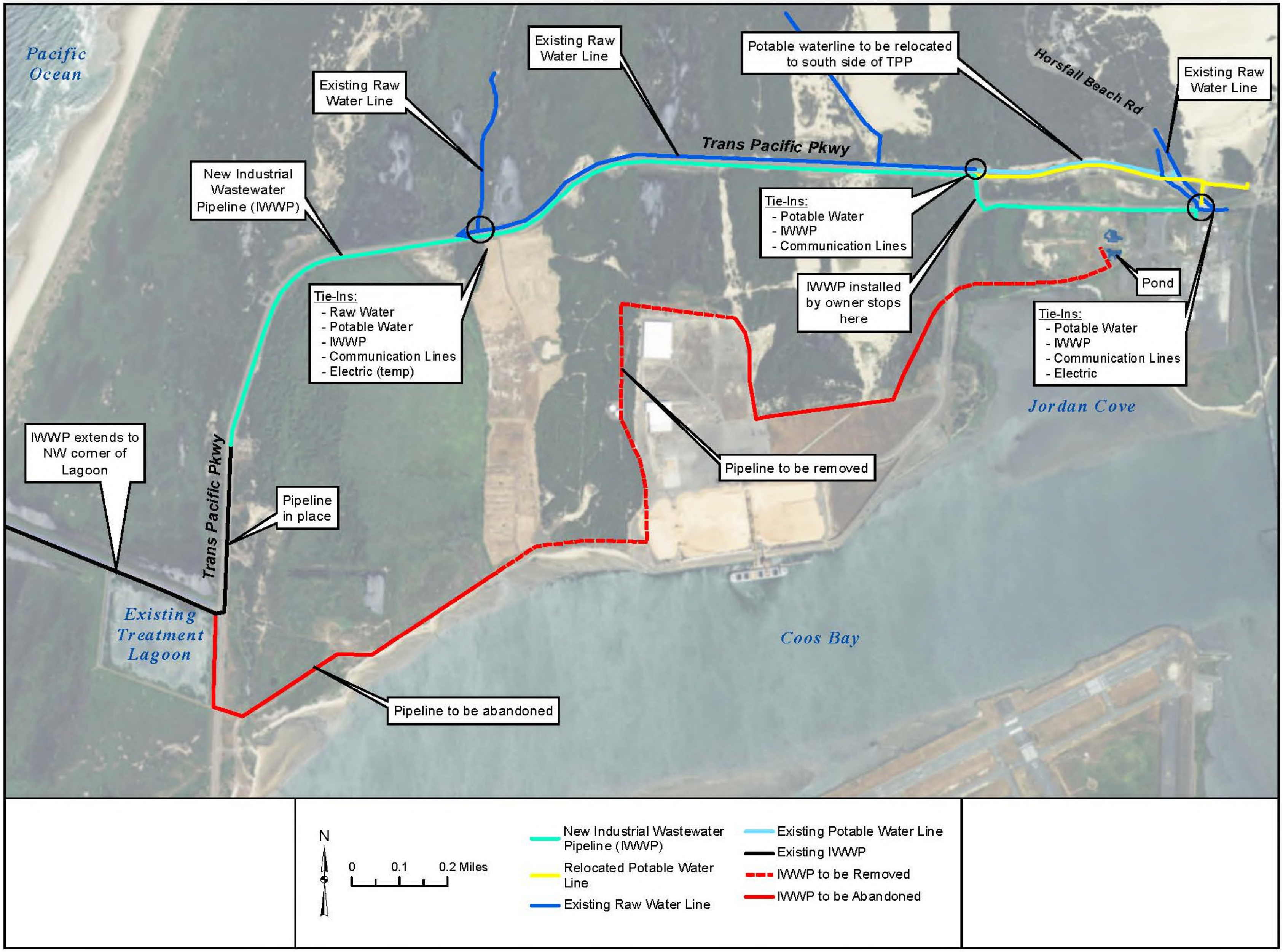

Figure 2.1-5
Industrial Wastewater Pipeline, Water Pipelines Relocation, and Utility Tie-Ins

Support Buildings

The LNG terminal would include buildings to house LNG process equipment, administration and office space, warehouse and receiving, guard houses and security, tugboat storage, and chemical and material storage. Support buildings would also include the non-jurisdictional SORSC and fire department building (see section 2.2). The SORSC would be located adjacent to the LNG terminal administration building on the South Dunes portion of the site. The fire department building would be located in the access and utility corridor.

2.1.1.6 Marine Waterway including Proposed Modifications to the Marine Waterway[23]

The Coast Guard defines the waterway for LNG marine traffic as extending from the outer limits of the United States territorial waters 12 nautical miles off the coast of Oregon, and 7.5 nautical miles up the Federal Navigation Channel to the LNG terminal site (figure 2.1-6). The Federal Navigation Channel extends from the mouth of Coos Bay to the city of Coos Bay Docks at about river mile (RM) 15.1. Jordan Cove would dredge four areas abutting the current boundary of the navigation channel between RM 2 to RM 7 (figure 2.1-1). Dredging could potentially modify the physical morphology of the channel, by widening four turns along the channel, to allow for more efficient transit of LNG carriers. These proposed dredging actions would not result in a change in the overall depth of the Federal Navigation Channel (only a widening of four turns along the channel). The COE is currently evaluating if the dredging of these four turns would alter the Federal Navigation Channel. The four dredging actions are summarized below.

- **Enhancement #1 – Coos Bay Inside Range channel and right turn to Coos Bay Range:** To reduce constriction to vessel passage at the inbound entrance to Coos Bay Inside Range. Widen channel from the current 300 feet to 450 feet, and lengthen the total corner cutoff on the Coos Bay Range side from the current 850 feet to about 1,400 feet.
- **Enhancement #2 – Turn from Coos Bay Range to Empire Range channels:** Widen the turn area from the Coos Bay Range to the Empire Range from current 400 feet to 600 feet and lengthen the total corner cutoff area from the current 1,000 feet to about 3,500 feet.
- **Enhancement #3 – Turn from the Empire Range to Lower Jarvis Range channels:** Add a corner cut on the west side in this area that would be about 1,150 feet wide to provide additional room for vessels to make this turn.
- **Enhancement #4 – Turn from Lower Jarvis Range to Jarvis Turn Range channels:** Widen turn area from current 500 feet to 600 feet and lengthen total corner cutoff area from the current 1,125 feet to about 1,750 feet, to allow vessels to begin a turn in this area earlier.

In addition, Jordan Cove would install five meteorological ocean data collection buoys to aid navigation within the waterway, by measuring wind speed and direction, current speed and direction, as well as tide height. Jordan Cove intends to replace three existing buoys with the new buoys (one located in the Pacific Ocean near the bay entrance, and one within Coos Bay along the LNG carrier route), and two new buoys located near the access channel.

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[23] The proposed modifications to the marine waterway (i.e., dredging at four points along the Federal Navigation Channel) are referred to as "marine waterway modifications" or "navigation channel modifications" in this EIS.

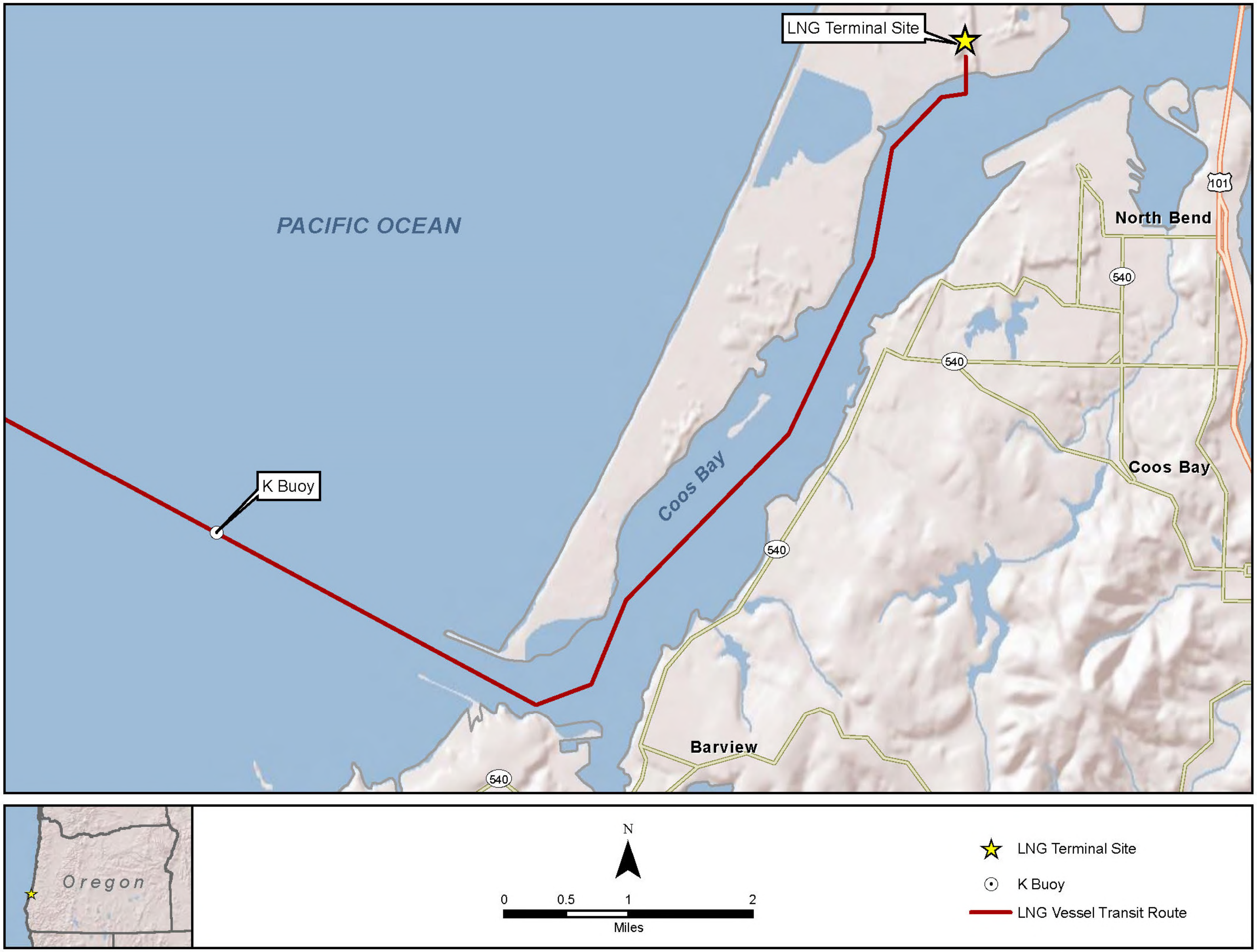

Figure 2.1-6
Proposed LNG Carrier Transit Route

2.1.1.7 Marine Access and Facilities

Access Channel

Jordan Cove would construct an access channel to connect the terminal to the Federal Navigation Channel (figure 2.1-7).[24] The access channel would begin at the confluence between the Jarvis Turn and the Upper Jarvis Range at about navigation channel mile (NCM) 7.5, and would be about 2,200 feet wide at the navigation channel and about 780 feet wide at the terminal. The distance from the north edge of the navigation channel to the mouth of the terminal would be about 700 feet. The walls of the access channel would be sloped to meet the existing bottom contours at an angle of 3 feet horizontal to one foot vertical (3:1). The access channel would be approximately 45 feet deep and would cover about 22 acres below the highest measured tide elevation of 10.3 feet (North American Vertical Datum of 1988 [NAVD88]).

Terminal Slip

Jordan Cove would construct a marine slip to support vessel operations at the north end of the access channel. This would be a single use slip that would be sized to provide flexibility to safely maneuver an LNG carrier from the access channel into the slip when another LNG carrier is already berthed on the east or west sides. The slip would also be sized to allow for tugs to move a temporarily disabled LNG carrier away from the loading berth on the east side of the slip to the emergency lay berth on the west side of the slip if necessary. The slip would be bounded on the east and west sides by sheet pile walls, creating a vertical face to support mooring structures. The northern side of the slip would be sloped to meet the existing bottom contours at an angle of 3 feet horizontal to one foot vertical (3:1). The minimum water depth within the slip would be -45 feet (NAVD88) in order to maintain at least 10 percent under-keel clearance when the ships are in dock. A berm/tsunami wall would also be constructed between the western edge of the slip and Henderson Marsh to approximate elevation +34.5 feet to increase tsunami resistance (figure 2.1-7).

Material Offloading Facility

The material offloading facility (MOF) would be constructed to receive components of the LNG terminal that are too large or heavy to be delivered by road or rail. The MOF would cover about 3 acres on the southeast side of the slip (see figure 2.1-7). The MOF would be constructed using the same sheet pile wall system as the LNG loading berth to an elevation approximately +13.0 feet (NAVD88). Following construction, the MOF would be retained as a permanent feature of the LNG terminal to support maintenance and replacement of large equipment components.

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[24] The access channel and a portion of the marine slip would be within state waters managed by the ODSL. Jordan Cove would construct the access channel and would transfer responsibility for maintenance to the Oregon International Port of Coos Bay (Port) following construction. The Port has already obtained an easement from ODSL for operation and maintenance of the access channel and the in-water portion of the slip. Jordan Cove would reimburse the Port for costs associated with its operation and maintenance of the access channel and slip.

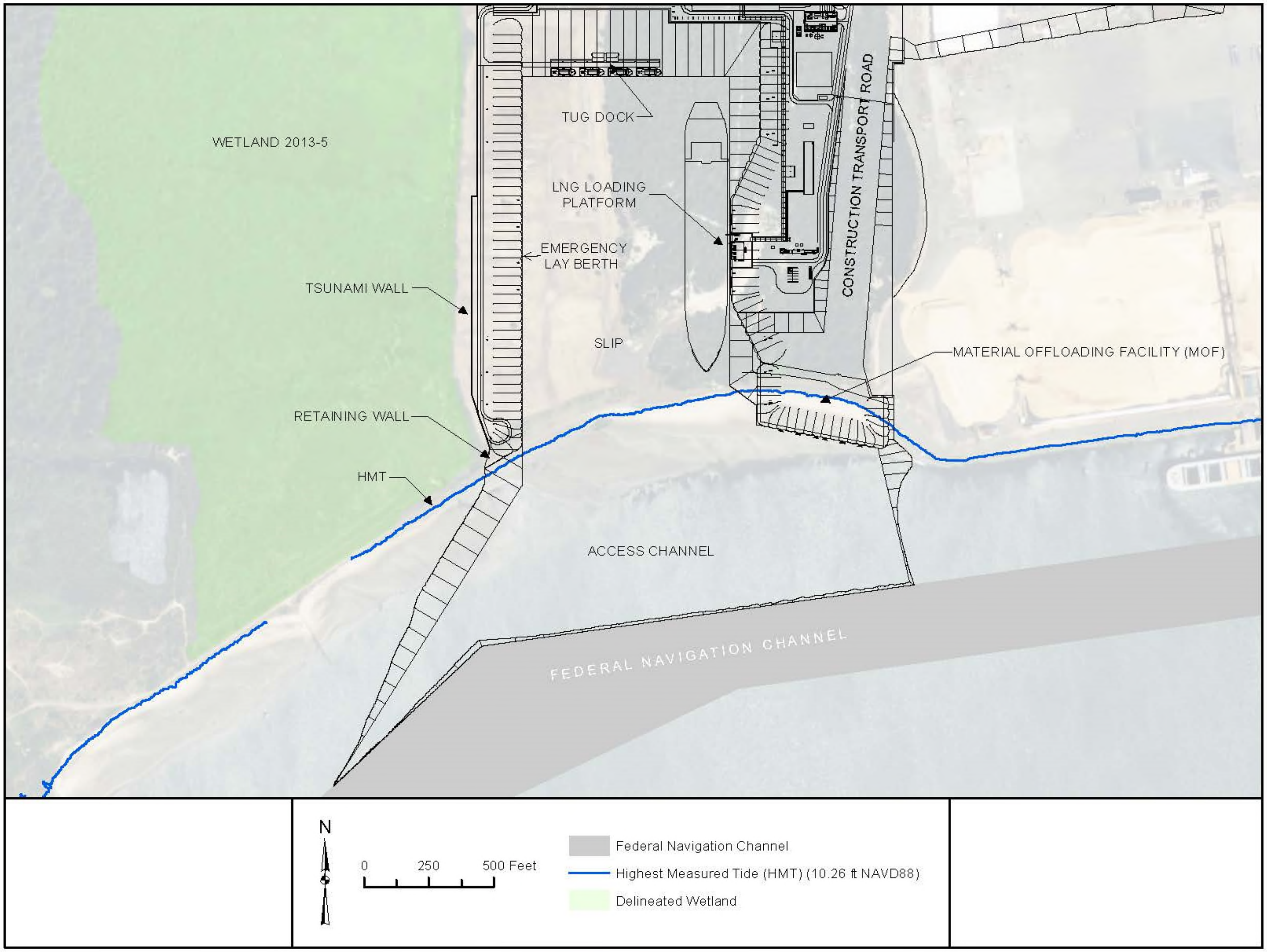

Figure 2.1-7
Plot Plan of the Marine Facilities

LNG Carrier Loading Berth and Product Loading Facility

An LNG carrier loading berth would occupy the eastern side of the slip. A profile of the loading berth is provided in figure 2.1-8. The loading berth would be constructed of steel sheet piles that support surface structures (the loading area) and provide the foundation for the breasting and mooring structures. The berth support wall would extend from the bottom of the slip (elevation approximately -45 feet) to approximate elevation +34.5 feet (NAVD88).[25]

The product loading facility (PLF), or LNG loading platform, would be a pile-supported concrete slab that provides structural support to the marine loading arms, terminal gangway, and other ancillary equipment at the berth. The PLF would be constructed on top of the sheet pile wall at approximate elevation +34.5 feet (NAVD88), with a foundation of reinforced concrete supported by steel pilings.

Emergency Lay Berth

An emergency vessel lay berth on the west side of the slip would be constructed to safely moor a temporarily non-operational LNG carrier (figure 2.1-7). This berthing facility would be supported by the west side sheet pile wall with a top-of-wall elevation of approximately +20 feet (NAVD 88). Support infrastructure would include an access road from the tug berth area, duct bank with cabling for powering the mooring hooks and capstans, and lighting of the ship access area.

Tug and Escort Boat Berth

A berth, also referred to as a tug dock, would be constructed on the north side of the marine slip (figure 2.1-7) to accommodate up to four tugboats, two sheriff's escort boats, and six other visitor boats with similar characteristics as the sheriff's boats. This dock would be about 470 feet long and 18 feet wide and would be precast concrete supported by steel piles. The tug dock would be accessible from land by a pile-founded trestle. Included as part of the dock would be two boat houses. North of the dock would be a tug operator building.

LNG Marine Traffic

Section 2.1.1.6 defines the extent of the marine waterway. For the analysis in this EIS, and the corresponding BA and EFH Assessment specific to species covered by the ESA and MSA, we also considered impacts from LNG carrier marine traffic extending out to the edge of the Outer Continental Shelf. Jordan Cove estimated that it would take an LNG carrier between 1.5 hours (at 6 knots) and 2 hours (at 4 knots) to travel through the waterway from Buoy "K" to the terminal (a description of the LNG carriers is provided in section 2.2.1.). An additional 90 minutes would be necessary for the LNG carrier to be turned in the access channel and parked at the terminal berth, with the assistance of tug boats. The entire round-trip transit time for a single LNG carrier to travel from Buoy K through the waterway, turn and dock at the berth, take on a full cargo of LNG, and then exit the terminal slip and travel through the waterway back out to the open ocean past Buoy K would be about 22 hours.

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[25] The slip and berth would be designed to accommodate LNG carriers as large as 217,000 m^3 in capacity.

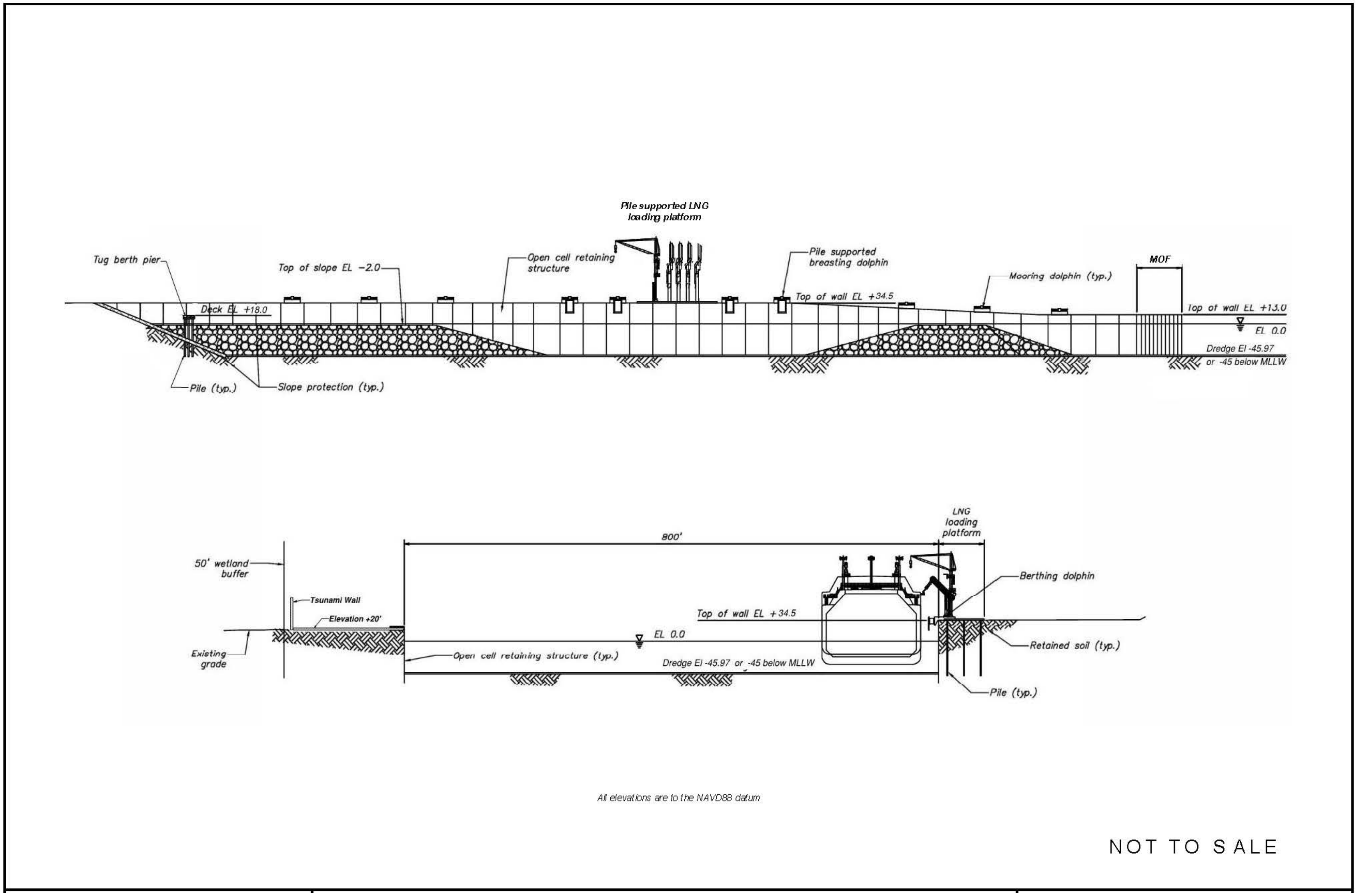


Figure 2.1-8
Profile of Marine Berth

Rock Apron

The COE expressed concern that erosion resulting from the Jordan Cove LNG Project's operation could result in impacts on Pile Dike 7.3 (located immediately west of the access channel) as well as the Project's slip. As a result, Jordan Cove would construct a rock apron west of the access channel to arrest slope migration, or equilibration, before it can progress to a condition that could potentially negatively impact Pile Dike 7.3 or the proposed slip. The design involves a 50-foot-wide by 3-foot-thick by approximately 1,100-foot long rock apron set back approximately 20 feet from the top (slope catch point) of the access channel side slope. The size of rock to be used is well graded 6-inch to 22-inch angular stone with a median size of 14 inches. The rock apron design also includes an approximately 100-foot-long extension of the slip's sheetpile bulkhead at the northwest corner of the access channel to minimize slope cut-back at this location. Total required rock volume is approximately 6,500 cy.

2.1.1.8 Dredged and Excavated Material Disposal

Dredging for the Marine Facilities

Dredging for the marine facilities, including the marine waterway modifications, would generate about 6.32 million cubic yards (mcy) of dredged and excavated material (see table 2.1.1.8-1). Of this, about 3.6 mcy would be dry excavated and then dredged in the fresh water pocket in the slip area and access channel behind an earthen berm that would remain in place to separate work prior to dredging activities in the bay. The remainder of the dredge material would be removed during open water dredging while exposed to the bay and Federal Navigation Channel.

TABLE 2.1.1.8-1

Materials Excavated and Dredged During Construction of LNG Terminal Marine Facilities

Area	Construction Phase	Volume (mcy)	Disposal Location
Slip	Excavation and Dredge Behind Berm	3.6	Ingram Yard, Corridor, South Dunes, Roseburg site
Slip	Salt Water Dredge	0.2	Ingram Yard, Corridor, South Dunes, Roseburg site
Protective Berm	Upland Excavation	0.03	Ingram Yard, Corridor, South Dunes
Protective Berm	Salt Water Dredge	0.5	Ingram Yard, Corridor, South Dunes, Kentuck Project
Access Channel	Upland Excavation	0.004	Ingram Yard, Corridor, South Dunes, Roseburg site
Access Channel	Salt Water Dredge	1.4	Ingram Yard, Corridor, South Dunes, Roseburg site
Marine Waterway Modifications	Salt Water Dredge	0.59	APCO Sites 1 and 2
	Total:	**6.32**	

Most of the material excavated and dredged during construction of the marine facilities would be used to raise the elevation of the terminal facilities above the tsunami inundation zone. Ingram Yard, the access and utility corridor, and the South Dunes portions of the site, including temporary use areas (see section 2.1.1.10), would receive material to raise their respective site elevations. Some material would also be deposited at the adjacent Roseburg Forest Products property, and at the Kentuck project mitigation site. Material dredged for the marine waterway modifications would be deposited at Al Pierce Company (APCO) Sites 1 and 2.

Dredging for the Marine Waterway Modifications

Approximately 590,000 cy of material would be excavated/dredged to complete the marine waterway modifications. Storage of the dredge material would be distributed between the APCO 1 and APCO 2 upland disposal sites (see figure 2.1-1), or placed entirely at APCO Site 2 if shown to be feasible.

Operational Maintenance Dredging

Jordan Cove proposes to conduct maintenance dredging about every 3 years with about 115,000 cy of material removed per dredging interval for the first 12 years of operation, and after that maintenance dredging could be done about every 5 years with up to 160,000 cy of materials removed during each dredging event.[26] For the marine waterway modification projects within the channel, maintenance dredging would also be conducted about every 3 years with about 27,900 cy of materials removed during each dredging event. Jordan Cove proposes to distribute maintenance dredge material between the upland APCO Sites 1 and 2 (see figure 2.1-3). Jordan Cove would be required to acquire a new permit from the COE if future dredge materials could not be distributed at the upland APCO Sites 1 and 2, due to unforeseen future conditions.

2.1.1.9 Mitigation Areas

Jordan Cove and Pacific Connector have identified several mitigation areas that are directly related to the proposed Project. These areas and associated mitigation actions are not under the jurisdiction of the Commission; however, because they are directly related to the proposed Project, we include them in this EIS where appropriate. Jordan Cove and Pacific Connector propose to mitigate the loss of wetlands that would result from both the Jordan Cove LNG and Pacific Connector Pipeline Projects through the Kentuck project (i.e., wetland impacts include permanent and temporary impacts and loss of aquatic resource types, functions and values; see section 4.3). The Kentuck project would cover about 140 acres on the eastern shore of Coos Bay at the mouth of Kentuck Slough (see figures 2.1-1 and 2.1-3). Formerly, this property was the Kentuck Golf Course, but it is currently owned by Jordan Cove. On August 30, 2016, the Coos County Board of County Commissioners granted Jordan Cove's request for a conditional use permit to allow for mitigation and restoration within this property.

Jordan Cove proposes to mitigate for the loss of aquatic vegetation via an eelgrass restoration program in Coos Bay, near the Southwest Oregon Regional Airport in North Bend, including establishing new eelgrass beds (see figures 2.1-1 and 2.1-3). Additional information about wetland impacts and mitigation is presented in section 4.3.3.

Jordan Cove developed three upland mitigation sites per recommendations from the ODFW in response to the mitigation policy set forth in OAR 635-415-0000 through 0025. The proposed upland habitat mitigation sites include the Panhandle site, the Lagoon site, and the North Bank site. The Panhandle site is approximately 133 acres and is located north of Trans-Pacific Parkway. The Lagoon site is approximately 320 acres and is located adjacent to the meteorological station. The North Bank site is approximately 156 acres and is located on the north bank of the Coquille River adjacent to the Bandon Marsh National Wildlife Refuge (NWR).

[26] Proposed maintenance dredge frequency and volume is based on a sedimentation study conducted by Jordan Cove and summarized in Jordan Cove's *Dredged Material Management Plan* filed as Appendix N.7 in Resource Report 7 as part of its September 2017 application to FERC.

2.1.1.10 Temporary Construction Use Areas

During construction of the LNG terminal, temporary use areas outside of the footprint of the permanent LNG terminal, would be required for equipment and material staging, dredge material disposal and transport, workforce housing, workforce parking, and road improvement. These facilities and their locations are shown on figures 2.1-1 and 2.1-3, and summarized below.

Laydown Yards

Jordan Cove would use several construction laydown areas immediately adjacent to the LNG terminal site, including at the north side of the Ingram Yard, within the Roseburg Forest Products property east of marine terminal facilities, and within the South Dunes portion of the site (figure 2.1-3). Jordan Cove would also use one laydown yard (Boxcar Hill) on the north side of the Trans-Pacific Parkway just north of the South Dunes portion of the site, one laydown yard (Port Laydown Site) within Port property about 2 miles south of the LNG terminal site, and two laydown yards across Coos Bay on North Point in North Bend (APCO Sites 1 and 2) (figures 2.1-1 and 2.1-3). The laydown yards would be used during construction to house construction offices, workforce lunchrooms, warehousing, equipment maintenance, and laydown of materials after delivery to the site.

Dredge Pipelines

During construction of the marine slip and access channel, a slurry pipeline and return water pipeline would be laid across the Roseburg Forest Products tract to the South Dunes portion of the site. A temporary dredge pipeline would also be laid adjacent to the Federal Navigation Channel (via a floating or submerged pipe) to transport dredge material from the four marine waterway modification sites to the APCO Sites 1 and 2, and a temporary dredge line would be laid between the Federal Navigation Channel and the Kentuck project site to transfer dredge material from marine transport barges to the disposal sites.

Workforce Housing

Jordan Cove proposes to construct a temporary workforce housing facility within the South Dunes portion of the LNG terminal site that could accommodate common facilities and 200 to 700 beds. Parking would be provided on-site, and shuttle buses would be provided to and from local communities to reduce traffic on the road network after working hours. After completion of construction and commissioning activities the entire facility would be decommissioned and removed from the site.

Off-Site Parking

To reduce construction traffic along U.S. Highway 101, Jordan Cove would establish a park-and-ride facility at the vacated Myrtlewood RV park near the community of Hauser, north of the U.S. Highway 101 McCullough Bridge (figures 2.1-1 and 2.1-3).[27] Jordan Cove would also provide dedicated buses to and from private RV parks, subject to demand, where those parks could house a large number of construction personnel. After construction of the terminal is completed, the off-site parking lot would be restored to pre-construction condition and use.

[27] Jordan Cove has indicated that they are working with local developers to identify a second park-and-ride that would be used for the Project. However, at this time the only park-and-ride that has been identified and filed with the FERC is the Myrtlewood RV park-and-ride.

2.1.2 Pacific Connector Pipeline and Associated Aboveground Facilities

The 36-inch-diameter, Pacific Connector natural gas pipeline would extend for about 229 miles across Klamath, Jackson, Douglas, and Coos Counties, Oregon and terminate at the proposed LNG export facility in Coos County (figure 1.1-1 in chapter 1). As identified in table D-1 in appendix D, the pipeline would be located adjacent to, but separated from, existing rights-of-way including powerlines, roads, and other pipelines for about 97.7 miles (43 percent).

The pipeline would have a design capacity of 1.2 Bcf/d of natural gas, with a maximum allowable operating pressure (MAOP) of 1,600 pounds per square inch gauge (psig).[28] The pipeline (and aboveground facilities) would be designed, constructed, tested, operated, and maintained to conform with USDOT requirements found in 49 CFR Part 192, *Transportation of Natural and Other Gas by Pipeline: Minimum Safety Standards*; the FERC requirements at 18 CFR 380.15, *Site and Maintenance Requirements*; and other applicable federal and state regulations. The location of the proposed pipeline Project facilities is shown on detailed maps included in appendix C and described below.

2.1.2.1 Aboveground Pipeline Facilities

New aboveground facilities would include one compressor station, 3 meter stations, 5 pig launcher/receiver assemblies, 17 mainline valves (MLV), and 15 communication towers (table 2.1.2.1-1).

TABLE 2.1.2.1-1

Pacific Connector Aboveground Facilities

Facility	MP	Operational Acres a/	County	Ownership/ Jurisdiction
Jordan Cove Meter Station, MLV #1, Pig Receiver, and Communication Tower	0.0	1.7	Coos	Private
MLV #2 (Boone Creek Road)	15.1	0.1	Coos	Private
MLV #3 (Myrtle Point Stikum Road)	29.5	0.1	Coos	Private
MLV #4 and Communication Tower (Deep Creek Spur)	48.6	0.1	Douglas	BLM
MLV #5 (South of Olalla Creek)	59.6	0.1	Douglas	Private
MLV #6 and Launcher/Receiver (Myrtle Creek)	71.5	0.5	Douglas	Private
MLV #7 (Pack Saddle Road)	80.0	0.1	Douglas	BLM
MLV #8 (Highway 227)	94.7	0.1	Douglas	Private
MLV #9 (BLM Road 33-2-12)	113.7	0.1	Jackson	Private
MLV #10 and Communication Tower (Shady Cove)	122.2	0.1	Jackson	Private
MLV #11, Communication Tower, and Launcher/Receiver (Butte Falls)	132.5	0.3	Jackson	Private
MLV #12 (Heppsie Mountain Quarry Spur)	150.7	0.1	Jackson	BLM
MLV #13 (Clover Creek Road)	169.5	0.1	Klamath	Private
MLV #14 and Launcher/Receiver (Keno)	187.4	0.4	Klamath	Private
MLV #15 and Communication Tower	196.5	0.1	Klamath	Private
MLV #16 and Communication Tower	211.6	0.1	Klamath	Private
Klamath Compressor Station, Klamath-Beaver and Klamath-Eagle Meter Stations, MLV #17, Pig Launcher, and Communications Tower	228.8	21.4	Klamath	Private
Blue Ridge Communication Tower	Approx. 20	0.2	Coos	BLM
Signal Tree Communication Tower	Approx. 45	0.2	Coos	BLM

[28] On October 5, 2018, Pacific Connector notified the Commission that it would use thicker pipe than initially proposed in order to increase the design pressure from 1,600 psig to 1,950 psig and allow for possible increased volume in the future, however the proposed MAOP remains at 1,600 psig. Any addition or change to the proposed psig would require additional review and approval from the FERC, and is not covered within the scope of the EIS.

TABLE 2.1.2.1-1 (continued)

Pacific Connector Aboveground Facilities

Facility	MP	Operational Acres a/	County	Ownership/ Jurisdiction
Sheep Hill Communication Tower	Approx. 70	0.2	Douglas	Private
Harness Mountain Communication Tower	Approx. 75	0.0	Douglas	Private
Starveout Communication Tower	Approx. 115	0.2	Douglas	Private
Flounce Rock Communication Tower	Approx. 123	0.2	Jackson	BLM
Robinson Butte Communication Tower	Approx. 159	0.2	Jackson	Forest Service
Stukel Mountain Communication Tower b/	Approx. 209	0.2	Klamath	BLM

a/ Values are rounded to the nearest tenth of an acre.
b/ Assumes that existing BLM communication Site Plan is sufficient. If not, supplemental environmental compliance may be required.

Meter Stations

The Jordan Cove Meter Station would be located within the South Dunes portion of the terminal. The meter station would be comprised of one building which would house gas chromatographs, moister analyzer, communication equipment, and flow computer. A canopy would also be installed to cover the control valves and ultrasonic meters. The Jordan Cove Meter Station would also include an MLV, a pig launcher/receiver, and a 140-foot-high steel communication tower. The station would be enclosed by a 7-foot-high chain-link fence, and the interior of the yard would be graveled.

The Klamath-Beaver and the Klamath-Eagle Meter Stations would be co-located within the fenced boundaries of the Klamath Compressor Station at about MP 228.8. The Klamath-Beaver Meter Station would include an interconnection with the existing GTN pipeline system; while the Klamath-Eagle Meter Station would serve as the interconnect with the existing Ruby pipeline system.

Klamath Compressor Station

The Klamath Compressor Station would be located approximately 1.8 miles northeast of the town of Malin, at the eastern terminus of the Pacific Connector pipeline, and would be accessible from Malin Loop and Morelock Roads. The station would include the Klamath-Eagle and Klamath-Beaver Meter Stations and would be located adjacent to the existing GTN Malin/Tuscarora Gas Transmission Company (Tuscarora) Meter Station and the Ruby Turquoise Flats facility.

The compressor station would include 62,200 International Organization for Standardization (ISO) hp of new compression and a 31,100 ISO hp standby compressor unit, consisting of turbine-driven, natural gas fired centrifugal compressor units. Other facilities would include an inlet filter/separator, lube oil cooler, inlet air silencer/cleaner, exhaust system, and gas coolers. The compressor building would include skid-mounted fuel gas conditioning, measuring, and regulation equipment. Related suction and discharge headers and piping would be installed between the pipeline and the compressor units. Other buildings inside the station would include a control room/ancillary equipment building and unit valve skid buildings. The ancillary equipment building would include an air compressor system, hot water boiler, and back-up generator. A high-pressure vent system with a silencer would be installed to allow the compressor to be blown down. There would also be a small office in one of the buildings and the station would contain aboveground pig launcher/receiver equipment, an MLV, and a 140-foot-high communication tower. The compressor station would be secured by a 7-foot-high chain-link fence.

The Klamath Compressor Station would be utilized as a maintenance base for operation of the pipeline facilities. The station would not be manned 24 hours per day, but would have emergency pipe, spare parts, and equipment and tools stored on site.

Mainline Block Valves

Pacific Connector would install 17 MLVs along its pipeline in compliance with USDOT requirements (CFR 192.179) (see table 2.1.2.1-1). The MLVs would be within the construction and operational right-of-way for the pipeline, except for the MLVs at meter stations, the compressor station, and that include pig launchers and receivers. Five of the MLVs would be automated to allow remote operation, which would require a 40-foot communication tower to be installed within the facility's fenced footprint.

Pig Launchers/Receivers

Pig launchers and receivers would allow Pacific Connector to maintain the interior of its pipeline using remotely operated pipe inspection and cleaning tools (known as "pigs"). A pig launcher would be located within the proposed Klamath Compressor Station, and a pig receiver would be installed at the proposed Jordan Cove Meter Station. There would also be pig launcher and receivers at MLVs #6, #11, and #14. The pig launcher and receiver facilities would be fenced at all locations.

Gas Control Communications

The meter stations and compressor station would require a communications link with the gas control monitoring system. New radio towers are proposed at the Jordan Cove Meter Station, the Klamath Falls Compressor Station, and at five MLVs. Pacific Connector has conducted initial communications studies and determined that leased space on eight existing communication towers would also be needed for gas control communications (see table 2.1.2.1-2 and figure 1.1-1). For the five locations on federal lands, Pacific Connector prepared a *Communication Facilities Plan* (dated January 2013) as part of its POD.

TABLE 2.1.2.1-2

Proposed and Existing Gas Control Communication Towers

Facility	County	Landowner	Tower Height (ft)	Operational Acres a/
Proposed New Towers Within Proposed Aboveground Facility Sites				
Jordan Cove Meter Station b/	Coos	Private (Pacific Connector)	140	1.7 c/
MLV #4	Douglas	BLM	40	0.1
MLV #10	Jackson	Private	40	0.1
MLV #11, Launcher/Receiver (Butte Falls)	Jackson	Private	40	0.3
MLV #15 (Klamath River)	Klamath	Private	40	0.1
MLV #16 (Hill Road)	Klamath	Private	40	0.1
Klamath Compressor Station	Klamath	Private (Pacific Connector)	140	17
Existing Communication Tower Sites d/				
Blue Ridge	Coos	BLM (Coos District)	170	0.2
Signal Tree (Kenyon Mt.)	Coos	BLM (Coos District)	120	0.2
Sheep Hill	Douglas	Private	125	0.2
Harness Mountain e/	Douglas	Private (Northwest Pipeline)	150	0.0
Starveout Communication	Jackson	Private	115	0.2
Flounce Rock	Jackson	BLM (Medford District)	120	0.2

TABLE 2.1.2.1-2 (continued)

Proposed and Existing Gas Control Communication Towers

Facility	County	Landowner	Tower Height (ft)	Operational Acres a/
Robinson Butte	Jackson	Forest Service (Rogue River National Forest)	125	0.2
Stukel Mountain	Klamath	BLM (Lakeview District)	100	0.2

a/ Acreages are rounded to the nearest 0.1 acre.
b/ A tower at this site would only be necessary if Pacific Connector is unable to mount an antenna on one of the structures within the LNG terminal site.
c/ The towers at meter or compressor stations and MLVs would be within the fenced operational area of the facilities.
d/ Space would be leased on an existing tower, or a new tower and equipment building installed if lease space is not available. Operational acres column assumes worst case.
e/ Communication equipment would be installed on an existing tower.

2.1.3 BLM and Forest Service Land Management Plan Amendment Actions

2.1.3.1 Proposed Amendments of the BLM Districts RMPs

Approximately 46.9 miles of the proposed Pacific Connector pipeline route would cross federal land administered by BLM Coos Bay, Roseburg, and Medford Districts and the Klamath Falls Field Office of the Lakeview District.

Similar to a county zoning ordinance, projects or activities that occur on BLM lands must be consistent with the respective RMP where the project or activity occurs. The proposed Right-of-Way for the Project on BLM-managed lands would not conform to the Southwestern Oregon RMP and the Northwestern and Coastal RMP (RMPs for Western Oregon). The RMPs for Western Oregon allow for the construction of linear rights-of-way within the LSR "as long as northern Spotted Owl (NSO) nesting-roosting habitat continues to support nesting and roosting at the stand level, and NSO dispersal habitat continues to support movement and survival at the landscape level," and construction of linear rights-of-way "as long as the occupied stand continues to support marbled murrelet nesting" (BLM 2016b: 71; BLM 2016a: 65). BLM staff initially evaluated that the proposed right-of-way would cross approximately 268 acres of LSR and approximately 116 acres of known or presumed occupied marbled murrelet (MAMU) habitat and/or NSO nesting-roosting habitat within LSR. Additional analysis concluded that the clearing and removal of vegetation required within the LSR for the proposed Project would likely result in some NSO habitat no longer continuing to support nesting and roosting at the stand level, and some MAMU habitat no longer continuing to support nesting at the stand level.

BLM management direction in the RMPs for Western Oregon specific to wildlife prohibits activities that "*disrupt marbled murrelet nesting at occupied sites ... within all land use allocations within 35 miles of the Pacific Coast and... within reserved land use allocation between 35-50 miles of the Pacific Coast*" (BLM 2016b:118; BLM 2016a: 98). BLM staff concluded that construction of the Project would likely result in disruption of MAMU nesting at some occupied sites within these two discrete geographic ranges.

In order to consider the Right-of-Way Grant, the BLM must address these inconsistencies by amending the affected RMPs to make provisions for the Project. BLM therefore proposes to amend the RMPs to re-allocate all lands within the proposed temporary use area and right-of-way to a District-Designated Reserve, with management direction to manage the lands for the purposes of the Pacific Connector Gas Pipeline Right-of-Way. Approximately 885 acres would be re-allocated. District-Designated Reserve allocations establish specific management for a specific use or to protect specific values and resources. Other uses that are compatible with the purpose of the District-Designated Reserve may be authorized.

District-Designated Reserve is an existing land use allocation in both the Northwestern and Coastal Oregon RMP and the Southwestern Oregon RMP. Under these RMPs, District-Designated Reserves encompass a wide variety of lands, including constructed facilities, infrastructure, roads, communication sites, seed orchards, quarries, lands biologically or physically unsuitable for timber production, Areas of Critical Environmental Concern (ACEC), and lands managed for their wilderness characteristics. District-Designated Reserves are reserved from sustained-yield timber production in order to manage them for another set of specific values and resources. Within the District-Designated Reserve, the BLM would maintain the values and resources necessary for construction, operation, maintenance, and decommissioning of the proposed Project.

Specifically, BLM proposes to add the following text to the RMPs for Western Oregon (BLM 2016a:59; BLM 2016b: 57):

District-Designated Reserve – Pacific Connector Gas Pipeline

Management Objectives

- See *District-Designated Reserves* management objectives.
- Maintain the values and resources for which the BLM has granted the right-of-way for the Pacific Connector Gas Pipeline Project.

Management Direction

- Allow the construction, operation, maintenance, and decommissioning of the Pacific Gas Connector Pipeline, notwithstanding the restrictions and requirements of management direction described for resource programs.

The Project-specific amendment would not change RMP requirements for other projects or authorize any other actions. Therefore, resource impacts of the proposed plan amendments are those associated with construction, operation, maintenance and decommissioning of the proposed pipeline. With this amendment, the granting of a ROW on BLM-managed lands for the Pacific Connector Project would conform to the Southwestern Oregon Record of Decision and Resource Management Plan (BLM 2016b) and the Northwestern and Coastal Oregon ROD and RMP (BLM 2016a).

Amendment Approaches Considered

Four different approaches were considered to address the identified plan conformance issues. Three were evaluated and determined to have resource and management impacts beyond those associated with the direct, indirect, induced and cumulative effects of construction, operation, maintenance, and decommissioning the proposed Project.

Change Management Direction for LSR, NSO, and MAMU to Accommodate Rights-of-Way

The BLM considered eliminating the requirement that rights-of way maintain NSO nesting-roosting habitat function and continue to support MAMU nesting in occupied stands within LSR at the stand level and removing the prohibition on activities that disrupt MAMU nesting at occupied sites within 35 miles of the Pacific coast. Similar rights-of-way that may be proposed in the future would conform with plan direction for LSR, NSO, and MAMU.

No projects of a similar nature have been proposed. However, this approach would reduce protections for LSR, NSO, and MAMU provided by the RMPs for Western Oregon throughout the LSR land use allocation and in all allocations within 35 miles of the Pacific coast, and could substantially alter the effects analysis conducted by the BLM for NSO and MAMU in the two RMPs for western Oregon. This alternative could trigger re-initiation of ESA consultation on BLM RMPs for western Oregon.

This amendment approach would generate environmental effects beyond those associated with the construction, operation, maintenance, and decommissioning of the proposed Project pipeline and is beyond the scope of the application submitted by the proponent and currently under consideration by the BLM. For these reasons, the BLM determined that this amendment approach would not meet the BLM's purpose and need. This amendment approach was not analyzed in further detail.

Change Management Direction for LSR, NSO, and MAMU at Specific Locations

The BLM considered amendments to the RMPs for Western Oregon to specifically exempt the proposed Project from management direction for LSR, NSO, and MAMU in with known conformance problems (known MAMU occupied stands, existing MAMU nesting habitat, and existing NSO nesting-roosting habitat). This amendment approach would not create environmental effects beyond those associated with construction, operation, maintenance, and decommissioning of the proposed Project. However, unanticipated or currently unknown conformance problems, such as newly identified MAMU occupied stands, could arise which would require additional amendments and supplemental analysis following completion of the FERC-prepared EIS.

This amendment approach presents a risk that could require additional amendments and supplemental analysis, and would result in identical environmental effects if the proposed Project right-of-way is granted. For these reasons, the BLM determined that this amendment approach is substantially similar to the proposed action and would not fulfill the BLM's commitment as a cooperating agency in the preparation of the EIS should supplemental analysis be required. This amendment approach was not analyzed in further detail.

Designate All Lands within the Proposed Right-of-Way as a Right-of-Way Corridor

Designation of a Right-of-Way Corridor under 43 CFR 2806 would be for the purpose of construction, operation, maintenance, and decommissioning of the proposed Project. Designated Rights-of-Way Corridors are typically 1,000 to 2,000 feet in width and designed to encourage co-location of additional facilities in the future. Designating a Right-of-Way Corridor would require an analysis of reasonably foreseeable projects that could be co-located in the future and could substantially alter the effects analysis conducted by the BLM for NSO and MAMU in the two RMPs for western Oregon. This amendment approach could trigger re-initiation of ESA consultation on BLM RMPs for Western Oregon.

This amendment approach would generate environmental effects beyond those associated with the construction, operation, maintenance, and decommissioning of the proposed Project pipeline and is beyond the scope of the application submitted by the proponent and currently under consideration by the BLM. For these reasons, the BLM determined that this amendment approach would not meet the BLM's purpose and need. This amendment approach was not analyzed in further detail.

2.1.3.2 Proposed Amendments of National Forest LRMPs

Approximately 30.6 miles of the Pacific Connector pipeline route would cross NFS lands administered by the Umpqua, Rogue River, and Winema National Forests (see figure 1.1-2). NFS lands are managed according to current LRMPs. Similar to a county zoning ordinance, projects or activities that occur on NFS lands must be consistent with the respective LRMP where the project or activity occurs. As proposed, the Pacific Connector Pipeline Project would not be consistent with certain provisions of the affected Forest Service LRMPs. Before the Forest Service can consent to the BLM Right-of-Way Grant application, the Forest Service must amend the affected LRMPs to make provisions for the Pacific Connector Project. With the exception of amendments to reallocate Matrix lands to LSR, the LRMP amendments described below are specific to the Pacific Connector Pipeline Project. The project-specific amendments would not change LRMP requirements for other projects or authorize any other actions. With these amendments, the Pacific Connector Pipeline Project would be a conforming use of the affected National Forests.

In addition to the proposed amendments specific for each National Forest described in the sections below, table 2.1.3.2-1 describes the proposed amendments that would apply to all three National Forests.

TABLE 2.1.3.2-1

Forest Service LRMP Amendments Associated with the Pacific Connector Pipeline Project that Apply to the Umpqua, Rogue River, and Winema National Forests

Amendment #	Amendment	Description
FS-1	Project-Specific Amendment to Exempt Management Recommendations for Survey and Manage Species on the Umpqua, Rogue River and Winema National Forests:	These National Forest LRMPs would be amended to exempt certain known sites within the area of the proposed Pacific Connector right-of-way grant from the Management Recommendations required by the 2001 "Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines. For known sites within the proposed right-of-way that cannot be avoided, the 2001 Management Recommendations for protection of known sites of Survey and Manage species would not apply. For known sites located outside the proposed right-of-way but with an overlapping protection buffer only that portion of the buffer within the right-of-way would be exempt from the protection requirements of the Management Recommendations. Those Management Recommendations would remain in effect for that portion of the protection buffer that is outside of the right of way. The proposed amendment would not exempt the Forest Service from the requirements of the 2001 Survey and Manage Record of Decision, as modified, to maintain species persistence for affected Survey and Manage species within the range of the northern spotted owl. This is a project-specific plan amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The amendment would provide an exception from these standards for the Pacific Connector Project and include specific mitigation measures and project design requirements for the project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.9(a)(2)(ii) – [the plan must include plan components to maintain or restore] "Rare aquatic and terrestrial plant and animal communities." § 219.9(b)(1) – "The responsible official shall determine whether or not the plan components required by paragraph (a) provide ecological conditions necessary to: …maintain viable populations of each species of conservation concern within the plan area."

2.1.3.3 Proposed Amendments Specific to the Umpqua National Forest LRMP

The Forest Service proposes to amend the Umpqua National Forest LRMP. The proposed amendments are described in table 2.1.3.3-1.

TABLE 2.1.3.3-1

LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Umpqua National Forest

Amendment #	Amendment	Description
UNF-1	Project-Specific Amendment to Allow Removal of Effective Shade on Perennial Streams:	The Umpqua National Forest LRMP would be amended to exempt the Standards and Guidelines for Fisheries (Umpqua National Forest LRMP, page IV-33, Forest-Wide) to allow the removal of effective shading vegetation where perennial streams are crossed by the Pacific Connector right-of-way. This change would potentially affect an estimated total of three acres of effective shading vegetation at approximately five perennial stream crossings in the East Fork of Cow Creek subwatershed from pipeline mileposts (MP) 109 to 110 in Sections 16 and 21, T.32S., R.2W., W.M., OR. The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(3)(i) – The plan must include plan components "to maintain or restore the ecological integrity of riparian areas in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity."
UNF-2	Project-Specific Amendment to Allow the Pacific Connector Pipeline Project in Riparian Areas	The Umpqua National Forest LRMP would be amended to change prescriptions C2-II (LRMP IV-173) and C2-IV (LRMP IV-177) to allow the Pacific Connector pipeline route to run parallel to the East Fork of Cow Creek for approximately 0.1 mile between about pipeline MPs 109.5 and 109.6 in Section 21, T.32S., R.2W., W. M., OR. This change would potentially affect approximately one acre of riparian vegetation along the East Fork of Cow Creek. The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(3)(i) – The plan must include plan components "to maintain or restore the ecological integrity of riparian areas in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity"
UNF-3	Project-Specific Amendment to Exempt Limitations on Detrimental Soil Conditions within the Pacific Connector Right-of-Way in All Management Areas:	The Umpqua National Forest LRMP would be amended to exempt limitations on the area affected by detrimental soil conditions from displacement and compaction within the Pacific Connector right-of-way. Standards and Guidelines for Soils (LRMP page IV-67) requires that not more than 20 percent of the project area have detrimental compaction, displacement, or puddling after completion of a project. The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(2)(ii) – [The plan must include plan components to maintain or restore] "soils and soil productivity, including guidance to reduce soil erosion and sedimentation."

TABLE 2.1.3.3-1 (continued)

LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Umpqua National Forest

Amendment #	Amendment	Description
UNF-4	Reallocation of Matrix Lands to LSR	The Umpqua National Forest LRMP would be amended to change the designation of approximately 585 acres from Matrix land allocations to the LSR land allocation in Sections 7, 18, and 19, T.32S., R.2W.; and Sections 13 and 24, T.32S., R.3W., W.M., OR. This change in land allocation is proposed to partially mitigate the potential adverse impact of the Pacific Connector Pipeline Project on LSR 223 on the Umpqua National Forest. This is a plan level amendment that would change future management direction for the lands reallocated from Matrix to LSR. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(1)(i) – [the plan must include plan components to maintain or restore] "Interdependence of terrestrial and aquatic ecosystems in the plan area." § 219.8(b)(1) – [the plan must include plan components to guide the plan area's contribution to social and economic sustainability] "Social, cultural and economic conditions relevant to the area influenced by the plan." § 219.9(b)(1) "The responsible official shall determine whether or not the plan components required by paragraph (a) of this section provide the ecological conditions necessary to: contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern within the plan area," and § 219.9(a)(2)(ii) – [the plan must include plan components to maintain or restore] "Rare aquatic and terrestrial plant and animal communities."

If any of the proposed amendments to the Umpqua National Forest LRMP described above are determined to be "directly related" to a substantive rule requirement, the Responsible Official must apply that requirement within the scope and scale of the proposed amendment and, if necessary, make adjustments to the proposed amendment to meet the rule requirement (36 CFR 219.13 (b)(5) and (6)).

2.1.3.4 Proposed Amendments Specific to the Rogue River National Forest LRMP

The Forest Service proposes to amend the Rogue River National Forest LRMP. The proposed amendments are described in table 2.1.3.4-1.

TABLE 2.1.3.4-1

LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Rogue River National Forest

Amendment #	Amendment	Description
RRNF-2	Project Specific Amendment of Visual Quality Objectives (VQO) on the Big Elk Road:	The Rogue River National Forest LRMP would be amended to change the VQO where the Pacific Connector pipeline route crosses the Big Elk Road at about pipeline MP 161.4 in Section 16, T.37S., R.4E., W.M., OR, from Foreground Retention (Management Strategy 6, LRMP page 4-72) to Foreground Partial Retention (Management Strategy 7, LRMP page 4-86) and allow 10-15 years for the amended VQO to be attained. The existing Standards and Guidelines for VQO in Foreground Retention where the Pacific Connector pipeline route crosses the Big Elk Road require that VQOs be met within one year of completion of the project and that management activities not be visually evident. The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment that would apply only to the Pacific Connector Pipeline Project in the vicinity of Big Elk Road and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.10(a)(1) – […the responsible official shall consider: …] "(1) Aesthetic values,… scenery,... viewsheds...". § 219.10(b)(i) – [the responsible official shall consider] "Sustainable recreation; including recreation settings, opportunities,…and scenic character…"
RRNF-3	Project-Specific Amendment of VQO on the Pacific Crest Trail:	The Rogue River National Forest LRMP would be amended to change the VQO where the Pacific Connector pipeline route crosses the Pacific Crest Trail at about pipeline MP 168 in Section 32, T.37S., R.5E., W.M., OR, from Foreground Partial Retention (Management Strategy 7, LRMP page 4-86) to Modification (USDA Forest Service Agricultural Handbook 478) and to allow 15-20 years for amended VQOs to be attained. The existing Standards and Guidelines for VQOs in Foreground Partial Retention in the area where the Pacific Connector pipeline route crosses the Pacific Crest Trail require that visual mitigation measures meet the stated VQO within three years of the completion of the project and that management activities be visually subordinate to the landscape. The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment that would apply only to the Pacific Connector Pipeline Project in the vicinity of the Pacific Crest Trail and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.10(a)(1) – […the responsible official shall consider: …] "(1) Aesthetic values,… scenery,... viewsheds...". § 219.10(b)(i) – [the responsible official shall consider] "Sustainable recreation; including recreation settings, opportunities,…and scenic character…"

TABLE 2.1.3.4-1 (continued)

LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Rogue River National Forest

Amendment #	Amendment	Description
RRNF-4	Project-Specific Amendment of Visual Quality Objectives Adjacent to Highway 140:	The Rogue River National Forest LRMP would be amended to allow 10-15 years to meet the VQO of Middleground Partial Retention between Pacific Connector pipeline MPs 156.3 to 156.8 and 157.2 to 157.5 in Sections 11 and 12, T.37S., R.3E., W.M., OR. Standards and Guidelines for Middleground Partial Retention (Management Strategy 9, LRMP Page 4-112) require that VQOs for a given location be achieved within three years of completion of the project. Approximately 0.8 miles or 9 acres of the Pacific Connector right-of-way in the Middleground Partial Retention VQO visible at distances of 0.75 to 5 miles from State Highway 140 would be affected by this amendment. The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment that would apply only to the Pacific Connector Pipeline Project in Sections 11 and 12, T.37S., R.3E., W.M., OR, and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.10(a)(1) – […the responsible official shall consider: …] "(1)Aesthetic values,… scenery,... viewsheds...". § 219.10(b)(i) – [the responsible official shall consider] "Sustainable recreation; including recreation settings, opportunities, . . . and scenic character...".
RRNF-5	Project-Specific Amendment to Allow the Pacific Connector Pipeline Project in Management Strategy 26, Restricted Riparian Areas:	The Rogue River National Forest LRMP would be amended to allow the Pacific Connector right-of-way to cross the Restricted Riparian land allocation. This would potentially affect approximately 2.5 acres of the Restricted Riparian Management Strategy at one perennial stream crossing on the South Fork of Little Butte Creek at about pipeline MP 162.45 in Section 15, T.37S., R.4E., W.M., OR. Standards and Guidelines for the Restricted Riparian land allocation prescribe locating transmission corridors outside of this land allocation (Management Strategy 26, LRMP page 4-308,). The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a site-specific amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(3)(i) – The plan must include plan components "to maintain or restore the ecological integrity of riparian areas in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity"
RRNF-6	Site-Specific Amendment to Exempt Limitations on Detrimental Soil Conditions within the Pacific Connector Right-of-Way in All Management Areas:	The Rogue River National Forest LRMP would be amended to exempt limitations on areas affected by detrimental soil conditions from displacement and compaction within the Pacific Connector right-of-way in all affected Management Strategies. Standards and Guidelines for detrimental soil impacts in affected Management Strategies require that no more than 10 percent of an activity area should be compacted, puddled or displaced upon completion of project (not including permanent roads or landings). No more than 20 percent of the area should be displaced or compacted under circumstances resulting from previous management practices including roads and landings. Permanent recreation facilities or other permanent facilities are exempt (RRNF LRMP 4-41, 4-83, 4-97, 4-123, 4-177, 4-307). The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(2)(ii) – [The plan must include plan components to maintain or restore] "soils and soil productivity, including guidance to reduce soil erosion and sedimentation."

TABLE 2.1.3.4-1 (continued)

LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Rogue River National Forest

Amendment #	Amendment	Description
RRNF-7	Reallocation of Matrix Lands to LSR	The Rogue River National Forest LRMP would be amended to change the designation of approximately 522 acres from Matrix land allocations to the LSR land allocation in Section 32, T.36S., R.4E. W.M., OR. This change in land allocation is proposed to partially mitigate the potential adverse impact of the Pacific Connector Pipeline Project on LSR 227 on the Rogue River National Forest. This is a plan level amendment that would change future management direction for the lands reallocated from Matrix to LSR. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(1)(i) – [the plan must include plan components to maintain or restore] "Interdependence of terrestrial and aquatic ecosystems in the plan area." § 219.8(b)(1) – [the plan must include plan components to guide the plan area's contribution to social and economic sustainability] "Social, cultural and economic conditions relevant to the area influenced by the plan." § 219.9(b)(1) "The responsible official shall determine whether or not the plan components required by paragraph (a) of this section provide the ecological conditions necessary to: contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern within the plan area", and § 219.9(a)(2)(ii)– [the plan must include plan components to maintain or restore: …] "(ii) Rare aquatic and terrestrial plant and animal communities".

If any of the proposed amendments to the Rogue River National Forest LRMP described above are determined to be "directly related" to a substantive rule requirement, the Responsible Official must apply that requirement within the scope and scale of the proposed amendment and, if necessary, make adjustments to the proposed amendment to meet the rule requirement (36 CFR 219.13 (b)(5) and (6)).

2.1.3.5 Proposed Amendments Specific to the Winema National Forest LRMP

The Forest Service proposes to amend the Winema National Forest LMRP. The proposed amendments are described in table 2.1.3.5-1.

TABLE 2.1.3.5-1

LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Winema National Forest

Amendment #	Amendment	Description
WNF-1	Project -Specific Amendment to Allow Pacific Connector Pipeline Project in Management Area 3:	The Winema National Forest LRMP would be amended to change the Standards and Guidelines for Management Area 3 (MA-3) (LRMP page 4-103-4, Lands) to allow the 95-foot-wide Pacific Connector pipeline project in MA-3 from the Forest Boundary in Section 32, T.37S., R.5E., W.M., OR, to the Clover Creek Road corridor in Section 4, T.38S, R.5. E., W.M., OR. Standards and Guidelines for MA-3 state that the area is currently an avoidance area for new utility corridors. This proposed Pacific Connector Pipeline Project is approximately 1.5 miles long and occupies approximately 17 acres within MA-3. The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements. This is a project-specific plan amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.10(a)(1) – [the responsible official shall consider] "Aesthetic values,… scenery,... viewsheds...". § 219.10(b)(i) – [the responsible official shall consider] "Sustainable recreation; including recreation settings, opportunities,…and scenic character…"

TABLE 2.1.3.5-1 (continued)

LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Winema National Forest

Amendment #	Amendment	Description
WNF-2	Project-Specific Amendment of VQO on the Dead Indian Memorial Highway:	The Winema National Forest LRMP would be amended to allow 10-15 years to achieve the VQO of Foreground Retention where the Pacific Connector right-of-way crosses the Dead Indian Memorial Highway at approximately pipeline MP 168.8 in Section 33, T.37S., R.5E., W. M., OR. Standards and Guidelines for Scenic Management, Foreground Retention (LRMP 4-103, MA 3A, Foreground Retention) requires VQOs for a given location be achieved within one year of completion of the project. The Forest Service proposes to allow 10-15 years to meet the specified VQO at this location. The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment that would apply only to the Pacific Connector Pipeline Project in the vicinity of the Dead Indian Memorial Highway and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.10(a)(1) – […the responsible official shall consider: …] "(1) Aesthetic values,… scenery,... viewsheds...". § 219.10(b)(i) – [the responsible official shall consider] "Sustainable recreation; including recreation settings, opportunities,… and scenic character…".
WNF-3	Project -Specific Amendment of VQO Adjacent to the Clover Creek Road:	The Winema National Forest LRMP would be amended to allow 10-15 years to meet the VQO for Scenic Management, Foreground Partial Retention, where the Pacific Connector right-of-way is adjacent to the Clover Creek Road from approximately pipeline MP 170 to 175 in Sections 2, 3, 4, 11, and 12, T.38S., R.5E., and Sections 7 and 18, T.38S., R.6E., W.M., OR. This change would potentially affect approximately 50 acres. Standards and Guidelines for Foreground Partial Retention (LRMP, page 4-107, MA 3B) require that VQOs be met within three years of completion of a project. The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment that would apply only to the Pacific Connector Pipeline Project in the vicinity of Clover Creek Road and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.10(a)(1) – […the responsible official shall consider: …] "(1) Aesthetic values,… scenery,... viewsheds...". § 219.10(b)(i) – [the responsible official shall consider] "Sustainable recreation; including recreation settings, opportunities,…and scenic character…".
WNF-4	Project -Specific Amendment to Exempt Limitations on Detrimental Soil Conditions within the Pacific Connector Right-of-Way in All Management Areas:	The Winema National Forest LRMP would be amended to exempt restrictions on detrimental soil conditions from displacement and compaction within the Pacific Connector right-of-way in all affected management areas. Standards and Guidelines for detrimental soil impacts in all affected management areas require that no more than 20 percent of the activity area be detrimentally compacted, puddled, or displaced upon completion of a project (LRMP page 4-73, 12-5). The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(2)(ii) – [The plan must include plan components to maintain or restore…] "Soils and soil productivity, including guidance to reduce soil erosion and sedimentation"

TABLE 2.1.3.5-1 (continued)

LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Winema National Forest

Amendment #	Amendment	Description
WNF-5	Project-Specific Amendment to Exempt Limitations on Detrimental Soil Conditions within the Pacific Connector Right-of-Way in Management Area 8:	The Winema National Forest LRMP would be amended to exempt restrictions on detrimental soil conditions from displacement and compaction within the Pacific Connector right-of-way within the Management Area 8, Riparian Area (MA-8). This change would potentially affect approximately 0.5 mile or an estimated 9.6 acres of MA-8. Standards and Guidelines for Soil and Water, MA-8 require that not more than 10 percent of the total riparian zone in an activity area be in a detrimental soil condition upon the completion of a project (LRMP page 4-137, 2). The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(2)(ii) – [The plan must include plan components to maintain or restore…] "Soils and soil productivity, including guidance to reduce soil erosion and sedimentation".

If any of the proposed amendments to the Winema National Forest LRMP described above are determined to be "directly related" to a substantive rule requirement, the Responsible Official must apply that requirement within the scope and scale of the proposed amendment and, if necessary, make adjustments to the proposed amendment to meet the rule requirement (36 CFR 219.13 (b)(5) and (6)).

2.1.4 Mitigation Actions Specific to the Right-of Way Grant on Federal Lands

Representatives of the BLM, Forest Service, and Reclamation have worked cooperatively with the FERC staff and the Project proponent to incorporate BMPs, project design features, and project requirements which would avoid, minimize, rectify, reduce, or eliminate environmental consequences (40 CFR 1502.14(f) and 1508.20(a-d)). The agencies deem these BMPs, project design features, or project requirements necessary to meet the respective regulatory requirements, accomplish the goals and objectives of their respective management plans, and to prevent unnecessary and undue environmental degradation. The BMPs, project design features, or requirements specific to the authorized use of BLM, NFS, and Reclamation lands are included as attachments to the applicant's POD. There are 28 appendices in the POD; they include draft monitoring elements to ensure that the wide array of actions are implemented and assess consistency of the actions relative to the goals and objectives of the respective LMPs. Collectively, the POD is incorporated into the Project's description, and is summarized in section 2.6.3 below.

In addition to the POD, the Forest Service has identified compensatory mitigation requirements. Additional detail is provided in section 2.1.5 below and in appendix F.

Under existing authorities and policy, the BLM may not specify compensatory mitigation specific to its lands or facilities; however, the BLM may incorporate the compensatory mitigation requirements of other agencies into the Right-of-Way Grant.

Reclamation has not identified any off-site compensatory mitigation measures specific to its lands or facilities.

2.1.5 Mitigation Plan Specific to NFS Lands

These compensatory mitigation actions are addressed programmatically in this EIS and may require additional analyses and surveys to comply with NEPA. The Forest Service anticipates this EIS would provide the basis for tiering subsequent site-specific NEPA analyses, in accordance with the CEQ regulations at 40 CFR 1508.28(b). As applicable, the Forest Service would conduct supplemental environmental analysis and consultation efforts with various federal, state, and local entities, as well as tribal governments, prior to authorizing future site-specific mitigation actions described in the CMP. The public would have the opportunity to comment on specific project proposals at that time. Subsequent environmental analysis for mitigation actions would not preclude the BLM from issuing authorizations necessary for construction and operation of the proposed pipeline project.

Forest Service interdisciplinary teams have developed a CMP for the Pacific Connector Pipeline Project specific to the national forests that would be impacted by the proposed project. The CMP is based on the respective LRMPs, the recommendations of the (2011) NSO recovery plan, the recommendations of the final Southern Oregon/Northern California Coast (SONCC) Coho Salmon Recovery Plan (2014), applicable Late Successional Reserve Assessments, and fifth-field Watershed Analyses (WA) for watersheds where impacts of the Pacific Connector Pipeline Project would occur. Members of the interagency team used professional judgment and knowledge of the affected landscapes to develop the mitigation actions described below. Mitigation measures reduce or compensate for environmental consequences of an action. Off-site mitigation is a supplemental mitigation to address important LRMP management objectives and standards and guidelines that cannot be fully mitigated on-site. Proposed mitigation actions are intended to be responsive to LRMP objectives that include:

- Compliance with the Aquatic Conservation Strategy;
- Habitat for Threatened or Endangered (T&E) species including the NSO and coho salmon;
- Mitigation of impacts and compliance with standards and guidelines for LSRs;
- Compliance with National Forest Management Act 2012 planning rule sustainability criteria at 36 CFR §§ 219.8 through 219.11; and
- Specific resource issues as they occur by watershed.

A central provision of the Forest Service CMP is that it is to remain adaptable to new information and changed conditions.

Table 2.1.5-1 describes the individual mitigation projects related to LRMP management goals and objectives on NFS lands that are included in the proposed action. These projects would be implemented by the Forest Service as a subsequent phase of the Pacific Connector Project with funding provided by the applicant. The applicant is also responsible for providing funding to Forest Service for planning efforts related to these mitigation actions.

TABLE 2.1.5-1

Mitigation Projects to Address LRMP Objectives on NFS Lands

Unit	Watershed	Mitigation Group	Project Type	Project Name	Quantity a/	Unit
Umpqua National Forest	Days Creek - South Umpqua	Stand Density Fuel Break	Fuels Reduction	Days Creek - South Umpqua Matrix Integrated Fuels Reduction	194	acres
		Stand Density Fuel Break	Fuels Reduction	Days Creek - South Umpqua LSR Integrated Fuels Reduction	254	acres
		Terrestrial Habitat Improvement	Snag Creation	Days Creek - South Umpqua LSR Snag Creation	32	acres
		Terrestrial Habitat Improvement	Snag Creation	Days Creek - South Umpqua Matrix Snag Creation	14	acres
		Terrestrial Habitat Improvement	Lupine Meadow Restoration	Upper Cow Creek Lupine Meadow Restoration	23	acres
	Elk Creek - South Umpqua	Aquatic and Riparian Habitat	Fish Passage	Elk Creek Fish Passage Culverts	5	sites
		Road sediment reduction	Road Storm-proofing	Elk Creek Road Storm-proofing	9.2	miles
		Road sediment reduction	Road Decommissioning	Elk Cr. Road Decommissioning	5.9	miles
		Stand Density Fuel Break	Fuels Reduction	Elk Creek Matrix Integrated Fuels Reduction	176	acres
		Stand Density Management	Commercial Thinning	Elk Creek LSR Enhancement	91	acres
		Stand Density Management	Off-site Pine Removal	Elk Creek LSR Off-site Pine Removal	300	acres
		Terrestrial Habitat Improvement	LWD Upland Placement	Elk Creek LSR LWD Placement	99	acres
		Terrestrial Habitat Improvement	Lupine Meadow Restoration	Elk Creek LSR Lupine Meadow Restoration	101	acres
		Terrestrial Habitat Improvement	Noxious Weed Treatment	Elk Creek Roadside Noxious Weeds	6.7	miles
		Terrestrial Habitat Improvement	Snag Creation	Elk Creek LSR Snag Creation	68	acres
		Fire Suppression	Water Source Improvement	Elk Creek Pump Chance	2	sites
	Evans Creek	Stand Density Fuel Break	Road Shaded Fuel Break	Evans Cr LSR Road Shaded Fuel Break	63	acres
	Trail Creek	Road sediment reduction	Road Decommissioning	Trail Creek Road Decommissioning	0.3	miles
		Road sediment reduction	Road Storm-proofing	Trail Creek Storm-proofing	2.2	miles
		Stand Density Fuel Break	Fuels Reduction	Trail Creek Matrix Integrated Fuels Reduction	500	acres
		Stand Density Fuel Break	Road Shaded Fuel Break	Trail Creek LSR Road Shaded Fuel Break	175	acres
		Terrestrial Habitat Improvement	Snag Creation	Trail Creek Matrix Snag Creation	109	acres
		Stand Density Management	Pre-commercial	Trail Creek LSR PCT Enhancement	112	acres
	Upper Cow Creek	Aquatic and Riparian Habitat	Fish Passage	Upper Cow Creek Fish Passage Culverts	6	sites
		Fire Suppression	Water Source Improvement	Upper Cow Creek Pump Chance	1	site
		Road Sediment Reduction	Road Closure	Upper Cow Creek Road Closure	1.2	miles
		Road Sediment Reduction	Road Decommissioning	Upper Cow Creek Road Decommissioning	1.0	miles
		Stand Density Fuel Break	Fuels Reduction	Upper Cow Creek LSR Integrated Fuels Reduction	632	acres
		Stand Density Fuel Break	Fuels Reduction	Upper Cow Creek Matrix Integrated Fuels Reduction	730	acres
		Stand Density Fuel Break	Road Shaded Fuel Break	Upper Cow Creek LSR Road Shaded Fuel Break	378	acres
		Stand Density Management	Commercial Thin	Upper Cow Creek LSR Enhancement	197	acres

TABLE 2.1.5-1 (continued)

Mitigation Projects to Address LRMP Objectives on NFS Lands

Unit	Watershed	Mitigation Group	Project Type	Project Name	Quantity a/	Unit
		Stand Density Management	Pre-commercial Thinning	Elk Creek LSR PCT Enhancement	116	acres
		Terrestrial Habitat Improvement	LWD Upland Placement	Upper Cow Creek LSR LWD Placement	65	acres
		Terrestrial Habitat Improvement	Snag Creation	Upper Cow Creek LSR Snag Creation	90	acres
		Terrestrial Habitat Improvement	Snag Creation	Upper Cow Creek Matrix Snag Creation	11	acres
		Reallocation of Matrix Lands to LSR	Land Re-Allocation from Matrix to LSR	LRMP Amendment UNF 4 LSR 223 Reallocation	585	acres
Rogue River National Forest	Little Butte Creek	Aquatic and Riparian Habitat	LWD In-stream	South Fork Little Butte Creek. LWD	1.5	mile
		Aquatic and Riparian Habitat	Stream Crossing Repair	Little Butte Creek Stream Crossing Decommissioning	32	sites
		Road sediment reduction	Road Decommissioning	Little Butte Creek Road Decommissioning	57.5	miles
		Stand Density Fuel Break	Pre-commercial Thinning	Little Butte Creek LSR Pre-commercial Thin	618	acres
		Terrestrial Habitat Improvement	Habitat Planting	Little Butte Creek Mardon Skipper Butterfly	20	acres
		Terrestrial Habitat Improvement	LWD Upland Placement	Little Butte Creek LSR LWD Placement	511	acres
		Terrestrial Habitat Improvement	Snag Creation	Little Butte Creek LSR Snag Creation	622	acres
		Reallocation of Matrix Lands to LSR	Land Reallocation from Matrix to LSR	LRMP Amendment RRNF 7, LSR 227 Reallocation	25	acres
	Big Butte Creek	Reallocation of Matrix Lands to LSR	Land Reallocation from Matrix to LSR	LRMP Amendment RRNF 7, LSR 227 Reallocation	497	acres
Winema National Forest	Spencer Creek	Aquatic and Riparian Habitat	Riparian Planting	Spencer Creek Riparian Planting	0.5	miles
		Aquatic and Riparian Habitat	Fencing	Spencer Creek Fencing	6.5	miles
		Aquatic and Riparian Habitat	LWD In-stream	Spencer Creek In-stream LWD	1.0	miles
		Aquatic and Riparian Habitat	Stream Crossing Repair	Spencer Creek Ford Hardening and Interpretive Sign	1	sites
		Aquatic and Riparian Habitat	Stream Crossing Repair	Spencer Creek Stream Crossing Decommissioning	25	sites
		Road sediment reduction	Road Decommissioning	Spencer Creek Road Decommissioning	29.2	miles
		Visuals	Stand Density Reduction	Clover Creek Visual Management.	114	acres

a/ Acres are rounded to the nearest whole acre and miles to the nearest tenth of a mile.

These mitigation actions would be a condition of the Forest Service letter of concurrence and would be included in the Right-of-Way Grant, if one were issued for this project. Implementation and funding of these actions would be carried out through negotiated agreements between the Forest Service and the applicant. A more detailed description of these mitigation actions is included in appendix F of this EIS.

2.1.6 Right-of-Way Grant to Cross Federal Lands

Pursuant to the Mineral Leasing Act of 1920 and in accordance with federal regulation 43 CFR Part 2880, the Pacific Connector Pipeline Project must secure a Right-of-Way Grant from the BLM to cross BLM, NFS, and Reclamation lands. Pacific Connector has applied to the BLM for a

Right-of-Way Grant to cross federal lands. The BLM proposes to consider issuance of a Right-of-Way Grant that provides terms and conditions for construction and operation of the Pacific Connector Project on federal lands in response to the proponent's application. Issuance of the Right-of-Way Grant must be in accordance with 43 CFR Parts 429, 2800, and 2880 and relevant BLM manual and handbook direction. In making this decision, the BLM would consider several factors including conformance with BLM RMPs and impacts on resources and programs. Following adoption of this EIS and receipt of concurrence from the Forest Service and Reclamation, the BLM would issue a Record of Decision that documents the agency's decision whether to amend the BLM RMPs and issue the Right-of-Way Grant. The Right-of-Way would incorporate the stipulations, project design features and mitigation, including compensatory mitigation specified by the concurring agencies.

This Right-of-Way Grant would be in addition to any authorization for the Project issued by the FERC. The Right-of-Way Grant, if approved, would be authorized by issuance of a Temporary Use Permit for up to three years for the pipeline clearing and construction, which would terminate upon completion of construction, and issuance of a Right-of-Way Grant for ongoing pipeline operations and maintenance for a 30-year term. The Temporary Use Permit contains the specific temporary construction and work areas necessary to build the Project. Once the Project is constructed and in operation, the Right-of-Way Grant would be modified to reflect the final location of the Project and the associated 50-foot-wide maintenance corridor[29] plus any roads on federal lands or under federal easements that are necessary for operations.

2.1.7 Mitigation on Non-Federal Lands

Both Jordan Cove and Pacific Connector are currently developing mitigation plans to address environmental impacts occurring on non-federal lands as part of their proposed action. Currently, these mitigation plans include the CMP for wetland impacts (see section 4.3), as well as the avoidance and minimization plans included in the POD[30] (though initially developed for federally-managed lands, most of the POD attachments apply to non-federal lands as well). Mitigation and BMPs are discussed in conjunction with the respective affected resources in chapter 4 of this EIS.

2.2 NON-JURISDICTIONAL FACILITIES

Under the NGA, the FERC is required to consider, as part of a decision to authorize jurisdictional facilities, all facilities that are directly related to a proposed project where there is sufficient federal control and responsibility to warrant environmental analysis as part of NEPA environmental review for the Project. Some proposed projects have associated facilities that do not come under the jurisdiction of the Commission. These "non-jurisdictional" facilities may be integral to the need for the proposed facilities, or they may be merely associated as minor components of the jurisdictional facilities that would be constructed and operated as a result of authorization of the proposed facilities. Non-jurisdictional actions associated with the Project were identified in

[29] In this EIS, the 50-foot-wide corridor may be referred to as the "operational maintenance corridor," "permanent maintenance corridor," "permanent pipeline easement," "permanent pipeline right-of-way," or similar, depending on the resource discussion and context. On all federal lands, the 50-foot-wide corridor would be based on a 30-year Right-of-Way with the federal land managing agencies, and would not constitute a permanent easement on federal lands.

[30] The POD was filed with the FERC as Appendix F.1 in Resource Report 1 as part of Pacific Connector's application on September 23, 2017.

association with both the LNG facility and the pipeline, as described below. Available environmental data further characterizing the impacts of the non-jurisdictional facilities is provided in our cumulative impacts analysis (section 4.14).

2.2.1 LNG Carriers

LNG exported from the Jordan Cove terminal to overseas markets would be transported in vessels specially designed and built for that task (i.e., LNG carriers). Jordan Cove expects that its terminal would be visited by about 100 to 120 LNG carriers per year. These carriers would be loaded with LNG at the terminal and deliver the cargo to customers, most likely around the Pacific Rim. LNG carriers would be under the ownership and control of third parties, not Jordan Cove, and would not be regulated by the FERC. The third-party owners and operators of the LNG carriers would have agreements with Jordan Cove for the transportation of the LNG to designated ports or customers. We do not have any information about the exact carriers that would be used to transport the LNG from the terminal; however, the slip and berth would be designed to accommodate LNG carriers as large as 217,000 m3 in capacity. Neither do we know the exact destinations for the LNG cargo nor the specific routes across the Pacific Ocean to customers that would be taken by LNG carriers, outside of the waterway within 12 miles of the Oregon Coast.

2.2.2 Southwest Oregon Regional Safety Center

Jordan Cove would construct the SORSC, a non-jurisdictional multi-organizational office complex, in the South Dunes area of the LNG terminal site. The SORSC would house the Jordan Cove Security Center, Coos County Dispatch Center, Coos County Emergency Operations Center, and offices for various businesses and agencies.

2.2.3 Fire Department

Jordan Cove would construct a stand-alone fire department building located in the access and utility corridor adjacent to the fire water tanks. This building would house the Jordan Cove Fire Department chief and staff.

2.2.4 Trans-Pacific Parkway/U.S. 101 Intersection Widening

Jordan Cove would add a turning lane to the Trans-Pacific Parkway (approximately 600 feet in length) to manage traffic entering U.S. Highway 101 from the west, and the addition of an automated traffic control signal. Approximately 1,150 wood piles would be installed along the road as part of this road-widening effort. The general location of the intersection is shown on figures 2.1-1 and 2.1-3.

2.2.5 Utility Connections for the Pipeline Facilities

All of the aboveground pipeline facilities would require either electrical power and/or telephone service. At the Klamath Compressor Station, electricity would be supplied by Pacific Power, which would require upgrades to an existing substation and distribution line immediately adjacent to the compressor station. New disturbance would be limited to the extension of three-phase distribution onto the compressor station property, and Pacific Connector states that Pacific Power does not anticipate disturbance would be required in new areas outside of the existing road right-of-way or existing Pacific Power right-of-way or fenced facilities. Water would be provided from water wells located on property owned by Pacific Connector, immediately adjacent to the compressor station. Telecommunications would be provided by Cal-Ore, which would require a short tie-in from the existing service available immediately adjacent to the compressor station.

For the Jordan Cove Meter Station, Pacific Power would supply electricity through a connection to an existing powerline located adjacent to the Trans Pacific Lane southwest of Ingram Yard. Telecommunications would be supplied from three existing networks, ORCA Communications, LS Networks, and Frontier Communications, through extensions of fiber optic and cable that would be installed to the SORSC proposed by Jordan Cove.

Pacific Connector has located its automated mainline valve facilities near available electrical power facilities such that only short tie-ins would be required. If it were to become necessary, in lieu of purchased power, thermal power generation equipment would be installed to provide electricity for the minimal power requirement at these sites.

2.3 LAND REQUIREMENTS

2.3.1 Jordan Cove LNG Terminal Facilities

The Jordan Cove LNG Project would require the use of about 1,355 acres of land. When complete, the Jordan Cove LNG terminal would occupy about 197 acres. Jordan Cove owns about 295 acres at the terminal site and would acquire the use of the remaining area (e.g., via easements or lease). Table 2.3.1-1 lists the land requirements for the Jordan Cove LNG terminal facilities.

TABLE 2.3.1-1

Land Requirements for the Jordan Cove LNG Project a/

Facilities	Acres Required During Construction b/	Acres Required During Operation b/
JURISDICTIONAL FACILITIES		
Total for Jurisdictional Facilities	202.6	197.1
NON-JURISDICTIONAL FACILITIES		
Southwest Oregon Regional Safety Center	5.4	5.4
Fire Department	0.8	0.8
Total for Non-Jurisdictional Facilities	**6.2**	**6.2**
TEMPORARY CONSTRUCTION AREAS		
Total for Temporary Construction Areas	**368.1**	**0**
MITIGATION SITES		
Eelgrass Mitigation Area and Dredge Line	33.4	0
Kentuck Project and Dredge Line	135.6	0
Panhandle Site	132.6	0
Lagoon Site	320.3	0
North Bank Site	156.1	0
Total for Mitigation Sites	**778.0**	**0.0**
GRAND TOTAL	**1,355.1**	**203.3**

a/ This table lists the acres of land that would be encompassed by Project components or mitigation areas, but may not directly relate to areas that would experience direct effects (e.g., the entire footprint of each of the mitigation areas may not experience direct effects such as clearing, but are included in this table to disclose the scope of the projects footprint). See chapter 4 for the acres of land and resources that would be affected by the Project.
b/ Columns may not sum correctly due to rounding.

2.3.2 Pacific Connector Pipeline and Associated Aboveground Facilities

Constructing and operating the Pacific Connector pipeline would require the use of about 4,946 acres of land, and about 1,403 acres of land, respectively. Table 2.3.2-1 lists the land requirements for the Pacific Connector Pipeline Project.

TABLE 2.3.2-1

Land Requirements for the Pacific Connector Pipeline Project a/

Project Component	Land Required During Construction (acres) b/	Land Required During Operation (acres) b/
Pipeline Right-of-Way	2,582.0	1,373.7 c/
Temporary Extra Work Areas	922.6 d/	0
Uncleared Storage Areas	676.4	0
Rock Source & Disposal Sites e/	41.2 e/	0
Contractor and Pipe Storage Yards	674.2	0
Access Roads	28.5 f/	2.2
Aboveground Facilities	21.4 g/	27.0 g/
Totals	**4,946.4**	**1,402.9**

a/ This table lists the acres of land that would be encompassed by Project components or designations (e.g., permanent easements), but may not directly relate to areas that would experience direct effects (e.g., the entire permanent easement would not be cleared during operation). See chapter 4 for the acres of land and resources that would be affected by the Project.
b/ Columns may not sum correctly due to rounding.
c/ 50-foot-wide permanent pipeline easement (on federal lands, 30-year maintenance corridor).
d/ Includes TEWAs, existing quarries, rock sources, and disposal areas that may be used as permanent storage areas. These areas would not be used during operation of the Project, and therefore are not included in the operational total.
e/ Includes rock source and disposal sites that would remain disturbed following construction but would not be used during operation of the Project and therefore are not included in the operational total.
f/ Road improvements would remain following construction, but these roads would not be used for operation of the Project and therefore are not included in the operational total.
g/ Construction impacts associated with the aboveground facilities are included in the construction land requirement for the pipeline right-of-way and TEWAs except the potential off-right-of-way communication tower sites and the Klamath Compressor station, which are included here. Portions of aboveground facilities that fall within the permanent pipeline easement are included under Pipeline Right-of-Way.

For private and non-federal lands crossed by the pipeline, Pacific Connector would need to negotiate a mutually agreed upon easement for its pipeline with the affected landowners. The agreement between Pacific Connector and the landowner would specify compensation for the easement, compensation for damage to property and loss of use during construction, and loss of renewable and nonrenewable or other resources. The agreement would also specify uses of the permanent right-of-way after construction. If the company is unable to reach an agreement with a landowner, and if the Project is authorized by the FERC, the Certificate would convey the right of eminent domain under section 7h of the NGA. In these situations, Pacific Connector could initiate condemnation proceedings, and the value of the easement and the amounts for compensatory damages would be determined by a local, state, or district court.

2.3.2.1 Pipeline

Construction Right-of-Way

As illustrated in figure 2.3-1, Pacific Connector would generally construct the pipeline using a 95-foot-wide right-of-way. Pacific Connector would also use, as necessary, temporary extra work areas (TEWAs) to accommodate construction across waterbodies, roads, steep terrain, dense forest, and other areas of concern.[31] Where feasible (i.e., where topographic conditions allow) through forested and scrub-shrub wetlands as well as stream crossings, the construction right-of-way would be narrowed to 75 feet in width to minimize impacts on these resources and be consistent with the FERC's *Procedures* (Section VI.A.3). See additional discussion in section 4.3 of this EIS.

[31] About 42 acres of the TEWAs would be existing quarries, rock sources, or rock disposal areas that would be permanent storage areas for excess rock, and these areas would remain as exposed rock sites following construction.

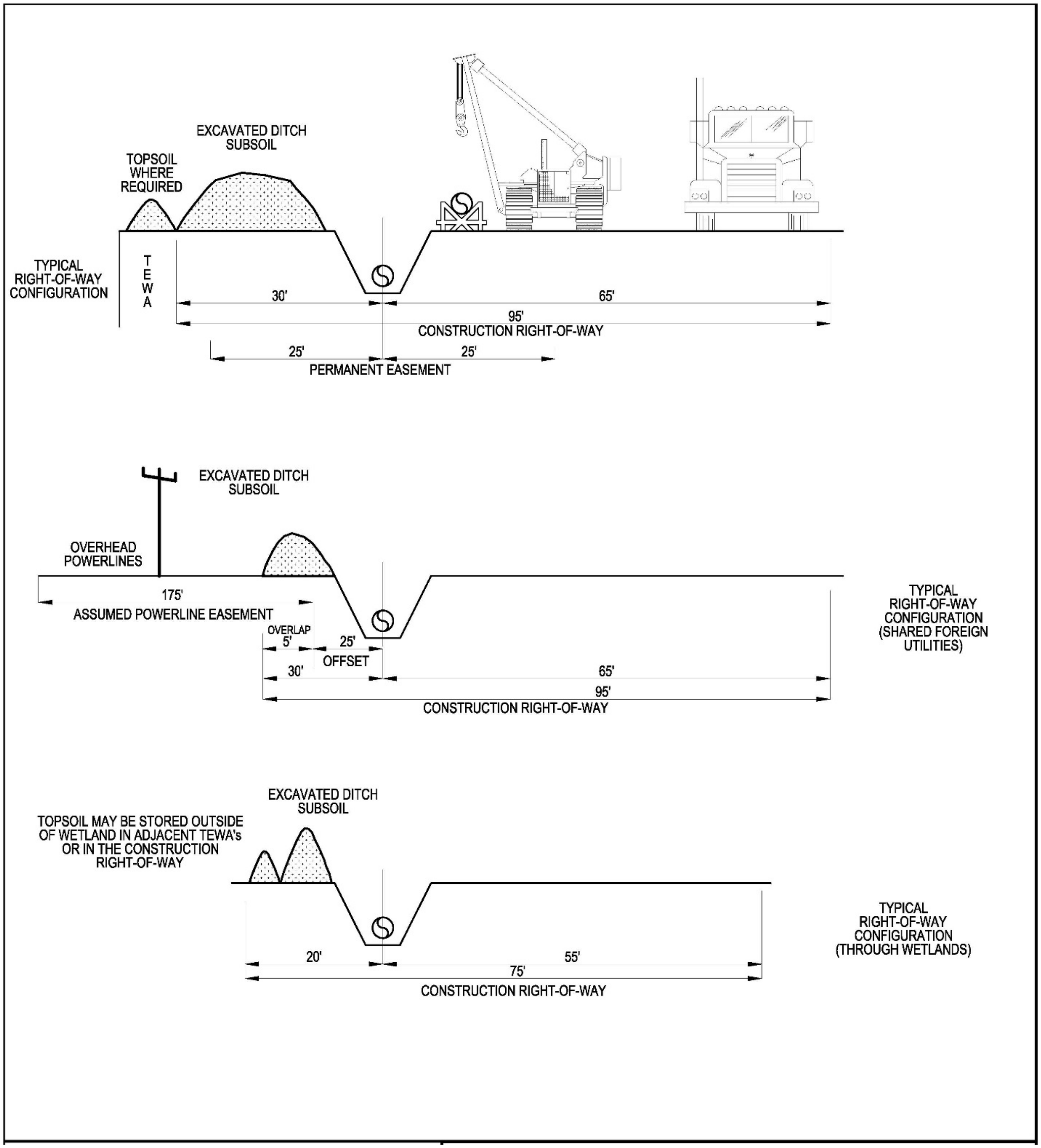


Figure 2.3-1. Typical Pipeline Right-of-Way Cross Sections

Pacific Connector would also use approximately 676 acres of uncleared storage areas (UCSA). UCSAs would not be cleared of trees during construction. UCSAs would be used to store forest slash, stumps, and dead and downed log materials that would be removed from the construction work area before construction and then scattered back across the right-of-way after construction.

In some locations, the UCSAs may be used to store spoil or to temporarily park equipment between the mature trees. However, storage and temporary parking of equipment/vehicles would not occur immediately adjacent to any trees so as to minimize tree damage. In extremely steep and side sloping topography, the UCSAs may be required as a contingency location to contain rock which rolls beyond the construction limits. Along extremely steep and narrow ridgeline areas, logs, slash, and dead and downed material may be used as cribbing to contain materials disturbed or excavated during right-of-way grading and trenching activities. During restoration, some of the materials that are pulled out of the cribbing may roll beyond the construction limits. Where feasible, Pacific Connector would retrieve materials that have rolled downhill using cables and chokers attached to standard on-site restoration equipment (i.e., bulldozers and trackhoes) to winch the material back to the right-of-way. There may be some cases where retrieval of the lost cribbing material may cause more harm to resources than allowing it to remain where it settled. On federal lands, Pacific Connector would protect trees within the UCSAs in accordance with the procedures outlined in its *Leave Tree Protection Plan* (Appendix P of its POD). After construction, the UCSAs would be restored to their pre-construction condition and use.

Operational Pipeline Right-of-Way

Pacific Connector would retain a 50-foot-wide permanent easement for the long-term operation and maintenance of the pipeline on non-federal lands. On federal lands, an operational right-of-way may be issued for a specific period of use, with potential for extension. After construction, workspace outside of the maintenance easement would be restored to its original condition and use (although mature forest would take many years to be re-established). The restoration and revegetation of the temporary construction right-of-way would be done in accordance with Pacific Connector's *Erosion Control and Revegetation Plan* (ECRP). On NFS and BLM lands where Riparian Reserves would be affected, up to a 100-foot riparian strip or to the edge of the existing riparian vegetation would be replanted adjacent to stream crossings.

Access Roads

Pacific Connector would primarily use existing roads to access pipeline workspaces. Existing roads that would be used for construction access are listed in table D-2 in appendix D of this EIS. Pacific Connector has identified 10 locations where it would be necessary to construct new temporary access roads (TARs). Pacific Connector has also identified 27 existing roads that would need to be modified to handle construction traffic. The roads would be stabilized using gravel and appropriate BMPs, as outlined in the ECRP, to minimize potential surface water runoff and to avoid potential sedimentation impacts. Following construction, new TARs would be removed, and the affected areas restored to pre-construction conditions.

Pacific Connector would construct 15 new permanent access roads (PARs) to access the pipeline and aboveground facilities. These roads would provide access during construction as well as during operations and maintenance activities. Most of the new PARs would be within Pacific Connector's operational pipeline easement.

Contractor and Pipe Storage Yards

Pacific Connector has identified 36 potential sites for yards and rail ports that may be used during construction to off-load and store pipe and stage contractor equipment (see table D-9 in appendix D). These sites are near the pipeline but generally not immediately adjacent to the proposed pipeline.

Pacific Connector has identified approximately 920 acres of TEWAs that would be disturbed during construction of the pipeline. All of these areas are considered temporary disturbance and would be restored upon completion of construction. All TEWAs that were forested prior to construction would be replanted with trees.

Rock Source and Permanent Disposal Sites

Pacific Connector has identified 20 potential rock source/disposal sites. These sites are indicated on the Mapping Supplement included as appendix C of this EIS. Of these locations, 15 sites are existing quarries/gravel pits or abandoned quarries/gravel pits. Although some of the existing/abandoned sites appear to have land use types other than quarries/gravel pits, Pacific Connector would not expand these sites beyond the existing or previously disturbed footprints.

Cathodic Protection System

Pacific Connector would protect the pipeline from corrosion over time through a cathodic protection (CP) system. The CP system would consist of below ground rectifier/anode beds that input a low voltage electrical charge into the pipeline. These rectifier/anode beds would be spaced about 30 to 40 miles apart and typically installed within previously disturbed areas near the permanent pipeline right-of-way. Each CP site would use electric power from a local utility. A typical CP site would include installation by a standard backhoe within an area up to 500 feet long by 15 feet wide and 5 feet deep. In limited locations a deep CP site may be required which would be installed by a truck-mounted drill rig. Identification of the CP sites and installation itself would occur about one year after pipeline installation to allow the trench to stabilize and for collection of post-construction data on electro-conductivity soil potentials, which is required before the system can be designed and installed. Pacific Connector would consult with appropriate federal, state, and local regulatory agencies after pipeline construction to determine the level of environmental compliance and agency authorizations necessary for the installation and maintenance of the CP system. On federal lands, any ground-disturbing construction and installation work to install the CP system would require separate authorization and environmental review.

2.3.2.2 Aboveground Facilities

Land required for construction and operation of the proposed aboveground facilities is listed in table 2.3.2-1 above. Operation of the aboveground facilities would require about 27 acres outside of the pipeline operational right-of-way.

2.3.2.3 Pipeline Facilities on Federal Lands

The Pacific Connector pipeline would cross 46.9 miles of federal land managed by the BLM, 30.6 miles managed by the Forest Service, and 0.31 mile managed by Reclamation (see table 2.3.2.3-1). The temporary and permanent acres of impact from the specific components are also provided in table 2.3.2.3-1. Tables 2.3.2.3-2 and 2.3.2.3-3 show the breakout by BLM District and by National Forest of the miles crossed through the various 2016 BLM RMP and Northwest Forest

Plan (NWFP) land allocations. Table 2.3.2.3-4 lists the Reclamation jurisdictional facilities, with their milepost locations, easement widths, acres of impact, and townships, ranges, and sections.

TABLE 2.3.2.3-1

Federal Lands Affected by the Pacific Connector Pipeline Project

	Jurisdiction		
Pipeline Facility/Component	**BLM**	**Forest Service**	**Reclamation**
Miles Crossed by Pipeline	46.9	30.6	0.31
Temporary Construction Acreage Requirements (acres)			
Construction Right-of-Way	535.02	349.75	3.69
TEWAs	166.26	102.76	0.46
UCSAs	183.75	123.17	0.00
Off-site Source/Disposal	6.99	9.26	0.00
Contractor and Pipe Storage Yards	0.00	0.00	0.00
Existing Roads Needing Improvements in Limited Locations a/	4.71	1.00	0.00
Temporary Access Roads	0.69	0.24	0.00
Total Temporary Impacts (acres)	**897.42**	**586.18**	**4.15**
Right-of-Way (50 feet)	284.00	185.35	1.90
Permanent Access Roads	0.34	0.00	0.00
Aboveground Facilities	0.26 b/	0.00	0.00
30-Foot Maintained	170.38	111.20	1.14

a/ Includes those existing roads requiring widening in specific locations; does not include limbing/brush clearing or blading/grading for potholes.
b/ MLVs #4, #7, and #12 are located on BLM lands.

TABLE 2.3.2.3-2

BLM Federal Land Allocations – Miles Crossed by the Pacific Connector Pipeline

Land Use Allocation	**Coos Bay District**	**Roseburg District**	**Medford District**	**Lakeview District**	**Total**
District-Designated Reserve (No Harvest)	0.04	0.47	5.04	0.00	**5.55**
District-Designated Reserve (Non-Forest)	0.69	1.65	2.32	0.04	**4.70**
Eastside Management Area	0.00	0.00	0.00	0.26	**0.26**
Harvest Land Base (Low Intensity Timber Area)	0.73	0.00	0.68	0.00	**1.41**
Harvest Land Base (Moderate Intensity Timber Area)	2.61	1.65	0.00	0.00	**4.26**
Harvest Land Base (Uneven-Aged Timber Area)	0.00	2.73	1.98	0.97	**5.68**
Late-Successional Reserve (Dry Forest)	0.00	5.06	4.21	0.00	**9.27**
Late-Successional Reserve (Moist Forest)	11.40	1.52	0.00	0.00	**12.92**
Riparian Reserve a/ (Dry Forest)	0.00	0.16	0.92	0.02	**1.10**
Riparian Reserve a/ (Moist Forest)	1.60	0.11	0.00	0.00	**1.71**
Totals	**17.07**	**13.35**	**15.15**	**1.29**	**46.86**

a/ Calculated using 2016 RMP DATA\RWO_ROD_SWO.gdb/RWO_ROD_SWO_LUA_poly and 2016 RMP DATA\RWO_ROD_NCO.gdb/RWO_ROD_NCO_LUA_poly.

TABLE 2.3.2.3-3

Forest Service Federal Land Allocations – Miles Crossed by the Pacific Connector Pipeline

Jurisdiction	**Late Successional Reserves (miles)**	**Matrix (miles)**	**Total**	**Riparian Reserves a/ (miles)**
Forest Service – Umpqua	5.03	5.78	**10.81**	0.78
Forest Service – Rogue River-Siskiyou	13.72	0.00	**13.72**	0.24
Forest Service – Fremont-Winema	0.00	6.05	**6.05**	0.38
Total	**18.75**	**11.83**	**30.58**	**1.40**

a/ Riparian Reserves overlay other land use allocations.

TABLE 2.3.2.3-4

U.S Bureau of Reclamation Administered Lands and Canals

U.S Bureau of Reclamation (Reclamation) Jurisdictional Facilities (Easement Width) a/	Approx. Pipeline Milepost	Length of Pipeline Crossing (feet)	Index No. Easement Width	Waterbody ID b/	Quarter Quadrant	Township	Range	Section
C-4-E Lateral c/	NA	Not Crossed c/	KO-20-080 30 feet	ADX293	SWNE	39S	9E	20
Withdrawn Land	NA	Not Crossed	KO-20	N/A	SWNE	39S	9E	20
No. 1 Drain	200.54	14.59	KO-20-276 60 feet	ADX294	SWNE	39S	9E	20
C-4-E Lateral	201.63	15.49	KO-20-164 40 feet	ADX096	NENW	39S	9E	28
C-4 Lateral	204.12	48.18	KO-09-013 50 feet	ADX100	NWNE	40S	9E	3
C-4-F Lateral	204.33	12.91	KO-09-013 50 feet	ADX101	NWNE	40S	9E	3
No. 3 Drain	204.74	17.80	KO-09-14 60 feet	ADX105	NWNW	40S	9E	2
C-4-C Lateral	205.50	18.28	KO-09-018 60 feet	ADX109	SWNE	40S	9E	2
C Canal	205.96	54.90	KO-09-027 75 feet d/	ADX111	NWSW	40S	9E	1
D-2 Lateral	206.51	23.76	KO-09-050 60 feet	ADX113	NWNE	40S	9E	12
5-A-1 Drain	207.11	4.00	KO-09-053 60 feet	AW-114	NESE	40S	9E	12
5-A Drain	207.26	28.61	KO-09-054 50 feet d/	ADX115	NESE	40S	9E	12
C-4-7 Lateral	207.40	15.20	KO-10-031 60 feet	ADX116	NWSW	40S	10E	7
5-A Drain	207.42	16.84	KO-10-032 50 feet	ADX117	NWSW	40S	10E	7
5-A Drain	207.60	61.56	KO-10-032 50 feet	ADX118	SWSW	40S	10E	7
5-A Drain	207.99	25.26	KO-10-034 50 feet	ADX119	NENW	40S	10E	18
5-A Drain	208.18	19.94	KO-10-034 50 feet	ADX123	SENW	40S	10E	18
5-K Drain	209.02	24.95	KO-10-048 30 feet d/	ADX130	SESE	40S	10E	18
C-9 Lateral	209.15	16.03	KO-10-047 30 feet	ADX134	NWNW	40S	10E	20
No. 5 Drain	210.26	17.90	KO-10-061 50 feet	ADX143	SESE	40S	10E	20
5-H Drain	210.85	10.71	KO-10-074 20 feet	ADX260	SWNW	40S	10E	28
G Canal	213.87	43.90	KO-10-086 165 feet	ADX275	SESE	40S	10E	26
Total		**490.81**						

a/ Reclamation Facility Name, (easement width) Reclamation ID, and Index No included as attributes in Bureau of Reclamation Pacific Connector-Crossing Shapefile provided to Pacific Connector - January 7, 2009. Easement widths determined from scanned easement plats provided by Reclamation.
b/ Waterbody ID from Pacific Connector wetland and waterbody surveys as shown on the Environmental Alignment Sheets in Appendix AA to the POD.
c/ The C-4-E Lateral is not crossed by the centerline but the easement for the lateral is within the construction right-of-way for approximately 270 feet.
d/ Canal easement widths not provided on easement plats provided by Bureau of Reclamation; therefore, crossing widths estimated based on photography and similar canal easements on adjacent canals.

In addition to the permanent and temporary access roads needed for construction listed in the preceding tables, existing federal roads would also be used. It is estimated that approximately 276 miles of BLM roads, 113 miles of Forest Service roads, and 2 miles of Reclamation roads would be utilized for construction activities.[32] All of the requirements for the use of federal roads are included in Appendix Y of the POD (i.e., the *Transportation Management Plan* [TMP]). This POD attachment outlines the requirements for road use permits, maintenance, modification and reconstruction, road decommissioning, culvert/bridge upgrades, new road construction (PARs and TARs), and traffic management. The federal agencies are continuing to coordinate with the applicant in refining the TMP, and road miles may vary as a result.

2.4 CONSTRUCTION PROCEDURES

Under the provisions of the Natural Gas Pipeline Safety Act of 1968, as amended, Jordan Cove would design, construct, operate, and maintain the LNG terminal facilities in accordance with the USDOT's Liquefied Natural Gas Facilities: Federal Safety Standards (49 CFR 193). The loading facilities and any appurtenances located between the LNG carriers and the last valve immediately before the LNG storage tank would be required to comply with applicable sections of the Coast Guard regulations in Waterfront Facilities Handling Liquefied Natural Gas (33 CFR 127).

The proposed pipeline facilities would be designed, constructed, operated, and maintained in accordance with USDOT regulations in Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards (49 CFR 192). Among other design standards, these regulations specify pipeline material selection; minimum design requirements; protection from internal, external, and atmospheric corrosion; and qualification procedures for welders and operations personnel. In addition, Pacific Connector would comply with the siting and maintenance requirements of the FERC's regulations at 18 CFR 380.15, and other applicable federal and state regulations.

Jordan Cove and Pacific Connector would construct the Project in accordance with its project-specific *Erosion and Sediment Control Plan* (ESCP), its *Upland Erosion Control, Revegetation, and Maintenance Plan* (Jordan Cove's *Plan*) and its *Wetland and Waterbody Construction and Mitigation Procedures* (Jordan Cove's *Procedures*).[33] Jordan Cove adopted elements of the FERC's *Plan* and *Procedures* (May 2013 versions) into its *Plan* and *Procedures* as applicable for the Project (see appendix E for modifications). We have reviewed Jordan Cove's *Plan* and *Procedures* and find them to be consistent with the FERC's *Plan* and *Procedures*. In addition, Jordan Cove has prepared Spill Prevention, Containment, and Countermeasures (SPCC) Plans for both construction and operations.[34]

[32] Estimates derived from Table A.8-1 in Resource Report 8 of Pacific Connector's September 2017 application to the FERC.

[33] Jordan Cove's ESCP including its *Plan* and *Procedures* was attached as Appendix H.7 in Resource Report 7 as part of the Environmental Report included with Jordan Cove's September 2017 application to the FERC.

[34] Jordan Cove's construction and operation SPCC Plans were included as Appendices F.2 and G.2 of Resource Report 2, respectively, of its September 2017 application filed with the FERC.

2.4.1 Jordan Cove LNG Terminal

2.4.1.1 Upland Site Preparation

Temporary Concrete Batch Plant

One of the first construction procedures that Jordan Cove would undertake is the installation of a temporary concrete batch plant within the LNG terminal site or within a construction laydown area. The concrete batch plant would support construction of LNG terminal facilities that include concrete. A washout area would be located adjacent to the batch plant to allow for containment and disposal of waste water related to concrete batching operation.

Demolition and Clearing

Site preparation would include demolition, clearing, and removal and relocation of existing infrastructure to enable earthworks to progress. During this initial phase the IWWP and several existing utilities would be relocated. Other demolition and clearing activities would include:

- Removal and disposal of hydrocarbon contaminated soils – The South Dunes portion of the site contains small areas of hydrocarbon-contaminated soils remaining after the decommissioning of the former Weyerhaeuser paper mill. The contamination is located in the vicinity of the proposed site for the permanent buildings. Jordan Cove plans to conduct additional testing to further characterize the area of potentially contaminated soils and would develop a disposal plan for the approval of ODEQ and would remove and dispose of the contaminated soils in accordance with the approved plan.
- Clearing – The dune areas at the LNG terminal site would be cleared and any merchantable timber would be processed for commercial sale. Scrub and stumps would be processed into mulch for use during construction.

2.4.1.2 Material Deliveries

Transportation of materials, supplies, and staff to the LNG terminal site would be accomplished via a combination of road, marine transport, and rail. The larger and heavier pieces of equipment would be delivered to the site by marine transport in two phases. Initial marine deliveries would be via a temporary material barge berth, constructed in the existing shoreline within the footprint of the eventual marine slip. The temporary material barge berth would allow for material deliveries by barge while the permanent MOF is under construction and would be removed when construction of the MOF is completed.

Jordan Cove anticipates that some bulk materials, such as temporary buildings, construction equipment, steel reinforcement, pipe spools, cable drums, and insulation, would be delivered to the site by road. An existing rail line is located adjacent to the LNG terminal site and would be utilized for deliveries as permitted.

2.4.1.3 Earthworks and Soil Improvement

Earthworks would include removal of topsoil and storage for re-use, cut (excavation and dredging), fill (placement of excavated material), and grading of material to the approximate design elevations. The upland earthworks phase would include work by heavy equipment and require some periods of 24-hour operation. Jordan Cove would construct a temporary traffic overpass to allow separation of the traffic traveling to and from the existing Roseburg Forest Products Company from the large, off-road haul trucks and equipment required for the earthworks phase. During this phase boiler ash previously disposed on the site of the LNG terminal would be relocated to the South Dunes portion of the site where it would be buried within the fill.

The soil conditions at the site require improvement before any aboveground facilities can be constructed. These conditions include peat, clay, buried driftwood, and liquefiable soil, which could cause excessive settlement and stability concerns, or issues associated with liquefiable soils should a seismic event occur. Liquefiable soils within the LNG terminal site have been delineated in distinct soil layers from the groundwater table to various depths down to about 30 feet. A peat layer about 2-4 feet thick is present in areas of the site generally from just below the groundwater table to about 7 to 15 feet below grade. A layer of clay up to about 2.5 feet thick has been identified in areas of the South Dunes, and there are several areas in the South Dunes portion of the site where accumulations of buried driftwood are estimated to be present.

Jordan Cove plans to conduct additional site investigations to further characterize the existing subsurface conditions at the site and based on results would develop a plan for soil improvement, however potential soil improvements identified by Jordan Cove are listed below.

- Soil Densification Method 1 – Vibro-compaction could be utilized to condition liquefiable soils. This method consists of driving a vibration device into the sand layers to compact the soils.
- Soil Densification Method 2 – Sand compaction piles could be utilized to compact liquefiable soils, depending on the availability of suitable equipment.
- Organic Material Treatment Method 1 – Excavation and removal would be the preferred method to remove larger peat deposits where dewatering of the excavation pits is possible without affecting adjacent wetlands or waterbodies.
- Organic Material Treatment Method 2 – Excavation and removal of peat without dewatering the excavation pits may be attempted in areas with adjacent off-site wetlands and waterbodies.
- Organic Material Treatment Method 3 – Mixing of the mineral surface soils with peat layers may be attempted where excavation is not feasible.

During the operation of the Weyerhaeuser mill, boiler ash was deposited at Ingram Yard. Jordan Cove would dry excavate this boiler ash, and relocate it to South Dunes, where it would be buried with the fill.

2.4.1.4 Subsurface Civil Work

Piling

Construction of the LNG terminal and associated marine facilities would require the installation of temporary and permanent piles. Approximately 1,400 temporary piles and 17,800 permanent piles would be installed. Piles would be installed using vibratory hammering methods for the sheet piles (approximately 60 percent of the total piles), vibratory and drilled methods for the pier piles (15 percent of the total piles) and vibratory and impact methods for the pipe piles (25 percent of the total piles). Jordan Cove states that pile driving would be done over two 10-hour shifts per day, 6 days per week (not on Sundays or major holidays) over a 31-month period.

On-site Underground Utilities

Installation of underground utilities and services would be completed early in the site preparation phase to allow completion of site grading for stormwater control, completion of plant roadways, and installation of foundations and aboveground work. Underground work would be closely coordinated with the site preparation earthwork to install as much of the underground facilities as possible while the site is still being brought to grade.

Foundations

Major foundation work for equipment and structures would generally follow the installation of pilings and underground utilities. Typically, shallow isolated or raft foundations would be used for equipment and structures unless the design requires the use of deep foundations. All foundation loads, analysis, design, and construction would be in accordance with statutory and regulatory requirements. Where required, foundations would be evaluated and designed to mitigate the hazards associated with settlement, bearing capacity, overturning, sliding, buoyancy, erosion, and scour. Formwork for foundations would comprise a mix of metal form systems and job-built wooden forms. Rebar required for foundations would be fabricated off-site, delivered, and tied into place on-site. The temporary on-site batch plant would provide concrete as required for poured foundations.

2.4.1.5 Marine Facilities

Construction of the marine facilities would be done in three phases. The first phase would include upland excavation of the slip. The second phase would include excavation and dredging of the slip area above the natural earthen berm maintained in place to separate the freshwater construction activities from Coos Bay. Maintaining the berm would allow year-round work without being in contact with the waters of Coos Bay. The third phase would require work within Coos Bay and would include excavating the access channel (including area around MOF), removal of the berm and excavation/dredging of the berm area, and installation of MOF fender piles. This third phase would occur during periods when fisheries considerations allow in-water work, between October 1 and February 15. The estimated volume of material removed from each phase and component of excavation and dredging for the marine facilities are listed in table 2.1.1.8-1. Additional details for construction of the marine facility components are described below.

Construction of Sheetpile Walls

The sheetpile system would serve as a retaining wall for the shoreline on the east and west sides of the slip. It would be designed to support the dead loads of the soils and structures, as well as the live loads of the LNG carrier at berth and LNG transfer equipment; it would also be designed to meet the seismic criteria for the facility and water-imposed loads. The sheetpile wall system would include face sheet piles for retaining the soils as well as tail-walls for anchorage of the retaining wall. Sheet piles and tail-walls would be driven from the land during the first phase of marine facilities construction while the slip construction activities are isolated from Coos Bay.

Dry Excavation

The existing natural ground surface is at an elevation of approximately +20 feet NAVD88. The water table across the slip occurs at an elevation of approximately +10 feet NAVD88. Material above an elevation of approximately +10 feet NAVD88 would be removed by conventional earthmoving equipment such as excavators, scrapers, bulldozers, and front-end loaders. Excavated material would be hauled by trucks to upland disposal within the Ingram Yard, Access/Utility Corridor, South Dunes, and Roseburg site. A berm would be maintained as a barrier to the bay during this construction phase. The north slope of the slip would be finished at 2.5 to 1 horizontal to vertical slope. The same slope would be maintained on the slip side of the temporary berm to preserve the integrity of the berm during excavation and dredging. Contouring of the final slip perimeter above +10 feet NAVD88 would be performed during this step.

Slip Dredging

The material removed from the slip area that is at or below the water table would be removed by means of hydraulic dredging using a barge mounted cutter-suction dredge. The dredge would be delivered by ocean-going barge to the site, partially disassembled, and then pulled over the berm into the slip area. A dredge slurry pipeline would connect the dredge to the South Dunes portion of the site, and a decant water return pipeline would return the water to the slip area or purpose-built decant basin. The hydraulic dredge would be capable of dredging to the final slip depth.

The slurry and decant water pipelines would follow the shoreline and then the route of the future access and utility corridor. The pipes would be made of 18- to 20-inch-diameter seamless polypropylene pipe placed on the ground, braced as necessary, and would span any wetlands or waterbodies along the route. At any point along the pipeline route where the slurry pipeline could rupture, and the contents could potentially enter the waters of Coos Bay, secondary containment would be provided. When the hydraulic transport has been completed, the pipelines would be drained, flushed with clean water, and cut apart only in those areas where any residual material in the pipeline could not potentially be released into the bay, wetlands, or other waterbodies. The pipeline would be removed and taken off-site for reuse, recycling, or disposal in a permitted landfill.

Dredged material that would be disposed of at the Kentuck project site would be transported along the Federal Navigation Channel via marine transport barge and then deposited on the site using a temporary transfer pipeline. The materials would be dredged “in the dry” (i.e., the material would be dry when dredged), and then re-liquefied and piped through the transfer pipeline to Kentuck.

Access Channel and Proposed Modifications to the Marine Waterway

The access channel would be dredged using a barge mounted crane with clamshell bucket or hydraulic dredge system. The operation would start at the MOF and progress out to the navigation channel. Jordan Cove anticipates that access channel dredging would occur around the clock in order to complete within the available window for in-water work from October 1 to February 15. The channel dredging would occur during the second available in water work window (with the MOF being constructed during the first available in-water window). Dredged material would be loaded into material barges and the barges would be towed to shore and the material transferred to trucks for placement at Ingram Yard, the access and utility corridor, Roseburg Forest Products property, or the South Dunes portion of the site. Material dredged from the along the Federal

Navigation Channel (as part of the proposed marine waterway modification) would be transported to APCO Sites 1 and 2 by temporary dredge pipeline laid adjacent to the Coos Bay navigation channel (via a floating or submerged pipe).

Driving of Piling for Marine Structures

Marine piling for the tug dock would be driven "in-the-dry" by land-based mobile cranes, meaning the piles would be installed prior to or concurrent with the freshwater dredging of the slip and while the berm is still in place separating the slip from Coos Bay. All piles required for the LNG loading foundation, and all mooring and berthing structures for the LNG and emergency berths would be located behind the sheetpile walls and would be driven on dry land.

Connection of Slip to the Channel

After completion of the slip excavation and dredging while working behind the berm, the berm would be removed, and the remaining area of the slip would be dredged. This work would be conducted during the allowed in-water work window of October 1 to February 15. Dredging may be conducted from both the Coos Bay side and the slip side to reduce the duration of the activity. Additional dredging to contour the access channel at the connection of the channel and slip would also be conducted at this time. Material would be removed by hydraulic dredge or clam-shell dredge. A portion of the material may be transported to the Kentuck project to be used as fill, and the remainder would be placed at the South Dunes portion of the site. Armoring of the remaining unarmored slip side slopes would then be completed.

Restoration of Marine Facilities

Following the excavation activities, all areas disturbed by marine facilities construction, including exposed slopes, would be protected from erosion and stabilized with an erosion protection system and/or an approved seed mixture specified for the site. The northern slip face would be armored with rip rap to protect the slope from scour. The dredge slurry and decant water return pipelines would be removed, and any areas that are disturbed by the haul truck or pipelines route that do not become part of the access and utility corridor would be restored to pre-construction condition.

2.4.1.6 LNG Loading Platform and Facilities

The LNG carrier loading facilities would be constructed once the eastern sheet pile wall system is complete. All of the loading facilities would be on the shore side of the slip, with no facilities located in the water of the slip. The platform with the loading arms (inclusive of the loading and vapor return arms) would be constructed on a concrete pad at the edge of the slip. The LNG transfer piping would be located over LNG troughs that would contain any spills and divert the LNG to a containment basin. The LNG carrier loading facilities would be constructed using land-based equipment. Installation of berth piping and equipment, and hookup and commissioning of the loading system and utilities would follow.

2.4.1.7 LNG Storage and Support Facilities

LNG Storage Tank Construction

Construction of the LNG storage tanks would be the most time-consuming element in the development of the LNG terminal. General steps would include installation of the foundations and tank bottom slab, construction of the outer concrete container wall, insertion of the bottom carbon steel vapor liner, construction of the steel dome roof and suspended deck, installation of the 9 percent nickel steel inner tank, installation of the internal tank accessories (pump columns, instrumentation, and piping), installation of external tank accessories, installation of insulation, and installation of LNG pumps. Following a successful inner container hydrotest (see below), the tank would be washed down and cleaned. After installation of the LNG pumps, the tank would be closed and purged with nitrogen to a positive gauge pressure. At this point in the construction process, the tank would be ready for cooldown with LNG.

Support Facilities

Construction of buildings and installation of major mechanical equipment would occur once LNG storage tank construction is underway. Installation of mechanical equipment would be followed by electrical and instrumentation installation. As the construction of the process portion of the LNG terminal progresses, work would commence on the pre-commissioning activities, so that these activities would be completed concurrently with the completion of the LNG storage tanks.

2.4.1.8 Testing

Jordan Cove would conduct testing of the LNG storage tanks in accordance with API 620, while piping would be tested in accordance with the American Society of Mechanical Engineers (ASME) B31.3. Some of the tests are described below.

Testing of the LNG Storage Tanks

Jordan Cove proposes to use raw water from the existing CBNBWB raw water pipeline for hydrostatic testing of the LNG storage tanks. The inner container of each LNG storage tank would be hydraulically tested by filling the tank with water, and then pressurizing the tank. To minimize water usage, the two tanks would be hydrotested with the same water by transferring the water at the conclusion of the hydrotesting of one tank to the other tank. For both tanks combined, about 60 million gallons would be used during hydrostatic testing. Following testing, the water would be locally discharged, following ODEQ approval, to the stormwater system for infiltration or discharged into the IWWP according to applicable NPDES permit requirements. If the hydrostatic test water is discharged to the IWWP, it has the capacity to handle the anticipated discharge of 2.9 mgd. Jordan Cove would use a pneumatic test on the outer container for each LNG storage tank. The pneumatic test would be completed in accordance with API 620 Section R.7.

Testing of Pipework

Piping within the LNG terminal facility would be tested using hydrostatic or pneumatic methods. In general, cryogenic piping (piping that would transfer LNG) would be pneumatically tested with dry air or nitrogen. Non-cryogenic piping (piping that would transfer natural gas) would be hydrotested using clean water. Water used for testing of pipeworks would be discharged in the same manner as water used for hydrostatic testing of the LNG storage tanks, as described above.

2.4.2 Pacific Connector Pipeline and Associated Aboveground Facilities

Construction of the proposed pipeline would primarily involve standard cross-country pipeline construction as described in section 2.4.2.1. Special construction techniques would also be used when constructing across wetlands; waterbodies; roads, railroads, and other utilities; agricultural and residential areas; and rugged terrain. These special construction techniques are described in section 2.4.2.2. Construction of the aboveground facilities is discussed in section 2.4.2.3.

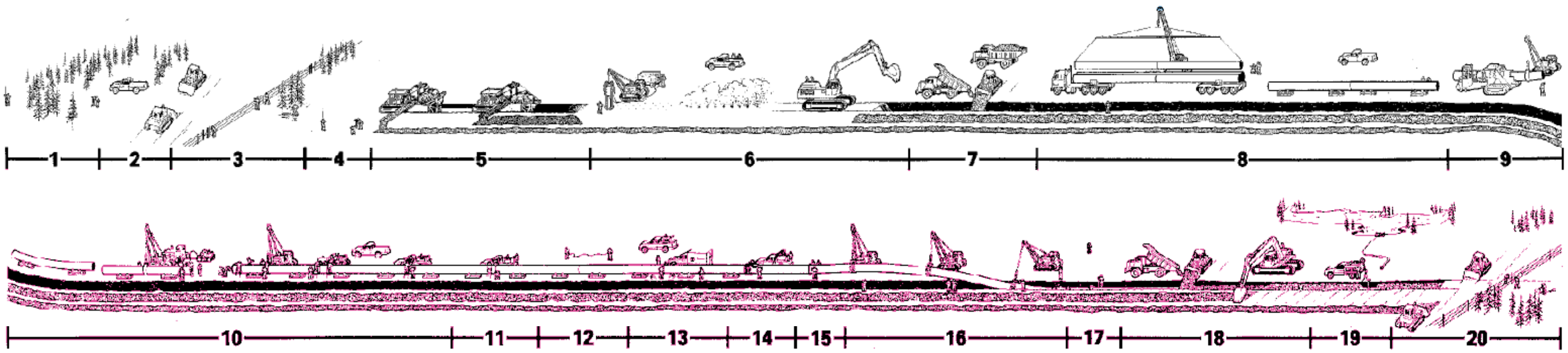
Minor alignment shifts or additional temporary workspace may be required prior to and during construction to accommodate currently unforeseeable site-specific constraints related to construction, safety, engineering, landowner, and/or environmental concerns. All such alignment shifts or workspace needs would be subject to review and approval by the FERC and the other permitting agencies prior to construction, as appropriate.

2.4.2.1 General Pipeline Construction Techniques

Figure 2.4-1 shows the typical steps of cross-country pipeline construction, which proceeds in the manner of an outdoor assembly line of specific activities that make a linear construction sequence. Typical steps include survey and staking of the right-of-way, clearing and grading, trenching, pipe stringing and bending, welding and coating pipe, lowering-in pipe and backfilling, hydrostatic testing, right-of-way cleanup, and restoration. Pacific Connector anticipates construction would be divided into eight separate construction spreads, with each spread consisting of all construction activities necessary to construct the pipeline along that spread, as follows:

- Early Works MPs 0.00-7.34R;
- Spread 1 MPs 7.34R-29.54;
- Spread 2 MPs 29.54-51.58;
- Spread 3 MPs 51.58-71.37;
- Spread 4 MPs 71.37-94.75;
- Spread 5 MPs 94.75-132.52;
- Spread 6 MPs 132.52-162.40; and
- Spread 7 MPs 162.40-228.81.

PIPELINE CONSTRUCTION SEQUENCE



LEGEND

1 - Right-of-Way Acquisition and Survey*
2 - Clearing and Grading
3 - Fencing
4 - Centerline Survey of Ditch*
5 - Ditching (Rock-Free)
6 - Ditching (Rock)
7 - Padding Ditch Bottom
8 - Stringing
9 - Bending
10 - Line Up, Stringer Bead and Hot Pass
11 - Fill and Cap Weld
12 - As-Built Footage*
13 - X-Ray* and Weld Repair
14 - Coating Field and Factory Welds
15 - Inspection (Jeeping) and Repair of Coating
16 - Lowering In and Tie-Ins
17 - As-Built Survey*
18 - Pad and Backfill
19 - Test and Final Tie-In
20 - Replace Topsoil and Cleanup

*Owner's Responsibility

Figure 2.4-1

Typical Pipeline Construction Sequence

Surveying and Staking

Prior to the start of construction, the exterior limits of the approved construction right-of-way and boundaries of TEWAs would be civil surveyed and clearly staked and signed. Professional land surveyors licensed in the state of Oregon would perform all work and would hold a valid and current Certified Federal Surveyor certificate for federal land surveying and setting of monuments. All surveys would be performed in accordance with procedures found in the *Manual of Surveying Instructions* (U.S. Department of the Interior 2009), and all applicable state or county statutes, codes and regulations, and specifications of the County Surveyor. Pacific Connector's environmental inspectors (EIs) would verify the limits of the staked right-of-way and TEWAs, and would monitor the stakes throughout construction. Any pre-existing property line or survey monuments that occur within the construction right-of-way would be protected where possible, and if damage occurs during construction, these monuments would be replaced according to state and federal standards. Approved access roads would be signed. Also signed would be sensitive environmental areas that would be off-limits to construction crews.

Property line monuments or survey corners on BLM-managed and NFS lands would be reestablished according to federal standards if damaged during construction. Civil surveys on federal lands would adhere to guidelines established by the BLM, Forest Service, and Reclamation. Pacific Connector developed a *Right-of-Way Marking Plan* in consultation with the BLM and Forest Service as part of the POD (see Appendix T to the POD). This plan identifies the survey standards and types of survey markings that would be used on federally-managed lands.

Access to the Construction Right-of-Way

Equipment involved in pipeline construction would be moved onto the right-of-way using approved access roads and would then generally proceed down the right-of-way. The standard 95-foot-wide construction right-of-way would include a travel lane for construction equipment and vehicles. Pacific Connector would place mats over wetlands and bridges over waterbodies along the travel lane, in accordance with its *Plan* and *Procedures*, and install temporary erosion control devices in accordance with its ERCP. Pacific Connector has produced a TMP for federal lands as Appendix Y of its POD and also a TMP for non-federal lands.[35]

Clearing and Grading

The construction right-of-way and TEWAs would be cleared of brush and trees. Pacific Connector has produced a *Right-of-Way Clearing Plan for Federal Lands* as Appendix U of its POD. The general clearing procedures outlined in that plan would also apply to non-federal lands. During clearing existing fences crossed by the pipeline route would be cut and braced, and temporary gates installed to control livestock and limit public access to the right-of-way. Temporary erosion control devices would be installed at the end of clearing activities.

Hayfields, pastures, and grassy areas would not be cleared except in areas directly over the trench or where grading would be required to create a level working surface. Tall shrubs, such as sagebrush, would be mowed or scalped off with a motor-grader or a bulldozer. Cleared grasses

[35] Appendix F.8 in Resource Report 8 included as part of Pacific Connector's September 2017 application to the FERC.

and brush would be stockpiled along the edge of the right-of-way or within TEWAs or UCSAs, then mulched and spread back over disturbed areas during final cleanup and restoration.

In forested areas, timber would be cut and cleared from the right-of-way and TEWAs. Clearing would follow seasonal timing restrictions as discussed in section 4.5 of this EIS. Merchantable timber would be removed and/or sold according to landowner stipulations. In general, ground-based skidding and cable (where feasible) logging methods would likely be the standard method; however, in some isolated rugged topographic areas with poor access, helicopter logging may be used. See additional discussion in section 4.4 of this EIS.

Following clearing, the right-of-way would be graded where necessary to create a reasonably level working surface to allow safe passage and operation of construction equipment. During grading, topsoil would be separated from subsoils in certain areas, and each would be stored in segregated piles within the construction right-of-way and TEWAs. Where topsoil would be segregated on non-federal lands,[36] Pacific Connector has requested 10 additional feet of TEWA for topsoil storage in addition to its nominal 95-foot-wide construction right-of-way in uplands. On BLM-managed and Forest Service lands, Pacific Connector would segregate topsoil in all wetlands according to its *Procedures*. Pacific Connector may segregate topsoil in other areas as determined from the results of biological surveys for federal Survey and Manage species and Region 6 sensitive species including moss, lichen and fungi. Where these species are identified within the construction right-of-way, Pacific Connector would consult with the BLM and Forest Service to determine if topsoil segregation in these areas is a feasible and appropriate mitigation or management measure to minimize impacts on these species.

Trenching

A rotary trenching machine, rock trencher, track-mounted backhoe, or similar equipment would be used to excavate a trench for the pipeline. Spoil excavated during trenching would be temporarily stockpiled to one side of the right-of-way adjacent to the trench. The depth of the trench would vary according to site-specific conditions and USDOT requirements in 49 CFR 192.327, which specifies that the minimum depth of cover must be:

- 30 inches in normal soil and 18 inches in consolidated (solid) rock for Class 1 locations; and
- 36 inches in normal soil and 24 inches in consolidated rock for Class 2, 3, and 4 locations, and under drainage ditches, public roads, and railroad crossings.

Pacific Connector states that it would strive to exceed USDOT depth requirements where possible and bury its pipeline up to 36 inches deep in Class 1 areas with normal soils and 24 inches deep in Class 1 areas with consolidated rock. The trench may be deeper at stream crossings with scour concerns based on Pacific Connector's study of channel migration and scour analysis.

In areas where bedrock is found within the pipeline trench depth, Pacific Connector would first attempt to dig the trench with specialized equipment, such as rock saws, or ripping using hydraulic hammers. If these methods are ineffective, blasting may be necessary to achieve the required trench depth. Pacific Connector has identified a high potential for blasting for about 100 miles of

[36] For example, topsoil salvaging would occur in areas occupied by Applegate's milkvetch, Kincaid's lupine, and Gentner's fritillary, per the *Federally-listed Plant Conservation Plan* (see section 4.6).

the proposed pipeline route. All blasting would be done by licensed contractors under the terms of applicable regulatory requirements. Pacific Connector produced a *Blasting Plan* as Appendix C of its POD. Blasting is further discussed in section 4.1 of this EIS.

Stringing, Bending, and Welding

After trenching, pipe sections would be trucked to the right-of-way and strung along the route, using side-boom tractors to unload the pipe from the flatbed trucks. A hydraulic bending machine would bend some pipe sections to fit the contour of the trench bottom, and in some locations pipe sections would be factory bent, or special pre-fabricated pieces would be used. A separate, trained crew of welders would weld the pipe sections together and place them on wooden skids adjacent to the trench. All welds would be visually inspected, nondestructively tested (using radiographic or equivalent methods), and repaired, if necessary. Line pipe, normally mill-coated prior to stringing, would require field applied coating at the welded joints prior to final inspection and the entire pipeline coating would then be inspected and repaired as needed.

Lowering-in and Backfilling

After welding and coating, the pipe would be lowered into the trench by side-boom tractors and excavators, after first inspecting the trench to ensure it is free of rocks or debris that could damage the pipe or the coating, and after adding padding such as sandbags at the bottom of the trench. To prevent water from the trench from entering wetlands or waterbodies, Pacific Connector would install permanent trench plugs, consisting of sandbags, foam, or bentonite, at the base of slopes adjacent to wetlands and waterbodies. Drain tiles crossed by the pipeline would be checked, and if damaged, they would be repaired before backfilling. Segregated topsoil, where applicable, would be replaced after backfilling the trench with subsoil. Following backfilling, a small crown of material would be left over the trench line to account for any future soil settling that might occur.

Hydrostatic Testing

After backfilling, the pipeline would be hydrostatically tested in accordance with USDOT regulations to ensure that is capable of operating at the MAOP. During the test, sections of the pipeline would be filled with water and pressurized. Should a leak or break occur during testing, the line would be repaired and retested until the specifications are achieved. Pacific Connector produced a *Hydrostatic Testing Plan* as Appendix M of its POD, which provides the location of the proposed hydrostatic test water withdrawal locations.

The pipeline would be tested in approximately 35 sections, each with varying lengths and water volume requirements. Pacific Connector would reuse test water from one section to the next as much as practical and minimize release between test sections (called cascading). The required volume of test water would range between approximately 16 to 60 million gallons depending on how much water would be reused by cascading. Water for hydrostatic testing would be obtained from commercial or municipal sources or from surface water right owners. If water for hydrostatic testing is acquired from surface water sources, Pacific Connector would obtain all necessary appropriations and withdrawal permits prior to construction, including permits through the OWRD. As part of this process, ODEQ and ODFW would review OWRD applications reviewed to evaluate potential impact on water quality and fish and wildlife and their habitats. Pacific

Connector would negotiate water appropriations with private owners in the year prior to construction.

Pumps used to withdraw surface water would be screened according to ODFW and NMFS standards to prevent entrainment of aquatic species. In addition, Pacific Connector included BMPs in its *Hydrostatic Testing Plan* to avoid the potential spread of aquatic invasive species and pathogens of concern. BMPs were developed in consultation with the BLM, Forest Service, the Center for Lakes and Reservoirs and Aquatic Bioinvasion Research and Policy Institute, and ODEQ.

Following testing the hydrostatic test water would be released from the pipeline test sections, potentially at each of the 35 test section breaks, or at fewer sites if cascading of water between test sections is used. Hydrostatic test water would be discharged in upland areas into erosion control devises typically constructed of hale bales and silt fence, in accordance with Pacific Connector's ECRP and the POD. Water discharged during testing would not be used to fill existing or proposed fire suppression sources (e.g., heli-ponds). Pacific Connector would apply for permission from the ODEQ prior to discharge of hydrostatic test water. Additional discussion of hydrostatic testing discharges can be found in section 4.3 of this EIS.

Dust Control

Fugitive dust[37] may be created by pipeline construction activities. To control dust, Pacific Connector would use water trucks to spray the right-of-way. Water for dust control would be obtained from commercial or municipal sources, and all appropriate approvals and/or permits would need to be obtained prior to withdrawal. Pacific Connector produced an *Air, Noise, and Fugitive Dust Control Plan* as Appendix B to its POD. See additional discussion of dust control measures in sections 4.3 and 4.12 of this EIS.

Cleanup and Permanent Erosion Control

After the pipeline is installed and the trench is backfilled, Pacific Connector would complete final grading, returning the right-of-way to its approximate original contours or to a stable contour in areas of steep slope. Fences, gates, drainage ditches, culverts, and other structures that may have been temporarily removed or damaged during construction would be permanently repaired, returned to their pre-construction condition, or replaced. All construction debris, including excess rock, would be removed from the right-of-way and placed in authorized disposal locations. On federal lands, site-specific crossing restoration plans would be implemented for perennial stream crossings. The right-of-way would be mulched, seeded, and revegetated in accordance with Pacific Connector's ECRP. Erosion control fabric would be used on streambanks.

Pacific Connector would install permanent erosion control devices consistent with the requirements of Section V.B. of FERC's *Plan* and as described in its ECRP. The permanent erosion control measures include trench breakers, slope breakers, and revegetation to stabilize disturbed areas. Pacific Connector would consult with the BLM, Forest Service, and Reclamation regarding the installation of permanent erosion control structures on federal lands, and with the

[37] Fugitive dust consists of small particles of dust suspended in the air, which are an inadvertent by-product of construction or other project-related activities.

NRCS regarding such structures on non-federal lands. Table 2.4.2.1-1 lists specifics from Pacific Connector's ECRP for the installation of slope breakers.

TABLE 2.4.2.1-1

Permanent Slope Breaker Spacing from Pacific Connector's ECRP a/

Slope	Highly Erosive Granitic Soils b/	Soils with Moderate or Low Potential for Erosion
0 to 5 percent	None required	None required
5 to 15 percent	100 feet	200 to 300 feet
15 to 30 percent	50 to 75 feet	75 to 100 feet
Greater than 30 percent	50 feet	50 feet

a/ Actual spacing would be determined at the time of installation based on site-specific topographic conditions on the right-of-way to ensure proper slope breaker construction and proper drainage to stable off-site areas. On the Umpqua National Forest between about MPs 109 and 110, where the alignment would cross the historic Thomason cinnabar claim group, waterbars would be installed at 50-foot intervals as recommended by the Forest Service.
b/ Granitic formations would be crossed by the pipeline between: MPs 79.1 to 80.5; MPs 81.6 to 82.2; MPs 87 to 88.8; MPs 97.0 to 101.2; MPs 103.0 to 105.4; and MPs 114.8 to 115.0.

Revegetation

All areas disturbed by construction, including the construction right-of-way, TEWAs, UCSAs, and contractor yards as necessary, would be restored and revegetated in accordance with Pacific Connector's ECRP. A seedbed would be established to a depth of up to four inches where necessary. Consistent with the FERC's *Plan*, if final grading occurs more than 20 days after pipe installation and backfilling, Pacific Connector would apply mulch on all disturbed areas prior to seeding. Based on recommendations provided to Pacific Connector by the Oregon State University Extension Service related to the fertilization rates for nitrogen fertilizer on new pasture seedlings, Pacific Connector would use a standard fertilization rate of 200 pounds per acre bulk triple-16 fertilizer on disturbed areas to be seeded. The Natural Resources Conservation Service (NRCS) did not recommend the addition of lime or other soil pH modifiers. Fertilizer would not be used in wetlands unless required by the land-managing agencies and would not be applied within at least 100 feet of flowing streams that have domestic use or support fisheries and would not be applied during heavy rains or high wind conditions.

It is expected that seeding would be timed to begin in August and could extend into the winter months at lower elevations. Disturbed areas would be seeded within six working days of final grading, weather and soil conditions permitting. Seeding may be done by broadcast methods, drilling, or hydroseeding. Broadcast seeding, using a mechanical broadcaster seeder, is the preferred method of seeding on steep slopes. After broadcast, the seedbed would be lightly dragged by chains or other appropriate harrows to cover the seeds thinly with soil. A drill seeder pulled by a plow may be used as an alternative to broadcast seeding in gently sloping areas. Hydroseeding would be done in accessible upland areas. Seed mixtures were determined in consultations with land-managing agencies and the NRCS. The seed mixtures are listed in Pacific Connector's ECRP and are further discussed in section 4.4 of this EIS. During right-of-way easement negotiations, private landowners may select their own seed mixtures other than those proposed for elsewhere along the pipeline route. The seed mixtures on BLM land were developed based on BLM Instruction Memo-2001-014, which specifies the use of native species, if possible. The POD has additional requirements for revegetation on federal lands.

Mulch would be applied on slopes were necessary to stabilize the right-of-way after seeding. Mulch would consist of native wood, certified weed-free straw, or hydromulch. The BLM and Forest Service have established ground cover standards and fuel loading requirements that are further discussed in section 4.4 of this EIS.

In forested lands, Pacific Connector would replant vegetation according to state and federal reforestation requirements. Reforestation efforts would occur in any given area the first winter/spring (between December and April) after the pipeline is installed in that area. On all forest lands crossed by the pipeline, trees would be replanted across the construction right-of-way up to 15 feet from either side of the pipeline centerline. In riparian areas, shrubs and trees would be replanted across the right-of-way for a width of 25 feet from the waterbody bank. Within Riparian Reserves, Pacific Connector would replant shrubs and trees to within 100 feet of the ordinary high-water mark (OHWM). A list of species to be replanted is included in Pacific Connector's ECRP, and revegetation is further discussed in section 4.4 of this EIS.

2.4.2.2 Special Pipeline Construction Techniques

Construction in rugged topography; across wetlands and waterbodies; through agricultural, residential, commercial, and industrial areas; at road and railroad crossings; and across existing buried pipelines and other utilities may require special construction techniques. These techniques are described below.

Rugged Topography

The Pacific Connector pipeline route would cross several mountain ranges, with steep and rugged topography (e.g., along the Coast Range and foothills between MPs 6.53R to 69.00, as well as between MPs 70 and 127.00). Through those mountains, the pipeline route would follow ridgelines, where feasible, to minimize the amount of cut and fill, and to avoid steep slopes, geologic hazards, and waterbody crossings, and to reduce erosion potential. In areas of steep slopes, two-tone construction techniques may be necessary, creating two step-wise level surfaces within the construction right-of-way (see Drawing #3430.34-X-0019 in Attachment C of Pacific Connector's ECRP, included with Resource Report 1 filed with Pacific Connector's application to the FERC). In addition, Pacific Connector's *Geological Hazards and Mineral Resources Report* identified geological hazards along the pipeline route. Site-specific mitigation measures for the crossing of some of these hazards are discussed in more detail in section 4.1.

During construction through rugged topography, Pacific Connector would consider the following factors:

- Identify adequate work areas to safely construct the pipeline.
- Provide a safe working grade.
- Utilize appropriate construction techniques for site-specific situations.
- Construct during the dry season as much as possible.
- Install temporary erosion control devices during construction.
- Install trench breakers, as appropriate, on slopes and near waterbody and road crossings.
- Backfill the trench immediately after pipe installation.
- Install permanent erosion controls soon after completing rough grading.

- Revegetate slopes with quick germinating seed mixtures.
- Mulch or install erosion control fabric on slopes, as necessary.
- Monitor and maintain the right-of-way as necessary to ensure stability.

Additionally, Pacific Connector's ECRP outlines procedures for fill on slopes exceeding a gradient of 3H:1V, including fill materials, slope preparation, and fill placement and compaction. The POD includes additional factors that would be considered on federal lands.

Waterbody Crossings

Construction of the Pacific Connector pipeline would affect approximately 352 waterbodies[38]. Waterbodies would be crossed in accordance with the FERC's *Procedures* and applicable permits or approvals from other agencies. Pacific Connector filed a *Wetland and Waterbody Crossing Plan* as Appendix BB of its POD. Crossings of perennial streams on NFS lands would be subject to site-specific plans that include construction restoration and monitoring requirements to ensure consistency with the Aquatic Conservation Strategy, and on BLM lands would be subject to the requirements of the BLM's 2016 RMPs. A more detailed discussion of impacts on waterbodies is provided in section 4.3 of this EIS.

TEWAs would be located more than 50 feet away from the edge of waterbodies where possible, and Pacific Connector has identified locations where site-specific conditions or other constraints prevent a 50-foot setback (see appendix E). Hazardous materials, chemicals, fuels, and oils would be stored at least 100 feet from the edge of waterbodies and wetlands (150 feet on federal lands).

Construction equipment would cross waterbodies on temporary bridges. The bridges would be designed to span the entire OHWM of the waterbody, wherever possible. Soil would not be used to stabilize bridges. In order to construct the temporary bridges, waterbody crossings may require one machinery pass through the waterbody without isolation measures in place to construct temporary equipment bridges. On BLM and NFS lands, all streams, whether wet or dry, would be crossed with (1) a bridge, (2) a temporary culvert, or (3) a low water ford with a rock mat.

All waterbodies would be crossed during the in-water work window recommended by the ODFW, or within an approved in-water work window developed through consultation with the ODFW, NMFS, COE, and FERC. Pacific Connector would attempt to cross intermittent streams and irrigation canals and ditches when they are dry, using standard upland cross-country construction methods. The standard depth of cover would be five feet below channel bottom of intermittent streams and ditches.

Pacific Connector would use the following methods to cross waterbodies with flowing water at the time of construction: diverted open cut, dry open cut, conventional bore, HDD, or Direct Pipe® (DP) technique. These are briefly described below.

<u>Wet Open-Cut Crossing</u>

No wet open-cut crossings are currently proposed for this Project. However, an open-cut crossing method may be required if all other crossing methods are attempted and fail. If an open cut crossing method is required, then additional permitting and impact analysis may be required before

[38] This value does not include the wetlands that would be affected by the Project.

the applicable agencies could allow the crossing to occur. A wet open-cut crossing method involves excavation of the pipeline trench across the waterbody with a backhoe-type excavator while water is still present in a waterbody. The excavators operate from one or both banks of the waterbody. Spoil excavated from the trench is placed above the OHWM for use as backfill, with the top 12 inches being segregated for use as the top layer of backfill. The pipe segment needs to be weighted, as necessary, to provide negative buoyancy prior to installation. Once the pipe is installed and the trench backfilled, the banks and stream bottom are restored to pre-construction contours and stabilized. However, as indicated above, this crossing method is not currently proposed, and would only be implemented if all other crossing methods (described below) fail, and may require additional analysis and permitting requirements.

<u>Diverted Open Cut Crossing</u>

Pacific Connector would use a diverted open cut for the eastern (second) crossing of the South Umpqua River at about MP 94.7. The river at this location is too wide for a typical dry crossing using either dam and pump or flume methods, and geotechnical studies indicate that subsurface conditions are not suitable for an HDD or conventional boring. At the proposed crossing location, the South Umpqua River channel is sufficiently flat, wide (175 feet bank to bank), and shallow (varying from a few inches to 15 feet deep), with flow slow enough to allow water to be diverted to one side while work is conducted on the opposite bank. Pacific Connector developed a site-specific plan for the eastern crossing of the South Umpqua River at MP 94.7.[39]

<u>Dry Open Cut</u>

Flume

The flume method would be used to cross streams less than 100 feet across. Water would be directed across the work area through one or more flume pipes. Sandbag and plastic sheeting would be used to support and seal the ends of the flume and to direct stream flow into the flume and over the construction area. Temporary dams at both the upstream (inlet) and downstream (outlet) sections of the flume would contain stream channel disturbance. After fish are salvaged from the confined area between the dams, water would be pumped out, through an upland dewatering structure, to create a dry work area for pipeline installation. Spoil from trenching would be stored in TEWAs located at least 10 feet away from the stream banks; with piles surrounded by silt fence. In-stream work (trenching, pipeline installation, and backfilling) would be conducted while the flume is in place, and the flume would be removed immediately after backfilling and bottom recontouring is completed. Details about stream fluming procedures were attached to the application filed with the FERC.[40]

Dam-and-Pump

The dam-and-pump method is an alternative dry construction technique that can be used to cross small or intermediate width waterbodies that are classified as coldwater fisheries. This method is preferred where the stream bottom is bedrock, and blasting may be necessary during trench excavation. Two temporary in-stream dams would be installed, with sandbags with plastic liner or other structures such as steel plates or water bladders. Stream flow would be diverted around the work area by pumping water through hoses. Intakes would be screened to prevent the entrainment of aquatic species. An energy-dissipation device would be used to prevent scouring

[39] See Appendix E.2 in Resource Report 2 as part of Pacific Connector's September 2017 application to the FERC.

[40] See Appendix C.2 in Resource Report 2 as part of Pacific Connector's September 2017 application to the FERC.

of the streambed at the downstream discharge location. The area between the dams would be dewatered, and the trench then excavated. Spoil would be stored in TEWAs located at least 10 feet from the banks; surrounded by silt fence. After pipeline installation and backfilling the dams would be removed and stream banks restored and stabilized. Pacific Connector would cross streams using the dam and pump method during the ODFW recommended in-water work windows. Details about dam and pump procedures were attached to the application filed with the FERC.[41]

Conventional Bore

Pacific Connector proposes to use conventional bore methods to cross under the Medford Aqueduct at MP 133.4, and all Reclamation water conveyance facilities (canals, laterals, and drains) associated with the Klamath Project. During a standard boring operation, pits are excavated on both ends of the bore, and the pipe fabricated and installed horizontally from one pit to the other beneath the feature being crossed. The walls of the bore pits may be supported by trench boxes or metal sheet piling. If groundwater seeps in to the bore or bore pits, a dewatering system would need to be used.

When crossing irrigation canals associated with Reclamation's Klamath Project, Pacific Connector committed to complying with Reclamation's Engineering and O&M Guidelines for Crossings – Bureau of Reclamation Water Conveyance Facilities (Canals, Pipelines, and Similar Facilities) unless otherwise described in the *Klamath Project Facilities Crossing Plan* (Appendix O of its POD). All crossings would require Professional Engineer–stamped design drawings approved by Reclamation prior to installation.

Horizontal Directional Drilling

Pacific Connector proposes to use the HDD method to cross under the Coos Bay Estuary (MPs 0.3–1.0 and 1.5–3.0) and three major waterbodies (Coos River at MP 11.1R; Rogue River at MP 122.7; and Klamath River at MP 199.4). This technique involves drilling a pilot hole under the feature being crossed, then enlarging that hole through successive reaming until large enough to install the pipeline. High pressure drilling fluids, usually consisting of a slurry made of bentonite clay mixed with water, would be jetted under pressure through the inside of the drill pipe to the drill head to advance the hole, and would then flow back to the drill entry point along annular space between the outside of the drill pipe and the drilled hole. Pipe sections long enough to span the entire crossing would be staged and welded along the construction work area on the opposite side of the waterbody, hydrostatically tested, and then pulled through the drilled hole. Upon completion of HDDs, the drilling mud returns would be hauled off-site and disposed of at an approved disposal facility in accordance with all applicable federal and state regulations. The right-of-way between the entry and exit hole of an HDD would generally not need to be cleared or graded, except for the area of the guide wires, and direct impacts on the waterbody and adjacent riparian vegetation would be avoided.

Pacific Connector prepared an HDD Feasibility Analysis.[42] That study showed that the HDD under the Coos Bay Estuary could be completed in two sections with a total length of about 8,970 feet and a maximum depth of about -190 feet; the HDD under the Coos River would be about

[41] See Appendix D.2 in Resource Report 2 as part of Pacific Connector's September 2017 application to the FERC.

[42] Attached as Appendix G.2 of Resource Report 2 as part of Pacific Connector's 2017 application to the FERC.

1,602 feet long with a maximum depth of -65 feet; the HDD under the Rogue River would be about 3,050 feet long with a maximum depth of -76 feet; and the HDD under the Klamath River would be about 2,309 feet long with a maximum depth of -71 feet. In case of an HDD failure, or the unanticipated release of drilling mud, Pacific Connector prepared a contingency plan.[43]

Direct Pipe Technology

DP technology is a trenchless construction method that can be used to install pipelines underneath rivers or roads without surface impacts. It is a combination of a micro-tunneling process and HDD. DPs are completed using an articulated, steerable micro-tunnel boring machine (MTBM) mounted on the leading end of the pipe or casing. Bentonite slurry is used to increase lubrication and advance the MTBM. The pipeline is pre-fabricated and welded in sections to the back of subsequent sections as the MTBM advances.

Pacific Connector proposes to use DP technology to install its pipeline under the western crossing of the South Umpqua River at about MP 71.3 and the associated crossings under I-5, Dole Road, and the Central Oregon & Pacific Railroad. This DP crossing would be about 1,680 feet long, with a maximum depth of -90 feet. Further details are available in Pacific Connector's I-5/South Umpqua River Direct Pipe Feasibility Evaluation and a separate site-specific crossing plan.[44]

Wetland Crossings

Pacific Connector would construct the pipeline across wetlands in accordance with the FERC's *Procedures*. The construction right-of-way through wetlands would be limited to a 75-foot width or less, where possible, and TEWAs would be located at least 50 feet away from wetlands, except where topographic constraints prevent this. Grading and stump removal in wetlands would only occur over the trench. Silt fence and straw bales would be installed at the edges of the construction right-of-way through wetlands. Trench plugs would be put in where the pipeline enters and exits wetlands. In saturated wetlands, Pacific Connector may use low ground weight equipment operating off pre-fabricated wooden mats. Pipe stringing in saturated wetlands may be done next to the trench or in adjacent TEWAs. If the wetland is flooded, Pacific Connector may use "push-pull" or "float" techniques. Pipeline installation through wetlands is further discussed in section 4.3 of this EIS.

Agricultural and Residential Areas

The FERC's *Plan* requires topsoil segregation in all residential areas, cultivated or rotated agricultural lands, pasture, and hayfields, or where requested by landowners. In these areas, topsoil would be stripped and segregated from either the full construction right-of-way, or over the trench line and subsoil storage area. Pacific Connector identified areas, in addition to most wetlands, where it intends to salvage and segregate topsoil along the pipeline route (see table D-4 in appendix D). Where topsoil segregation is proposed, Pacific Connector has requested 10 feet of TEWA in addition to the 95-foot construction right-of-way to stockpile segregated soils. Agricultural lands are further discussed in section 4.2 of this EIS and residential lands in section 4.7.

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[43] Attached as Appendix H.2 to Resource Report 2 as part of Pacific Connector's 2017 application to the FERC.

[44] The former is attached as Appendix J.2 and the latter as Appendix E.2 to Resource Report 2 as part of Pacific Connector's 2017 application to the FERC.

Another requirement of the FERC's *Plan* is that excess rock should be removed from at least the top foot of soil in all actively cultivated or rotated cropland, pasture, hayfields, and agricultural lands. Pacific Connector would use rock pickers where necessary to remove excess rocks from these areas during cleanup. Rocks would be removed consistent with the size, density, and distribution in areas adjacent to the right-of-way. Excess rock would be disposed of in existing rock quarries and permanent disposal sites (see table D-7 in appendix D). Pacific Connector also attached an *Overburden and Excess Material Disposal Plan* as Appendix Q to its POD.

The FERC's *Plan* requires that soils in agricultural and residential areas be tested for compaction after construction, and any compaction should be alleviated. According to Pacific Connector's ECRP, during restoration activities soil compaction would be relieved by regrading and scarifying. This may include ripping and chisel plowing up to 18 inches deep.

Pacific Connector would work with individual landowners in agricultural areas to determine how the right-of-way would be restored where the pipeline would cross cropland, orchards, nurseries, or vineyards. If requested by the landowner, the landowner would restore the agricultural land and Pacific Connector would compensate the landowner. In residential areas, Pacific Connector would restore disturbed lawns, ornamental shrubs, gardens, and other landscape features in accordance with their agreement with the landowner. A contractor familiar with local horticultural or landscape practices would do the restoration work in residential areas, or Pacific Connector may choose to compensate a landowner to restore their property.

Pacific Connector has developed site-specific construction mitigation plans for residences within 25 feet of work areas. Some of the typical measures to be taken in residential areas include notification of landowners, limiting hours of construction, dust control, maintaining access, fencing, reducing the width of the right-of-way to increase the buffer to the pipeline, and replacing landscaping (see section 4.7 of this EIS).

Road, Railroad, and Utility Crossings

The Pacific Connector pipeline would include multiple road and railroad crossings. Conventional bores are typically used to cross under railroads, with DP and HDD technology proposed for one crossing each (see table D-2 in appendix D). Roads would either be bored or open cut. At least five feet of cover would be maintained over pipeline crossings of paved county, city, and state roads, as well as railroad crossings.

Pacific Connector would obtain all necessary permits from applicable county, state, or federal land-managing agencies for public roads to be crossed, and permission to cross private roads from the landowners. Pacific Connector produced a TMP for federal lands (as Appendix Y to the POD) and a TMP for non-federal lands.[45] Transportation management is discussed in more detail in section 4.10 of this EIS.

Pacific Connector would endeavor to notify agencies and private landowners at least seven days in advance of any road work or closures caused by pipeline construction activities. During an open cut crossing, Pacific Connector would try to keep one lane of the road open for traffic, with detours around construction, plating over the open trench, or other methods. However, in some situations

[45] Attached as Appendix F.8 in Resource Report 8 as part of Pacific Connector's September 2017 application to the FERC.

the road may have to be closed for a day when the pipeline would be installed across it. Where road closures occur, Pacific Connector would provide access around the construction site for local residents and emergency vehicles. Advanced signage would be used to provide notice of construction activities. In addition, Pacific Connector would utilize traffic control measures, such as signs, lights, barriers, and flaggers to ensure public safety and provide for efficient movement of traffic through or around the construction area, and to protect workers.

The Pacific Connector Pipeline would cross numerous existing utilities, including other pipelines, powerlines, and cables. Prior to construction, Pacific Connector would contact the local "One Call" or "Call Before You Dig" system to determine the location of utilities to be crossed and these utility crossings would then be marked in the field during pre-construction surveys. Pacific Connector would coordinate with each utility owner/operator to design crossings. In most instances, the new pipeline would have to be installed beneath the existing buried utility to maintain the necessary depth of cover.

2.4.2.3 Aboveground Facility Construction

Aboveground sites would be cleared and graded as applicable to accommodate the planned facilities. Excavation would be performed as necessary to accommodate the new reinforced concrete foundations for meter and compressor station equipment. The meter and compressor station equipment would be shipped to the site by truck. All components in high-pressure natural gas service would be strength tested prior to placing in service. Before being placed in service, all controls and safety equipment and systems would be checked and tested. MLVs would be installed within Pacific Connector's operational easement. The installation of the MLVs would meet the same standards and requirements established for pipeline construction.

2.5 CONSTRUCTION SCHEDULE AND WORKFORCE

The date for the start of construction would depend on completion of all required environmental and safety reviews and receipt of all necessary permits, approvals, and Commission authorization. Jordan Cove states that construction of the LNG terminal and slip we be expected to take five years. All in-water work for the terminal, including placement of material for the MOF, dredging, and work required to remove the berm separating the slip and the access channel would occur during an in-water work window between October 1 and February 15. Jordan Cove estimates that the construction workforce would average about 1,020 workers with a peak of about 2,000 workers occurring in year 3 of construction.

Pacific Connector states that construction and restoration of the pipeline and associated facilities would take place over the course of five years. Early works, including the two HDD crossings of Coos Bay, would begin in year one. Some forest clearing along the pipeline would beginning during year 2. Mainline pipeline and aboveground facility construction would take place during years 3 and 4, with the pipeline being placed into service by about the middle of year 4. Right-of-way restoration would begin during year 4 and continue into year 5. The total workforce during construction of the pipeline and associated facilities is estimated to range between about 88 and 4,242 workers, with an average of about 886 workers, with the peak occurring during summer and fall of year 1 of mainline construction (see section 4.9).

2.6 ENVIRONMENTAL INSPECTION, AND COMPLIANCE MONITORING

2.6.1 Jordan Cove Environmental Inspection Program

During construction, Jordan Cove and Pacific Connector would provide contractors with all Project design documents, including environmental alignment sheets, and copies of all applicable federal, state, and local permits. Jordan Cove would provide environmental training before a contractor or Jordan Cove employee steps out to a work area, and training records would be kept to demonstrate training activities. Numerous individuals, including company Chief Construction Inspectors, would supervise construction activities. Environmental Inspectors (EI) would be hired to ensure compliance with approved construction methods and all applicable permit and consultation requirements and conditions.

EIs would have peer status with all other activity inspectors along with the authority to stop activities that violate the environmental conditions of the FERC authorization, other permits, or landowner/land managing agency requirements, and to order appropriate corrective actions. The EIs would also be responsible for advising the chief construction inspector when conditions (such as wet weather) make it advisable to restrict construction activities. EI duties would include maintaining status reports and training records.

The EI's responsibilities would include:

- ensuring compliance with the requirements of the Jordan Cove and Pacific Connector's *Plan* and *Procedures* (including modifications), the environmental conditions of the section 3 and Certificate authorization, the mitigation measures proposed by the applicant (as approved and/or modified by FERC's authorization), other environmental permits and approvals, and environmental requirements in landowner easement agreements;
- verifying that the limits of authorized construction work areas and locations of access roads are properly marked before clearing;
- verifying the location of signs and highly visible flagging marking the boundaries of sensitive resource areas, waterbodies, wetlands, or areas with special requirements along the construction work area;
- identifying erosion/sediment control and soil stabilization needs in all areas;
- ensuring that the location of dewatering structures and slope breakers would not direct water into known cultural resources sites or locations of sensitive species;
- verifying that trench dewatering activities do not result in the deposition of sand, silt, and/or sediment near the point of discharge into a wetland or waterbody. If such deposition is occurring, the dewatering activity would be stopped and the design of the discharge would be changed to prevent reoccurrence;
- identifying, documenting, and overseeing corrective actions, as necessary to bring an activity back into compliance; and
- keeping records of compliance with the environmental conditions of the FERC Certificate, and the mitigation measures proposed by the Project sponsor in the application submitted to the FERC, and other federal or state environmental permits during active construction and restoration.

2.6.2 FERC Environmental Compliance Monitoring

During construction of the Project, third-party Compliance Monitors representing the FERC would be present on a full-time basis to inspect construction procedures and mitigation measures and provide regular feedback on compliance issues to the FERC and Jordan Cove and Pacific Connector's environmental inspection team. Construction progress and environmental compliance would be tracked and documented by the Compliance Monitors. The Compliance Monitors would report directly to a Compliance Manager who would report directly to the FERC Project Manager. Other objectives of the third-party Compliance Monitoring program would be to facilitate the timely resolution of compliance issues in the field; provide continuous information to FERC regarding noncompliance issues and their resolution; and review, process, and track construction-related variance requests. Changes to previously approved mitigation measures, construction procedures, and construction work areas due to unforeseen or unavoidable site conditions would require various levels of regulatory approval, with the delegation of some authority to the third-party Compliance Monitors. FERC would also receive regular construction status reports filed by Jordan Cove and conduct periodic field inspections during construction and restoration of the Project. FERC would have the authority to stop any activity that violates an environmental condition of the FERC authorization issued to Jordan Cove. Other federal, state, and local agencies could also monitor the Project to the extent determined necessary by the agency.

2.6.3 Monitoring by Land Managing Agencies on Federal Lands

Monitoring is an essential element of project implementation (CEQ 2011). If the BLM issues a Temporary Use Permit and a Right-of-Way Grant for the Pacific Connector Pipeline Project, those authorizations would provide the terms and conditions for construction, operation, maintenance, and eventual termination of the facility on federal public lands. As cooperating agencies with jurisdiction by law for activities that occur on lands they administer, the BLM, Forest Service, and Reclamation have a responsibility to monitor implementation of the Pacific Connector Pipeline Project to assure that the terms and conditions of the Right-of-Way Grant are carried out (43 CFR 2885.24). This monitoring would be in addition to the Environmental Compliance Monitoring carried out by third-party Compliance Monitors representing the FERC.

CEQ regulations for NEPA (40 CFR 1505.3) also provide that a monitoring and enforcement program should be adopted as part of the decision to implement the Project. Many of the requirements of the POD that are a part of the BLM Right-of-Way Grant on federal lands are project design measures that reduce the environmental consequences of the Project on-site. The Forest Service has also proposed off-site compensatory mitigation plans (see section 2.1.5). In addition to monitoring implementation of the Temporary Use Permit and the Right-of-Way Grant, the BLM, Forest Service, and Reclamation also have a responsibility to monitor authorized actions, whether they are project design features described in the POD or off-site mitigation measures included in Forest Service mitigation plans. As needed, agency representatives of the BLM, Forest Service, and Reclamation would participate in the monitoring process to assure that agency priorities are accomplished and agency obligations are fulfilled. Reclamation agency representatives would be on-site during all crossings of Reclamation facilities. Reclamation would require a minimum 48-hour notice for each crossing to ensure that Reclamation agency representatives are able to be on-site during the crossing installations.

Pacific Connector worked closely with the BLM and Forest Service to minimize impacts on federal lands during the proposed pipeline route selection and construction footprint design process. In developing the POD interdisciplinary teams of the BLM and Forest Service worked with Pacific Connector to implement project design features that would reduce impacts on LSR, Riparian Reserves, soil resources, water quality, recreation, and other resources as described in the POD attachments below. Additional discussion on the steps taken to avoid or reduce impacts on LSR and Riparian Reserves is included in appendix F. The POD developed by Pacific Connector is part of the Right-of-Way Grant application and includes monitoring requirements to ensure that impacts from construction and operation of the Project are minimized and that objectives of the respective land management plans are accomplished. The POD includes 28 attachments, 27 of which were developed in cooperation with the BLM, Forest Service, and Reclamation (the remaining attachment is the Environmental Alignment Sheets for the Project). These attachments are individual plans detailing Pacific Connector's proposed method for construction and operation of the proposed pipeline on federal lands. A description of the POD is summarized in table 2.6.3-1. Ongoing discussion between the applicant and agencies may result in refinements to the POD. Because the proposed actions specific to federal lands include amendments to LMPs, the regular monitoring and reporting programs of the respective BLM RMPs and Forest Service LRMPs would be used in addition to those identified in the POD.

TABLE 2.6.3-1

Pacific Connector's Plan of Development

Appendix	Appendix Title	Description
A	Aesthetics Management Plan for Federal Lands	The purpose of this Plan is to outline methods that Pacific Connector would implement to ensure compliance with agency land and resource management plans pertaining to visual and aesthetic resources within the Pipeline Project area. This Plan establishes goals for managing visual resources as they relate to construction, reclamation and management of the Pacific Connector Pipeline Project and describes actions to be taken by Pacific Connector to minimize impacts on visual resources.
B	Air, Noise and Fugitive Dust Control Plan	This Plan describes the practices that would be implemented during construction of the Pacific Connector Pipeline Project to minimize or control the potential impacts on air quality or the impacts caused by noise or fugitive dust on federal lands crossed by the pipeline project. The minimization and control measures described in this plan are also important to protecting the safety of construction workers, visiting agency personnel, and the general public that may use the public roads during the construction activities or reside near the construction right-of-way.
C	Blasting Plan	The purpose of this Blasting Plan is to provide guidelines for the safe use and storage of blasting materials proposed for use during construction of the Pacific Connector Pipeline Project. This Blasting Plan is intended to help ensure the safety of construction personnel, the public, nearby facilities and sensitive resources.
D	Communication Facilities Plan	The purpose of this plan is to describe the construction, modification, operation and maintenance of communication facilities necessary for the operation of the Pacific Connector Pipeline Project on federal lands managed by the BLM and the Forest Service. The communication facilities are necessary to enable communications between facilities constructed in conjunction with the pipeline project and the Pacific Connector gas control center.
E	Contaminated Substances Discovery Plan	The purpose of the Contaminated Substances Discovery Plan is to outline practices to protect human health and worker safety and to prevent further contamination in the event of an unanticipated discovery of contaminated soil, water, or groundwater during construction of the Pacific Connector Pipeline Project.

TABLE 2.6.3-1 (continued) **Pacific Connector's Plan of Development**		
Appendix	**Appendix Title**	**Description**
F	Corrosion Control Plan	Pacific Connector would implement methods to protect the pipeline system from external, internal, and atmospheric corrosion in accordance with USDOT 49 CFR 192. Corrosion Control is critical to public safety and the safe/reliable operation of the pipeline. This plan will illustrate methods used to identify the corrosion control needs for the pipeline project, as well as methods to provide the required protection and mitigation.
G	Environmental Briefings Plan	The purpose of this Plan is to outline the environmental reporting procedures, briefings, or notifications that Pacific Connector would provide to the federal land-managing agencies prior to construction, during construction, post construction, and during operations of the Pacific Connector Pipeline. Detailed compliance management documents would be developed based on the conditions in the permits/authorizations issued for the project and would be provided to the federal land-managing agencies prior to construction.
H	Emergency Response Plan	The purpose of this Emergency Response Plan is to identify the standards and criteria that Pacific Connector would follow to minimize the hazards during pipeline operation resulting from a gas pipeline emergency in accordance with the Pipeline and Hazardous Materials Safety Administration's regulations in 49 CFR 192.615 and 192.617.
I	Erosion Control and Revegetation Plan	The Erosion Control and Revegetation Plan outlines the erosion control and revegetation procedures that Pacific Connector would utilize during construction of the pipeline to minimize erosion, sedimentation and enhance revegetation success on all lands crossed by the pipeline.
J	Plant Conservation Plan	The purpose of this plan is to describe the conservation measures that Pacific Connector would implement to minimize the potential effects on federally-listed plants, including one plant identified as a species of concern, that have been documented during Pipeline project survey efforts to-date, or that may be documented during subsequent survey efforts prior to ground-disturbing activities. The plan outlines avoidance, minimization, propagation, restoration and other mitigation measures for federally-listed plant species.
K	Fire Prevention and Suppression Plan	The Fire Prevention and Suppression Plan describes the measures to be used by Pacific Connector and its contractors (Contractor) to ensure that fire prevention and suppression techniques are carried out in accordance with federal, state and local regulations.
L	Fish Salvage Plan	The fish salvage plan has been developed to minimize adverse effects on Endangered Species Act (ESA) listed salmonids (Southern Oregon/Northern California Coast coho salmon and Oregon Coast coho salmon), non-listed salmonids (Chinook, steelhead, cutthroat trout) and ESA-listed catostomids (Lost River sucker and shortnose sucker) during construction of the Pacific Connector Pipeline Project as well as other aquatic organisms.
M	Hydrostatic Test Plan	In accordance with USDOT 49 CFR Part 192, Pacific Connector would strength test (or hydrostatic test) the pipeline system (in sections) after it has been lowered into the pipe trench and backfilled. The purpose of the hydrostatic test is to verify the manufacturing and construction integrity of the pipeline before placing it in service to flow natural gas.
N	Integrated Pest Management Plan	This plan would provide Pacific Connector's management and staff with the necessary BMPs to address the control of noxious weeds, invasive plants, forest pathogens, and soil pests across the route of the Pipeline. The BMPs have been created to minimize the potential spread of invasive species and minimize the potential adverse effects of control treatments.
O	Klamath Project Facilities Crossing Plan	The Plan identifies the locations within Klamath County, Oregon where the Pacific Connector alignment crosses facilities within the Klamath Project that are administered by the Klamath Basin Area Office of Reclamation and the methods proposed to construct the pipeline project across Reclamation facilities.
P	Leave Tree Protection Plan	The purpose of this plan is to describe the measures that would be implemented during construction of the Pacific Connector to identify, conserve and protect selected trees (living and snags) within or along the edges of the pipeline project's certificated work limits.
Q	Overburden and Excess Material Disposal Plan	The purpose of this Plan is to identify the proposed locations on federal lands that may be used for the permanent and temporary storage of excess rock, timber, and spoil generated during timber removal and pipeline construction of the Pacific Connector Pipeline Project.

TABLE 2.6.3-1 (continued) **Pacific Connector's Plan of Development**		
Appendix	**Appendix Title**	**Description**
R	Prescribed Burning Plan	The Prescribed Burning Plan describes the protocols that Pacific Connector would follow to obtain appropriate agency authorization on all lands (federal, state and private) crossed by the pipeline, where it is necessary to dispose of forest slash by burning. This plan also outlines the appropriate BMPs that would be utilized to safely conduct slash burning operations.
S	Recreation Management Plan	The purpose of the Plan is to assist in the management of existing recreation resources on lands within the pipeline project area or impacted by the pipeline. This Plan establishes goals for managing recreation in the vicinity of the pipeline and describes actions to provide continued safe access, prevent resource damage, and to avoid potential user conflict.
T	Right-of-Way Marking Plan	The purpose of this Plan is to identify the survey standards and types of survey markings that would be used by Pacific Connector on federal lands during the pre-construction, construction, and operational phases of the pipeline project.
U	Right-of-Way Clearing Plan	The purpose of this Right-of-Way Clearing Plan (Plan) is to outline the methods that Pacific Connector would implement during timber (and other vegetation) removal within the construction right-of-way and TEWAs. This Plan was developed utilizing applicable BMP compliance protocols outlined in the Erosion Control and Revegetation Plan for the pipeline project.
V	Safety and Security Plan	The purpose of this plan is to describe safety standards and practices that would be implemented to minimize health and safety concerns related to the construction of the pipeline project.
W	Sanitation and Waste Management Plan	The purpose of the Plan is to outline the procedures that would be implemented by Pacific Connector and its contractors to manage sanitation and waste materials during construction and operations of the Pacific Connector Pipeline Project.
X	Spill Prevention, Containment, and Countermeasures Plan	The Plan identifies measures to be taken by Pacific Connector and its contractors to prevent, contain and respond to spills during the construction of the pipeline project.
Y	Transportation Management Plan	The purpose of the plan is to cover all pipeline project transportation-related activities involving Agency-jurisdiction roads or rights-of-way and identifies ongoing cooperative procedures.
Z	Unanticipated Discovery Plan	This plan provides the procedures Jordan Cove, Pacific Connector, its personnel and consultants would follow in the event that unanticipated discoveries of historic properties, archaeological objects, archaeological sites, or human remains are made during the construction and operation of the Project.
AA	Environmental Alignment Sheets	A set of photo-based maps depicting the centerline and construction right-of-way at a scale of 1":200' and the associated environmental features and requirements.
BB	Wetland and Waterbody Crossing Plan	The Plan outlines the construction methods, restoration procedures, and BMPs that Pacific Connector would utilize during construction of its pipeline. The measures set out in this plan would be employed to avoid, minimize, and restore potential impacts associated with wetland and waterbody crossings, as well as to minimize potential effects on aquatic resources.

2.7 OPERATION AND MAINTENANCE PROCEDURES

2.7.1 LNG Terminal Facilities

Jordan Cove would operate and maintain its facilities in compliance with 49 CFR 193, 33 CFR 127, National Fire Protection Association (NFPA) 59A, and other applicable federal and state regulations. Before commencing operation of the LNG terminal, Jordan Cove would prepare and submit for approval operation and maintenance manuals that address specific procedures for the safe operation and maintenance of the LNG storage and processing facilities. Jordan Cove would also prepare an operations manual that addresses specific procedures for the safe operation of the ship unloading facilities in accordance with 33 CFR 127.305. Operating procedures would address normal operations as well as safe startup, shutdown, and emergency conditions.

All operations and maintenance personnel at the terminal would be trained to properly and safely perform their jobs. Jordan Cove states that operators would meet all the training requirements of the Coast Guard, USDOT, ODOE, Oregon State Fire Marshall, Coos Bay, Coos County Fire Department, and other regulatory entities. The SORSC would provide on-site resources and assets, including a Sherriff's office and fire department.

The LNG terminal and related facilities would be staffed with about 180 full-time equivalent employees working three shifts, so there would be coverage 24 hours a day, 365 days a year. The terminal's full-time staff would conduct routine maintenance and minor overhauls. Major overhauls and other major maintenance would be handled by bringing in maintenance personnel specifically trained to perform the maintenance. All scheduled and unscheduled maintenance would be entered into a computerized maintenance management system.

2.7.2 Pipeline and Associated Aboveground Facilities

Pacific Connector would test, operate, and maintain the proposed facilities in accordance with USDOT regulations provided in 49 CFR Part 192; the FERC's guidance at 18 CFR 380.15; rules and regulations promulgated by PHMSA; and maintenance provisions of its ECRP. The pipeline right-of-way would be clearly marked where it crosses public roads, waterbodies, fenced property lines, and other locations as necessary. All pipeline facilities would be marked and identified in accordance with applicable regulations.

The aboveground facilities would be inspected for the life of the pipeline at intervals that meet USDOT requirements. Pipeline personnel would perform routine checks of the facilities, including calibration of equipment and instrumentation, inspection of critical components, and scheduled and routine maintenance of equipment. Safety equipment, such as pressure-relief devices, fire detection and suppression systems, and gas detection systems, would be tested for proper operation. Corrective actions would be taken for any identified problem. Vegetation at aboveground facilities would be periodically maintained using mowing, cutting, trimming and the selective use of herbicides.

To facilitate periodic pipeline corrosion/leak surveys, a corridor centered on the pipeline and up to 10 feet wide would be maintained in an herbaceous state, with no vegetation greater than 6 feet in height. Trees that are located within 15 feet of the pipeline and that are greater than 15 feet in height would be cut and removed from the right-of-way. Vegetation within the permanent easement would be periodically maintained by mowing, cutting, and trimming (either by mechanical or hand methods). Maintenance activities are expected to occur approximately every three to five years depending on the growth rate. During maintenance, trimmed or cut vegetation would be scattered across the operational easement to naturally decompose and to discourage off-highway vehicle (OHV) traffic. Occasionally, where site conditions allow, chipping of this material may also occur. Herbicides would not be used for brush control; however, if noxious weed infestation occurs on the permanent easement, selective use of herbicides would be used to control these species. Herbicides would not be used in or within 100 feet of a waterbody's mean high-water mark.

Pacific Connector would employ a permanent staff of 15 employees, including six operations technicians in the Coos Bay pipeline office in Coos County, five employees in the Medford pipeline office in Jackson County, and four employees at the compressor station near Malin in Klamath County. In addition, the pipeline and aboveground facilities would be monitored all the time using Pacific Connector’s gas control communication system and radio towers reporting back to a command center at the Williams’ office in Salt Lake City, Utah.

3.0 ALTERNATIVES

As required by NEPA, Commission policy, and in cooperation with the COE, BLM, Forest Service, Reclamation, and the other NEPA cooperating agencies, we identified and evaluated reasonable and practical alternatives to the facilities (and locations) proposed by Jordan Cove and Pacific Connector as described in section 2.1 of this document. Specifically, and consistent with the Purpose and Need of the Project as described in section 1.2, we evaluated the No Action Alternative, System Alternatives, LNG Terminal Site Alternatives, and Pipeline Alternatives (including Federal Lands Alternatives and Compressor Station Alternatives). To satisfy its responsibilities per the CWA Section 404(b)1(1) Guidelines, the COE also evaluated whether alternatives would be practicable.[46]

Our evaluation of alternatives is based on Project-specific information provided by the applicants, affected landowners, and other concerned parties; publicly available information; our consultations with federal and state resource agencies; federally recognized tribes; and our expertise and experience regarding the siting, construction, and operation of LNG export facilities and interstate natural gas transmission facilities and their potential impact on the environment. In evaluating alternatives, we considered and addressed, as appropriate, the comments provided to the Commission regarding possible alternatives.

As described in section 1.4, the Commission received thousands of letters and comments expressing concern about the Project. Many of these letters requested that we evaluate alternatives to the Project. In response to these comments, we required the applicants to provide additional environmental information, requested they assess the feasibility and practicability of alternatives as proposed by the commenters (including other federal agency alternatives requests); conducted site visits and field investigations; met with affected landowners and local representatives and officials; and consulted with federal and state regulatory agencies and tribes. All comments concerning alternatives were considered, and many, but not all, of these alternatives are included in this analysis. Not included in this analysis is an assessment of renewable energy resources as an alternative to the Project. Renewable energy resources include, but are not limited to, wind, solar, and hydroelectric power. These resources are alternatives to electrical power production. Because the Project's purpose is to transport natural gas across southern Oregon and convert it to LNG for export to overseas markets, not generate electricity, the development and use of renewable energy resources would not meet the purpose of the Project, and therefore is not a reasonable or practicable alternative to the proposed action and is not considered further in this analysis.

The purpose of this analysis is to satisfy NEPA requirements that agencies take a "hard-look" at a project's impacts, inform the public of these impacts, and determine whether the adoption and implementation of an alternative(s) would be preferable to the proposed action. As described below, we consider numerous reasonable and practicable alternatives to the proposed action. In consultation with the NEPA cooperating agencies, using our collective professional judgment, and through environmental comparison, each alternative is considered until it is clear that the

[46] When making a decision on whether to issue a permit for the Project, the COE must consider whether the proposed Project represents the least environmentally damaging practicable alternative pursuant to the CWA section 404(b)(1) guidelines. The term "practicable" means available and capable of being done after taking into consideration cost, existing technology, and logistics in light of the overall purpose of the Project. The COE may only permit discharges of dredged or fill material into waters of the U.S. that represent the least damaging practicable alternative, so long as the alternatives do not have other significant adverse environmental consequences.

alternative would not satisfy one or more of the evaluation criteria (see below). Furthermore, it is important to note that the Commission's role under the NGA is to review applications filed with it, not to develop a general plan for energy infrastructure. Thus, comments suggesting that the Commission require applicants to pursue alternatives that are substantially different than their proposals will be considered, but may not result in a reasonable alternative that would be addressed in our alternatives analysis.

Evaluation Process

The purpose of this evaluation is to determine whether an alternative would be preferable to the proposed action. To determine if an alternative would be preferable to a proposed action, we generally evaluate an alternative using three criteria:

1. does the alternative meets the stated purpose of the project;
2. is technically and economically feasible and practical; and
3. offers a significant environmental advantage over a proposed action.

The alternatives were reviewed against the evaluation criteria in the sequence presented above. If the alternative would not meet the Project's purpose, or is not feasible or practical, we did not compare environmental information to determine if the third evaluation criterion was satisfied.

The first consideration for including an alternative in our analysis is whether or not it could satisfy the stated purpose of the Project. As described previously, the purpose and need of the Jordan Cove Project is to export natural gas supplies derived from existing interstate natural gas transmission systems to overseas markets; and the purpose and need of the Pacific Connector Project is to connect the existing interstate natural gas transmission systems of GTN and Ruby with the proposed Jordan Cove LNG terminal. Alternatives that do not achieve these purposes cannot be considered as feasible or reasonable alternatives to the Project. Furthermore, the Commission cannot simply ignore a project's purpose and substitute a purpose it or a commenter deems more suitable.

The only location where the GTN and Ruby pipeline systems interconnect is near Malin, Oregon. Malin is a major natural gas trading hub providing access to multiple supply basins in the United States and Canada. GTN and Ruby have a combined natural gas transportation capacity of 3.8 Bcf/d at Malin providing access to diverse and abundant supplies to support Jordan Cove's export operations. Therefore, in the alternatives analyses below, all pipeline alternatives originate near Malin, Oregon. All of the alternatives considered here, except the No Action Alternative, are able to meet the Project purpose stated in section 1.2 of this EIS.

Not all conceivable alternatives are technically and economically feasible and practical. Technically feasible alternatives, with exceptions, would generally involve the use of common LNG facility and pipeline construction methods. Economically practical alternatives would result in an action that generally maintains the price competitive nature of the proposed action. An alternative that would involve the use of a new, unique, or experimental construction method(s) may be technically feasible, but not economically practical. Generally, we do not consider the cost of an alternative as a critical factor unless the added cost to design, permit, and construct the alternative would render the project economically impractical.

To determine if an alternative is practicable and would provide a significant environmental advantage over the proposed action, we compare the impacts of the alternative and the proposed action (e.g., number of wetlands/waterbodies affected by the alternative and number of wetlands/waterbodies affected by the proposed action). To ensure consistent environmental comparisons and to normalize the comparison of resources, we generally use "desktop" sources of information (e.g., publicly available data, aerial imagery) and assume the same construction and operation right-of-way widths and general workspace requirements. We evaluate data collected in the field if surveys were completed for both the proposed action and the corresponding alternative. Our environmental comparison uses common factors such as (but not limited to) total amount, length/distance, and acres affected of a resource. Furthermore, this analysis considers impacts on both the natural and human environments. The natural environment is generally characterized by vegetation, waterbodies, wildlife, and other biological resources; while the human environment includes land use, existing infrastructure, and community (socioeconomic) characteristics. Where appropriate and available, we also use site-specific information. In comparing the impact between resources, we also consider the magnitude of the impact anticipated on each resource. As applicable, we assess impacts on resources that are not common to the alternative and the proposed action (e.g., an alternative affects old growth forest whereas the proposed action affects agricultural lands). Our determinations attempt to balance the overall impacts (and other relevant considerations) of the alternative(s) and the proposed action. Recognizing the often-competing interests driving alternatives and the differing nature of impacts resulting from an alternative (i.e., impacts on the natural environment versus impacts on the human environment), we also consider other factors that are relevant to a particular alternative or discount or eliminate factors that are not relevant or may have less weight or significance. Ultimately, an alternative that is environmentally comparable or results in minor advantages in terms of environmental impact would not compel us to shift the impacts from the current set of landowners to a new set of landowners.

The factors considered for an aboveground facility alternative are different than those considered for a pipeline route alternative because an aboveground facility is a fixed location rather than a linear facility which is routed between two points. In evaluating aboveground facility locations, we consider the amount of available land, current land use, adjacent land use, location accessibility, engineering requirements, stakeholder comments, and impacts on the natural and human environments.

3.1 NO ACTION ALTERNATIVE

NEPA requires federal agencies to consider and evaluate a No Action Alternative. Additionally, a No Action Alternative serves as a baseline against which the impacts of the proposed action are compared and contrasted. Under the No Action Alternative, the proposed action would not occur, the permits and authorizations listed in section 1.5 would not be required, and as a result, the environment would not be affected.

Under the No Action Alternative, the RMPs of the Coos Bay, Roseburg, Medford, and Klamath Falls Resource Area of the Lakeview District and the LRMPs of the Rogue River, Umpqua, and Winema National Forests would not be amended to make provision for the Project. Furthermore, the Forest Service would not consent to the BLM to grant an easement because construction of the Project would not be consistent with the National Forest LRMPs. The BLM would not issue a Right-of-Way Grant for the Project because the Project would not be a conforming use of federal land. Under the No Action Alternative, there would be no need for Reclamation to concur with BLM with respect to issuance of a Right-of-Way Grant. Also, the FWS and NMFS would not issue Biological Opinions (BO) because there would be No Effect on species listed under the ESA.

Under the No Action Alternative specific to the COE's role in the Project review, construction of the Project would result in a modified project design or location that eliminates work that would require a Department of the Army permit (i.e., avoidance of aquatic resource impacts) or the COE's denial of the permit.

In Order No. 3041-A issued July 20, 2018, the DOE amended its previous authorization to export LNG from the Jordan Cove LNG Project to countries with which the U.S. has a FTA(DOE 2018). By law, under Section 3(c) of the NGA, applications to export natural gas to FTA nations that require national treatment for trade in natural gas are deemed to be consistent with the public interest. The DOE also issued a conditional authorization to the Jordan Cove Project to export to non-Free Trade Agreement countries in Order No. 3413 on March 24, 2014. For the non-Free Trade Agreement conditional authorization, granted under Section 3(a) of the NGA, the DOE determined that exports from the Jordan Cove Project were not inconsistent with the public interest, provided the Project successfully completes the environmental review. In its application, Jordan Cove states the purpose of its Project is to export natural gas supplies derived from existing interstate natural gas transmission systems (linked to the Rocky Mountain region and Western Canada) to overseas markets, particularly Asia. According to Jordan Cove, the Project is a market-driven response to increasing natural gas supplies in the U.S. Rocky Mountain and Western Canada markets, and the growth of international demand, particularly in Asia.

Given that the Project is market-driven, it is reasonable to expect that if the Jordan Cove LNG Project is not constructed (the No Action Alternative), export of LNG from one or more other LNG export facilities could also be authorized by the DOE and eventually be constructed. Thus, although the environmental impacts associated with constructing and operating the Project would not occur under the No Action Alternative, equal or greater impacts could occur at other location(s) in the region as a result of another LNG export project seeking to meet the demand identified by Jordan Cove.

As stated in the introduction to this section, the No Action Alternative would not meet the Project's purpose and need. Therefore, we conclude that the No Action Alternative does not meet the Project purpose (criterion 1) and an alternative project to meet the market demand has not been proposed but would require a similar footprint. Although the resources that would be affected by an alternative project are not defined, we conclude that it would not likely provide a significant environmental advantage over the proposed action (criterion 3). Therefore, we do not consider the No Action Alternative further. However, the other NEPA cooperating agencies, consistent with their review and regulatory responsibilities, may choose to select this alternative.

3.2 SYSTEM ALTERNATIVES

System alternatives would make use of existing or other proposed LNG facilities and pipelines to meet the purpose of the Project. Implementing a system alternative would make it unnecessary to construct all or part of the Project, although some modifications or additions to existing LNG facilities or pipeline transmission systems/facilities, or other proposed LNG or pipeline transmission systems/facilities might be necessary. The pipeline portion of a system alternative would involve the use of all or portions of other natural gas transmission systems to transport natural gas from near Malin, Oregon, to the proposed terminal near Coos Bay, Oregon. Existing natural gas pipelines in southern and central Oregon include the jurisdictional interstate transportation systems operated by Northwest, GTN, and Ruby, and the non-jurisdictional intrastate Coos County Pipeline (figure 3.2-1).

As of the issuance of this EIS, there are no existing LNG export (or import) terminal facilities located on the west coast of the contiguous United States (Washington, Oregon, and California). Additionally, we are not aware of any proposed LNG export (or import) terminals on the west coast of the contiguous United States. Existing and proposed East Coast and Gulf Coast LNG export facilities are located 2,000 – 3,000 miles from Oregon, and would not be reasonable alternatives. According to USDOT PHMSA, there are four LNG storage facilities (peak-shaving plants) in Oregon and Washington connected to natural gas pipeline systems. These facilities are not designed to export LNG, are insufficient to meet the purpose of the Project, and would require significant modifications to meet the Project's purpose. Additionally, an LNG storage facility is being built in Tacoma, Washington (i.e. the Tacoma LNG) that would provide fuel for marine vessels and natural gas service for local residential and commercial customers. However, this facility which is located on a 30-acre site in a highly industrialized area is physically constrained with insufficient land available for the expansion necessary to meet the Project's purpose. Therefore, we conclude that there are no reasonable LNG system alternatives in the contiguous United States.

We received several comments suggesting this analysis consider existing and proposed LNG export facilities located in Alaska, Canada, and Mexico. In Alaska, there is an idle LNG export facility on the Kenai Peninsula. The Commission is also currently reviewing an application (FERC Docket No. CP17-178-000) to construct and operate a new LNG export facility in Nikiski, Alaska. These facilities are not connected to the "lower-48" natural gas transmission pipeline network and although constructing a pipeline from the existing GTN and Ruby pipelines systems near Malin, Oregon to the existing or proposed facility in Alaska (a distance of close to 3,000 miles) is technically feasible, it is not economically practical. Furthermore, constructing a pipeline to Alaska from Malin would result in significantly more environmental impacts than the proposed Project as this pipeline would be an order of magnitude longer than the currently proposed pipeline. Based on the length of the Pacific Connector Pipeline and the total footprint, including all extra workspace, the pipeline would affect about 21.6 acres per mile of length. Therefore, adding 2,700 miles would affect as much as 58,320 acres of land. Consequently, we conclude that an LNG system alternative making use of the existing or proposed Alaska LNG facilities would not provide a significant environmental advantage and do not consider it further in this analysis.

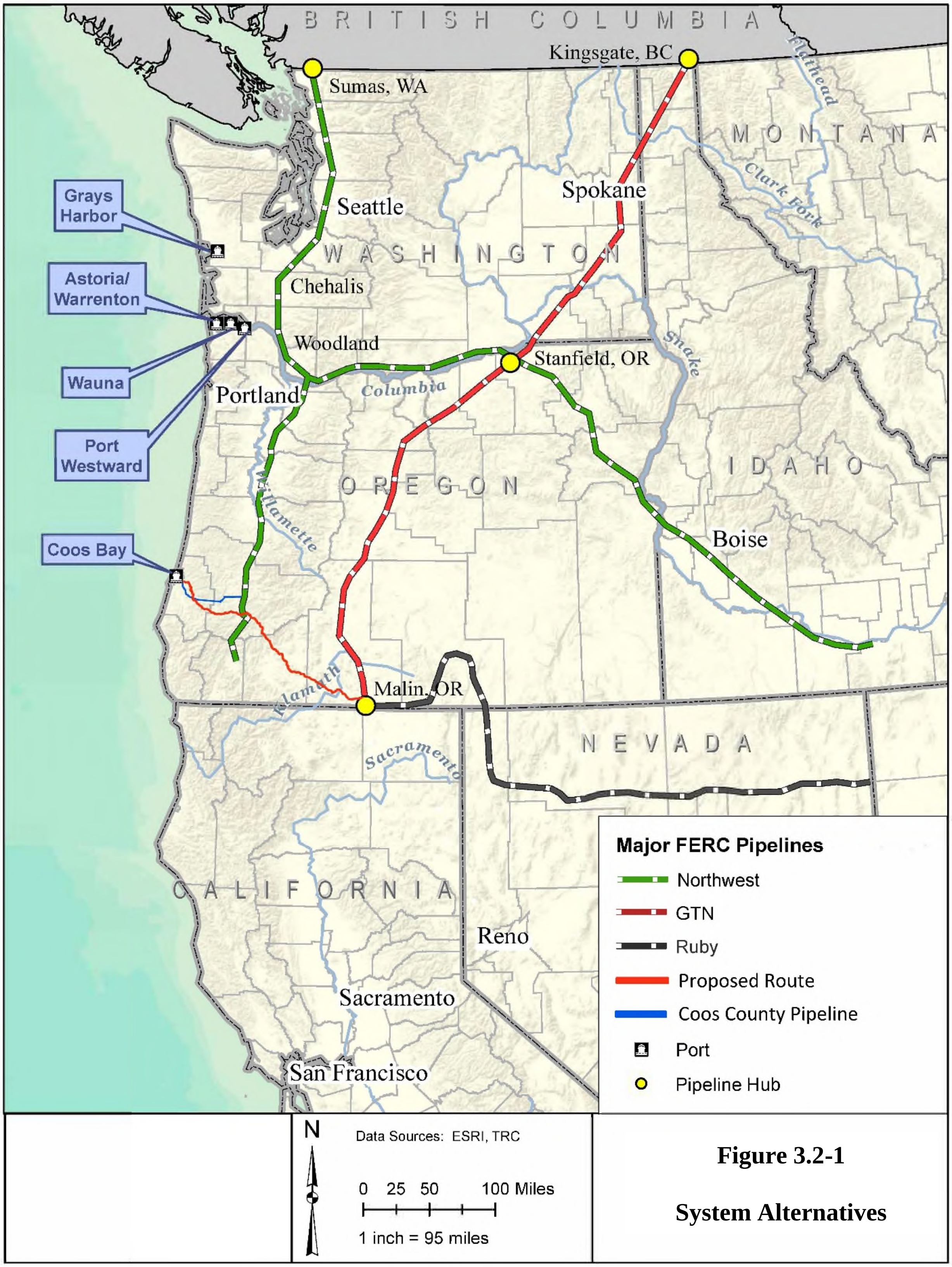

Figure 3.2-1

System Alternatives

According to Natural Resources Canada (2018), 13 LNG export facilities have been proposed in British Columbia, Canada (see table 3.2-1). The final specifications and permitting/ construction statuses of these facilities are unknown. Assuming these facilities have been designed to accommodate a pre-determined need/level of service, it may be possible that with modifications, one or more of these facilities would be able to provide an equivalent level of service to that which would be provided by the Project. However, we are unable to determine what modifications would be necessary and what the impacts of those modifications would be. Furthermore, although constructing a pipeline from the existing GTN and Ruby pipelines systems to western Canada (a distance ranging from 700 to 1,400 miles) is technically feasible, it would increase the Project footprint by between about 10,100 and 25,300 acres. Therefore, we conclude that an LNG system alternative making use of a proposed western Canada LNG facility would not provide a significant environmental advantage and do not consider it further in this analysis.

TABLE 3.2-1

Proposed Canadian LNG Projects

Project	Terminal Location	Output (Max Bcf/d)
Cedar LNG Project	Near Kitimat, B.C.	0.8
LNG Canada Project	Port Edward, Prince Rupert Island, B.C.	3.5
WesPac LNG Marine Terminal	Tilbury Island, B.C.	0.6
Kitimat LNG Project	Kitimat, B.C.	1.3
New Times Energy Ltd.	Prince Rupert area, B.C.	1.6
Orca LNG Project	Prince Rupert area, B.C.	3.2
Steelhead LNG Project	Sarita Bay, Vancouver Island, B.C.	4.3
Woodfibre LNG Project	Near Squamish, B.C.	0.3
Stewart Energy Project	Stewart, B.C.	4.0
Discovery LNG Project	Campbell River, Vancouver Island, B.C.	2.6
Kitsault Energy Project	Kitsault, B.C.	2.7
Triton LNG Project	Floating facility – TBD near Kitimat or Prince Rupert, B.C.	0.3
Watson Island LNG	Watson Island, near Prince Rupert, B.C.	Unknown

There are no existing LNG export facilities on the west coast of Mexico. However, there are two import facilities—the Costa Azul LNG Project in Baja California, and the Manzanillo LNG Project in Colima. The owner of the Costa Azul Project (Sempra Energy) is proposing to convert this project into an LNG export terminal. We are not aware of any other proposed LNG facilities in Mexico; however, we acknowledge that additional proposals may exist. Similar to the proposed Canadian LNG facilities, the final specifications and permitting/construction status of the Costa Azul LNG Project is unknown. Assuming this facility has also been designed to accommodate a pre-determined need/level of service, it may be possible that with modifications, it would be able to provide an equivalent level of service to that which would be provided by the Project. However, we are unable to determine what modifications would be necessary and what the impacts of those modifications would be. Although constructing a pipeline from the existing GTN and Ruby pipelines systems to Baja California (a distance of about 900 miles) is technically feasible, it would increase the Project footprint by about 14,500 acres. Therefore, we conclude that an LNG system alternative making use of the Costa Azul LNG facility would not provide a significant environmental advantage and do not consider it further in this analysis.

The Northwest Pipeline is an approximately 3,900-mile-long bi-directional interstate natural gas transmission system. This system crosses the states of Washington, Oregon, Idaho, Wyoming, Utah, and Colorado. This transmission system provides access to British Columbia, Alberta, Rocky Mountain, and San Juan Basin natural gas supplies. In Oregon, two lateral pipelines connect to the Northwest mainline system. The Camas to Eugene and the Eugene to Grants Pass Lateral are generally parallel to I-5, running north to south through western Oregon. The laterals begin in the north as dual 20-inch-diameter pipelines, and consist of a single a 10-inch-diamter pipeline at the southern end. The only portion of the Northwest Pipeline system that could potentially serve as a system alternative to move gas from near Malin to the LNG terminal in Coos Bay would be a portion of the north-south Eugene to Grants Pass Lateral. Such an alternative would require modifying roughly the eastern one-half of the proposed pipeline to connect to the southern end of the Grants Pass Lateral, then constructing about 70 miles of "looping" pipeline north along the Grants Pass Lateral to near Sutherlin, Oregon, and then constructing about 50 miles of new pipeline west to Coos Bay. Such an alternative would result in roughly the same length of pipeline as proposed; however, may affect more forested area, and could result in similar or greater environmental impacts. Therefore, the implementation of a system alternative involving the use of the Northwest Pipeline Grants Pass Lateral would not provide a significant environmental advantage over the proposed action.

The GTN interstate natural gas transmission system includes about 600 miles of 36- and 42-inch pipeline beginning at Kingsgate, British Columbia, traversing through northern Idaho, southeastern Washington, and central Oregon, and terminating near Malin. Natural gas for the GTN pipeline originates primarily from western Canadian supplies; although it can receive Rocky Mountain gas through interconnections with Northwest near Spokane and Palouse, Washington and Stanfield, Oregon. The Ruby interstate natural gas transmission system includes about 680 miles of 42-inch-diameter pipeline beginning near Opal, Wyoming, and extending west through Montana and Idaho to Malin. Neither GTN nor Ruby would be suitable as system alternatives and neither would be able to meet the purpose of the Project because both systems terminate near Malin and would require a connection to a west coast LNG facility similar to the proposed pipeline route from Malin to Coos Bay. Therefore, systems alternatives involving these systems would not provide a significant environmental advantage over the proposed action.

The Coos County Pipeline is a non-jurisdictional 12-inch-diameter local distribution company (LDC)[47] pipeline that extends about 60 miles from the Northwest Grants Pass lateral, near Roseburg, to Coos Bay. The Coos County Pipeline has a MAOP of 1,000 psig and was designed to bring gas to the communities around Coos Bay. The terminus of the Coos County Pipeline is approximately 7.7 miles south of the proposed Jordan Cove LNG terminal. Northwest Natural built a pipeline lateral from the terminus of the Coos County pipeline across Coos Bay to the North Spit, as part of its LDC system. The diameter and available capacity of the Coos County Pipeline are too small to meet the purpose of the Project. The Coos County Pipeline does not connect to the GTN and Ruby Pipeline systems. Expanding the Coos County Pipeline as needed to provide the required natural gas capacity from the GTN and Ruby Pipeline systems would result in similar impacts as that of the proposed action. For these reasons, the Coos County Pipeline as an existing system cannot meet the Project purpose and expanding it to meet the purpose would not provide a significant environmental advantage.

3.3 LNG TERMINAL SITE ALTERNATIVES

We received numerous comments stating that LNG site alternatives in California, Washington, Canada, and Mexico be considered. Commenters suggested that sites in these states and countries could be more suitable for an LNG terminal. We do not evaluate in this EIS alternative projects

[47] LDCs (local distribution company) are intrastate systems that are regulated by the state, and do not come under the jurisdiction of the FERC.

or LNG terminal sites located in Canada or Mexico. Below we address the potential for an LNG terminal to be sited in California, and then we address potential alternative sites in Oregon and Washington.

As stated previously, the Commission's staff evaluates a proposal and reasonable alternatives. While we may ask the project proponent to evaluate alternative technologies in order to minimize impacts, we do not redesign proposals. However, some alternative technologies or facility designs represent such a large departure from the applicant's proposal that they could significantly affect the feasibility and economic practicality of the proposal. Consequently, we are not evaluating offshore site alternatives that would require specialized LNG carriers. We do however, evaluate the concept of an inland (non-waterfront) alternative (see section 3.3.4).

3.3.1 LNG Terminal Site Alternatives in California

California has 11 public ports. The closest deepwater port to Coos Bay in California is the Port of Humboldt Bay. The Port of Humboldt Bay is located approximately 185 miles south of Coos Bay and 225 miles north of San Francisco (the next closest deepwater port is in San Francisco bay). The Samoa Peninsula lies between the Pacific Ocean and Humboldt Bay and hosts several active and former marine facilities, berths, docks, and terminals. According to the 2018 Humboldt Bay Maritime Industrial Use Market Study, 948 acres of land have been designated for Coastal-Dependent Industry (CDI) on the Samoa Peninsula including the approximately 344-acre Eureka Municipal Airport site which has waterfront access and is the largest single property on the peninsula. It is unknown whether a combination of other CDI properties equaling approximately 200 acres is available. The channel system leading into and within Humboldt Bay varies in length, width, and depth. The Bar and Entrance Channel is approximately 8,500 feet long, 500 to 1,600 feet wide, and is authorized to a depth of 48 feet mean low level water (MLLW). The North Bay Channel which serves the Samoa Peninsula is 18,500 feet long, 400 feet wide, and is authorized to a depth of 38 feet MLLW. The distance by air from Malin, Oregon to Humboldt Bay is about 170 miles (the distance from Malin, Oregon to Coos Bay by air is also about 170 miles). We estimate the pipeline distance between these two points would be at least 200 miles, which is comparable to the proposed pipeline.

An LNG terminal in Humboldt Bay would impact the environment in a manner similar to that of the proposed Project, including; permanent conversion of land use, dredging, turbidity, loss of wetlands, visual impacts, air quality and noise. Concerns at this location such as marine traffic restrictions, socioeconomic impacts, tsunamis, and public safety would also be the same as the proposed Project. A natural gas transmission pipeline from Malin, Oregon to Humboldt Bay, California would traverse Klamath County, Oregon as well as Siskiyou and Humboldt Counties, California. The environment crossed by a pipeline from Malin to Humboldt Bay would be similar to that of the proposed route, including; mountainous terrain, several large rivers, three national forests, and BLM-managed lands. This pipeline route would also cross the ranges of over 20 federally-listed threatened and endangered species including NSO, MAMU, and salmon. Concerns with this pipeline route such as rural property values, socioeconomic impacts, and public safety would also be the same as the proposed Project.

Based on the expected similar impacts of an LNG terminal in Humboldt Bay and the associated natural gas transmission pipeline from Malin, Oregon to Humboldt Bay, we conclude this alternative would not result in a significant environmental benefit when compared to the proposed action.

3.3.2 LNG Terminal Site Alternatives in Oregon and Washington (LNG Terminal Site Characteristics)

As provided in Jordan Cove's application and identified in table 3.3.2-1, we are evaluating four terminal site alternatives. We determined that a reasonable LNG terminal site alternative should include the following site characteristics.

1. **Available Land –** a parcel or combination of parcels available[48] for development and large enough to accommodate the proposed LNG terminal facilities and associated safety exclusion zone, about 200 acres.
2. **Deep Channel Access –** a channel with depth of at least 36 feet MLLW in order to accommodate the draft of anticipated LNG carriers.
3. **Waterfront Access –** a site that can safely accommodate the mooring of an LNG carrier and the facilities required to transfer LNG from the terminal to the carrier.
4. **Comparable Pipeline –** a site that could be reached by a comparable natural gas transmission pipeline from the intersection of the GTN and Ruby pipeline systems.

For the purposes of our alternatives analysis of sites, we do not further evaluate sites that do not or could not satisfy these LNG site requirements. For example, sites that are of insufficient size or are unavailable for purchase or lease are not carried forward into this analysis.

Locations having the four necessary characteristics were identified in Astoria, Wauna, and Port Westward, Oregon, and Grays Harbor, Washington (figure 3.2-1). An environmental comparison and discussion of these LNG terminal site alternatives is provided below.

Each alternative site would require construction of new natural gas pipelines, and in some cases modifications and upgrades to existing transmission pipelines to access western Canadian and U.S. Rocky Mountain natural gas sources from the intersections of the GTN pipeline and Ruby pipeline near Malin, to meet the stated Project purpose. An estimate of the pipeline length required for each alternative is included in table 3.3.2-1. In each of these alternatives, the associated natural gas supply pipeline would need to cross the Cascade Mountains.

[48] Section 3 of the NGA does not grant the authority of eminent domain. In some cases, a site may be of adequate size for an LNG terminal, but the owner is unwilling to sell or lease the property.

TABLE 3.3.2-1

LNG Terminal Port Alternatives Comparison

Feature	Proposed (Coos Bay)	Alternative Port: Astoria, OR	Wauna, OR	Port Westward, OR	Grays Harbor, WA
Available Site Size (acres)	412	519	321	336	272
Supply pipeline length (miles)	229	399	375	332	379
Pipeline construction footprint (acres) a/	4,946	8,618	8,100	7,170	8,186
Freshwater wetland impacts (acres) b/	83	143	49	51	61
Estuarine/open water impacts (acres) b/	35	130	35	60	42
Number of listed species with potential habitat	21 c/	10	15	16	9
Existing residences within 1 mile (number)	116	975	5	828	1,637

a/ Estimated using the average area per mile that would be affected by the proposed pipeline, including all extra temporary work space (21.6 acres/mile).
b/ Assuming all mapped resources within the site would be affected.
c/ This includes the LNG terminal site and LNG carrier transit in the waterway. There are only seven federally listed species that may occur at the LNG terminal site itself.

As shown in table 3.3.2-1, environmental features and potential impacts from use of the alternative sites would vary when compared to the proposed site. Three sites (Astoria, Port Westward, and Grays Harbor) would have a significantly greater number of residences located within 1 mile, while one site (Wauna) would have significantly fewer. Three sites (Wauna, Port Westward, and Grays Harbor) would have less impact on freshwater wetlands than the proposed site, while one site (Astoria) would have more. One site (Astoria) is estimated to require significantly more impact on estuarine and open water habitats than the proposed site. All four alternative sites would require at least 100 more miles of supply pipeline than the proposed site, ranging from an estimated 103 miles (Port Westward) to 170 miles (Astoria) of additional pipeline required, which would require an estimated 2,224 to 3,672 additional acres of disturbance for pipeline construction. When evaluating these potential impacts, we have not identified an alternative site that would result in a significant environmental advantage over the proposed site. Therefore, we conclude that none of the regional alternative sites would result in a significant environmental advantage over to the proposed site in Coos Bay.

3.3.3 Coos Bay Terminal Alternatives

We evaluated one alternative site for the LNG terminal facilities within Coos Bay. The alternative site is located west of the swinging railroad bridge and on the western side of the Coos Bay Navigation Channel. The swinging railroad bridge is an impediment to vessel traffic and the eastern side of the channel does not contain any sufficiently sized parcels due to the presence of the North Bend and Coos Bay communities. Sites along the west side of the North Spit are not suitable because navigational accessibility is limited by exposure to the open ocean.

The Jordan Point alternative site is located about 1 mile east of the proposed LNG terminal site at about river mile 8.5 of the Coos Bay Federal Navigation Channel (figure 3.3-1). The Jordan Point site would be approximately the same size as the proposed site, and Jordan Cove indicates the site would be available for development of an LNG facility. The alternative site overlaps part of the South Dunes portion of the proposed site. A comparison of major environmental factors between the Jordan Point site and the proposed site are listed in table 3.3.3-1.

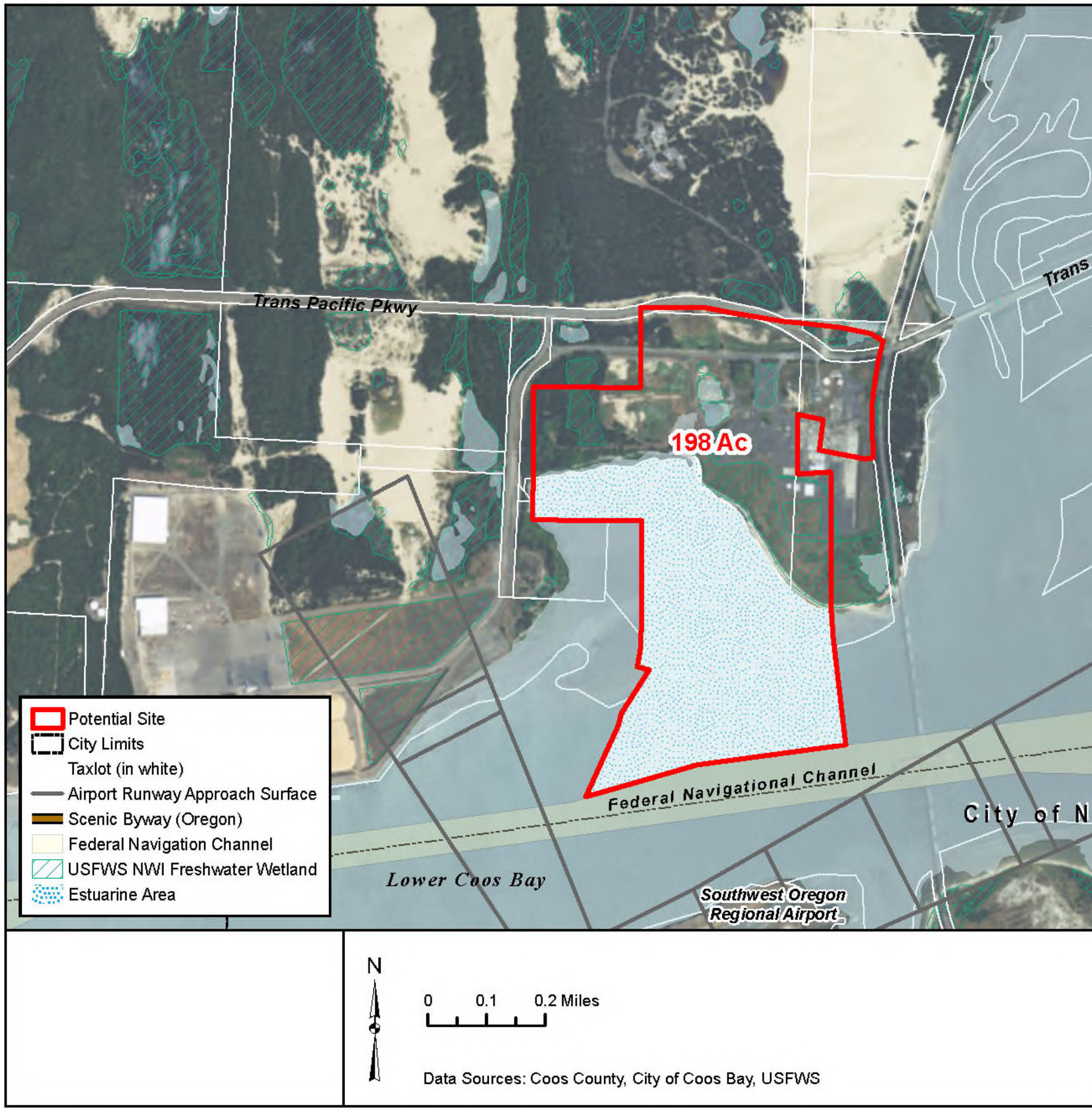

Figure 3.3-1

Jordan Point Site Alternative

TABLE 3.3.3-1

Comparison of Proposed and Jordan Point Alternative LNG Sites

Environmental Factor	Proposed Site	Jordan Point Site
Estuarine Area (acres) a/	32	101
Wetland Area (acres) b/	2	22
Threatened and Endangered Species (number) c/	9	9
Approximate Site Size (acres)	199	198
Land Availability	Y	Y
Federal Land Affected (acres) d/	0	0
Within Airport Runway Approach Zone	No	No
Adequate Area for Safety Exclusion Zone	Y	Y
Existing Residences within 1 Mile (number) d/	116	128

a/ Based on approximate boundary of shoreline to the edge of the Federal Navigation Channel or waterward extent of the potential site boundary.
b/ Based on NWI wetland GIS data within potential site boundary, See Figures 10.3-9 to 10.3-11 in Jordan Cove Resource Report 10.
c/ Based on FWS 2017a and NMFS 2015.
d/ Based on GIS tax lots.

The number of residences within 1 mile would be slightly more for the Jordan Point site (128) than for the proposed site (116), and LNG carriers would have to travel about 1 mile farther along the Federal Navigation Channel to reach the site. Based on NWI mapping, the Jordan Point site would also include more wetlands (approximately 22 acres) compared to the proposed site (approximately 2 acres). The primary disadvantage of the alternative site is its farther distance from the Federal Navigation Channel, which would require a greater area of dredging within the estuarine area between the site and channel (approximately 101 acres) compared to the proposed site (32 acres). For the reasons described above, the Jordan Point site would not provide a significant environmental advantage over the proposed site.

3.3.4 Inland (Non-Waterfront) Alternative

We received comments from the COE requesting that we evaluate an inland LNG terminal site, in order to reduce impacts on wetlands and Coos Bay. An inland alternative site would locate the liquefaction and LNG storage facilities at an upland location outside of Coos Bay and would be connected to the proposed marine loading facilities by an LNG cryogenic pipeline or LNG trucking system. At the proposed site, approximately 86.1 acres of wetlands would be affected by construction and approximately 22.3 acres of wetlands would be permanently lost (see table 4.3.3.1-1). An inland site would not completely eliminate impacts on wetlands as numerous operational and safety facilities would still be required along the shoreline to support the marine loading and LNG carrier berth facilities. Operational and safety facilities would include spill containment systems and utilities such as compressed air, nitrogen, potable water, utility water, fire water, and electrical equipment. An inland site would also require the use of a marine berth and turning basin; therefore, dredging in Coos Bay would still be necessary. As a result, impacts on Coos Bay would not be substantially reduced by an inland terminal site. In either scenario, impacts on Coos Bay would be localized and relatively short term.

Due to the presence of the Oregon Dunes National Recreation Area immediately north of the proposed site, the cities of North Bend and Coos Bay, immediately south, and the Pacific Ocean to the west, any inland site alternative would need to be located at least five miles east of the proposed site. Furthermore, due to the steep topography east of Coos Bay, the distance from the marine loading facilities to a suitable parcel of land for the terminal facilities would likely be greater than five miles and likely require a larger site with more ground disturbance (50 acres or more) to accommodate the significant earthwork (spoil storage, leveling, and slope considerations) that would be required to create an appropriate site. The marine loading facilities would remain at the proposed site because LNG carriers are prevented from travelling farther east by the rail and Highway 101 bridges across Coos Bay.

An LNG cryogenic pipeline, which would be subject to expansion and contraction due to temperature fluctuations, could be located aboveground or underground within a tunnel system. Regardless of the pipeline placement, the USDOT's siting requirements and regulations would apply. In order to ensure pipeline integrity and public safety, the USDOT may require the operating company to obtain legal control of activities up to 400 feet on each side of the pipeline, resulting in an additional 450 acres of land encumbered by the permanent easement. The subsequent amount of affected land when compared to the amount of land typically affected by a natural gas pipeline would be significantly greater. In addition, the USDOT siting requirements for LNG cryogenic pipelines require security features (fencing and exclusion zones) and spill containment systems. At a minimum, an LNG cryogenic pipeline system would need to accommodate the LNG ship loading pipe, an LNG recirculating and cooldown pipe, and the ship vapor return pipe as well as access points for inspection and maintenance work. The cryogenic pipelines would also require insulation along the entire length to maintain (low) operating temperatures. These facilities would require a larger permanent operational easement and would likely require a larger construction right of way, both of which would increase impacts on the environment. Unlike an interstate natural gas pipeline regulated under Section 7 of the NGA that provides for the use of eminent domain, temporary and permanent easements required for an LNG cryogenic pipeline regulated under Section 3 of the NGA must be obtained without the use of eminent domain which could result in a longer pipeline route further increasing impacts on the environment. An LNG cryogenic pipeline would also require pump stations to ensure LNG flows and pressures are maintained. These pump stations would need additional provisions for electrical power, security, firewater, control room, etc. and would require the permanent use of additional lands and impacts on the environment. A cryogenic pipeline transporting LNG from an inland terminal site to the marine loading facilities is technically feasible, but would require numerous design and siting changes, resulting in additional environmental impacts, and could affect the economic competitiveness of the Project.

An inland LNG terminal alternative could impact a larger footprint than the proposed site and would affect other resources. Because the proposed site has been previously disturbed, the impacts of an inland LNG terminal could be greater than the impacts at the proposed site. Furthermore, constructing a LNG cryogenic pipeline would require several additional systems and measures to be designed and implemented to ensure safety and integrity. Ultimately, when considering the footprint of the inland terminal, the marine loading facilities, power infrastructure for the pumps, and the difficulties and costs associated with a redesigned pipeline, we conclude that while perhaps feasible, an inland site would not be practical.

A trucking system transporting LNG from an inland terminal site to the marine facilities at the proposed output volumes would require thousands of truck trips per day. This amount of traffic on area roads would be a significant impact and would greatly increase public safety concerns. In addition, exhaust emissions from the trucks would impact local air quality. Therefore, we conclude that an inland terminal with a trucking system would not provide a significant environmental advantage over the proposed LNG terminal.

3.4 PIPELINE ROUTE ALTERNATIVES AND VARIATIONS

We evaluated numerous pipeline route alternatives and variations to determine whether their implementation would be preferable to the proposed corresponding action. Major route alternatives are generally greater than 50 miles in length and can deviate from the proposed route by a significant distance. Route variations are generally less than 50 miles in length and deviate from the proposed route to a lesser degree than a major route alternative.

Route alternatives and variations were identified based on public comments, information provided by Pacific Connector, agency consultations, and our independent review of the Project. Also, as required by Subsection 28 (p) of the Mineral Leasing Act, the agencies considered opportunities for co-location with existing rights-of-way where the proposed pipeline would cross federally managed lands. In addition to alternatives and variations evaluated in this EIS, during the course of refining the proposed route, Pacific Connector incorporated a number of minor route modifications to address agency concerns and landowner requests, constructability issues or constraints, to avoid cultural resources or geological hazards, or reduce impacts on special status, threatened, or endangered species. These include minor modifications recommended by the BLM between MPs 119.5 and 119.8, at MP 126.0, and at MP 131.5, and between MPs 183.9 and 187, and recommended by the Forest Service between MPs 154.7 and 155.1, MPs 157.1 and 158.7, and MPs 171.2 and 173.0.

3.4.1 Major Route Alternatives

Elements we considered during our analysis of potential alternatives included pipeline length, use of or co-location with existing rights-of-way, forest land, agricultural land, waterbody and wetland crossings, residences, known cultural resources, habitat for federally listed threatened or endangered species, and geological hazards and slope stability.

3.4.1.1 All Highway Alternative

We evaluated the All Highway Alternative as a potential alternative that would follow existing highways as much as possible in order to co-locate rights-of-way and reduce the creation of new corridors through resource areas. This alternative would follow Highway 50 west from Malin to Highway 39, northwest to Klamath Falls, then along Highway 140 west to Medford, then along I-5 north to Winston, then west along Highway 42, and then north along Highway 101 to Coos Bay. This route would be approximately 281 miles long, or about 52 miles longer than the proposed route, resulting in approximately 600 acres of additional construction right-of-way disturbance.

The potential advantage of the All Highway Alternative is that the pipeline would be co-located with the existing highway right-of-way, co-locating new disturbance and associated impacts with existing disturbance. However, as explained below, the pipeline would be placed adjacent to, but not within, highway rights-of-way, and therefore the alternative would still require acquisition of new right-of-way. The Federal Highway Administration (FHWA) historically prohibited the installation of new utility facilities within the rights-of-way of access-controlled freeways except in some extraordinary cases. This prohibition was consistent with the American Association of State Highway Transportation Officials (AASHTO) policies for longitudinal accommodation. However, with a 1988 amendment to the FHWA regulations, the FHWA's policy changed to allow each state to decide whether to permit new utility facilities within these rights-of-way, or continue to adhere to the stricter AASHTO policies (FHWA 2014). Oregon defines its policy for accommodating utilities in highway rights-of-way in OAR 734-055-0080. In general, Oregon does not allow utilities to occupy interstate rights-of-way with the exception of perpendicular crossings (Caswell 2008).

In addition to the further disturbance that would result from the longer length of the alternative, there are disadvantages related to its location parallel to highways. The pipeline route paralleling the highway rights-of-way has constraints such as highway cuts and fills; elevated roadway sections, bridges, overpasses and underpasses; clover leaf and other interchanges; as well as commercial, industrial, and residential developments located immediately adjacent to the rights-of-way and interchanges. For these reasons, we have determined that implementation of the All Highway Alternative would not result in a significant environmental advantage and is not preferable to the proposed route.

3.4.1.2 Federal Lands Route Alternative

We considered a conceptual Federal Lands Alternative that would place the pipeline entirely on federal lands as a potential alternative to avoid or significantly reduce impacts on private property. Given the patchwork nature of federal land holdings in the Project area in southern Oregon, with federal blocks scattered between private tracts, we were unable to identify a route between Malin and Coos Bay that would be entirely on federal lands and not cross private lands. Therefore, a route that would be entirely on federal land and would avoid private property is not feasible and is not considered further in this EIS.

3.4.1.3 Federal Lands Avoidance Route Alternative

We attempted to identify a pipeline route alternative that would avoid crossing federally managed lands. However, given the extensive Forest Service lands and the checkerboard nature of BLM-managed lands in southwest Oregon (see figure 1.1-1), we were unable to identify a route between Malin and Coos Bay that would avoid crossing federally managed lands. We also attempted to identify a pipeline route that would avoid crossing federally managed lands by heading in any direction from Malin and eventually reaching Coos Bay, regardless of length. Again, due to the extensive and connected Forest Service lands to the north, east, south, and southwest of Malin, we were unable to identify a route that could reach Coos Bay without crossing federally managed lands. Therefore, a federal lands avoidance route alternative is not feasible and is not considered further in this EIS.

3.4.2 Pipeline Variations

3.4.2.1 Coos Bay Estuary Variations

We received a number of comments concerning the impact of the pipeline crossing of the Coos Bay estuary, including comments from the Coos Tribe. Pacific Connector proposes to cross the Coos Bay estuary using HDD in two segments between MPs 0.3–1.0 and MPs 1.5–3.0. We evaluated several pipeline variations in this area that would modify the crossing location and method to determine if any alternatives might reduce effects on the estuary, including a North Route Variation, a Modified North Route Variation, and a Haynes Inlet East Avoidance Variation (see figure 3.4-1).

The North Route Variation and the East Avoidance Variation would begin at the pipeline terminus and cross north of Haynes Inlet to the north of Sherwood, and both include HDDs to avoid impacts on the Mangan and Wetle Natural Resource Conservation Service Wetland Reserve Program (WRP) easements on the west and east side of Haynes Inlet (see figure 3.4-1). The Modified North Route Variation would have the same route as the North Route Variation until a point north of Sherwood where it includes an HDD (approximately 5,200 feet in length) that extends from ridgeline to ridgeline on either side of the inlet.

A comparison of major environmental and land use features crossed by each of these variations compared to the corresponding segment of proposed route is included in table 3.4.2.1-1. The potential advantage of the variations is avoidance of pipeline-related disturbance on the North Point area of North Bend, and avoidance of the Federal Navigation Channel that would be crossed twice, by HDD, at MP 0.66 and MP 1.6 of the proposed route. However, activities proposed by Jordan Cove, which would still occur with use of any of these variations, would affect both the North Point area and the Federal Navigation Channel, essentially negating any benefit of avoiding these areas with the pipeline. The North Point would still be used for construction laydown yards and dredge spoil disposal (within APCO sites 1 and 2, see sections 2.1.1.8 and 2.1.1.10) and the Federal Navigation Channel would still be affected by dredging for the access channel and the marine waterway modifications (see section 2.4.1.5).

The primary disadvantages of the Coos Bay Estuary variations are greater pipeline length and greater associated construction disturbance. Other disadvantages include greater number of waterbody crossings, more forest clearing, and greater number of private land parcels affected.

For the reasons described above, we have determined that implementation of these alternatives would not result in a significant environmental advantage and are not preferable to the proposed route.

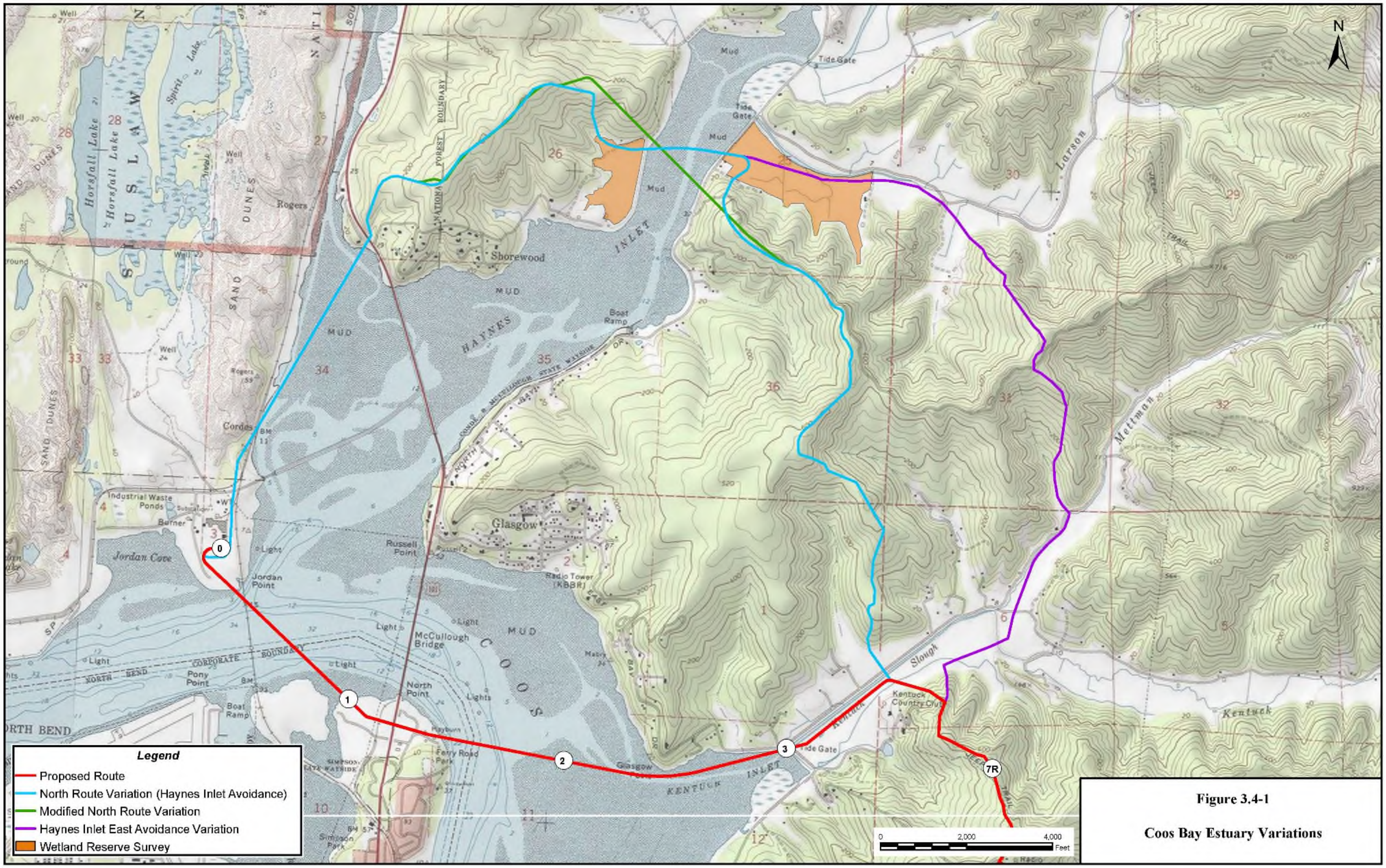

Figure 3.4-1

Coos Bay Estuary Variations

TABLE 3.4.2.1-1

Comparison of Coos Bay Estuary Variations with Proposed Route

Impact/Issue		**Proposed Route**	**North Route Alternative**	**Modified North Route Alternative**	**Haynes Inlet East Avoidance Alternative**
Variation length (miles) a/		3.43 (2.20 HDD)	7.15 (1.65 HDD)	6.55 (2.54 HDD)	7.55 (1.65 HDD)
Construction right-of-way (acres) b/		9.3	65.5	52.4	67.9
Temporary extra work areas (TEWA) (acres)		54.9	60.9	49.3	64 c/
Total acres of construction disturbance		64.2	126.4	101.7	131.9
Operational easement (acres) d/		9.8	36.3	30.0	45.8
Land ownership (miles)	0.2	5.5	5.1	5.3	0.2
	3.3	1.7	1.4	2.3	3.3
	0.0	0.0	0.0	0.0	0.0
Number of residences within 50 feet of the construction right-of-way		0	0	0	1 (HDD)
Number of waterbodies crossed e/		3	7	6	16
Length of wetland crossings (feet) e/		3,168	3,711	950	12,936
Agricultural land affected (miles)		0.5	0.5	0.2	2.2
Forest lands affected (miles) f/		0.0	3.5	3.8	2.8
Miles of right-of-way parallel or adjacent to existing rights-of-way (percent of route length)		0.2	1.9	1.9	2.5
COE 408 facilities g/		2	0	0	0
NRCS WRP Easements h/		0.0	0.4	0.0	0.9
Miles of critical habitat for federal T&E species and EFH species		0 (2.2 avoided by HDD)	0 (1.3 avoided by HDD)	0 (1.2 avoided by HDD)	0 (1.3 avoided by HDD)

General: All values are rounded (acres to nearest whole acre, miles to nearest tenth of a mile, feet to nearest whole foot).

a/ Variation lengths are measured from the point where they deviate from and then return to the proposed route. Lengths cannot be accurately calculated by comparing mileposts due to shifts in the alignment.

b/ The construction right-of-way for the proposed route and Alternatives is 9 feet wide in upland areas and, where HDDs are proposed, the right-of-way width has been removed.

c/ TEWAs for the Haynes Inlet East Avoidance Variation are estimated.

d/ The assumed permanent easement width is 50 feet.

e/ NWI coverages and photo interpretation were used for the Proposed Route and the Haynes Inlet East Avoidance Variation.

f/ Includes all forestland types: Evergreen forest, Mixed conifer, Regenerating forests and clear-cuts. The routes do not cross late successional nor old-growth forests.

g/ The proposed route would traverse under the Coos Bay Federal Navigation (shipping) Channel twice at MPs 0.66 and 1.6 by HDD. The alignment of the Haynes Inlet East Avoidance Variation was realigned to avoid crossing dikes associated with the Larson Inlet Flood Damage Reduction (FDR) Project located along Larson Slough. According to the National Levee Database (http://geoplatform.usace.army.mil/home), the Larson Inlet FDR Project is a federally authorized and constructed and a non-federally operated and maintained, agricultural flood-protection project.

h/ The Mangan WRP would be crossed by both North and East Avoidance Variation on the west side of Haynes Inlet for approximately 1,150 feet. The Wetle WRP would be crossed on the east side of Haynes Inlet by the North Route Variation for approximately 1,130 feet and by the East Avoidance Variation for approximately 3,450 feet.

3.4.2.2 Blue Ridge Variation

Based on comments received during scoping and concerns expressed by the BLM regarding steep topography, late-successional old-growth (LSOG), and potential impacts on threatened and endangered terrestrial species, we evaluated an alternative between about MPs 11 and 25 referred to as the Blue Ridge Variation. The 15.2-mile-long Blue Ridge Variation, which is depicted in figure 3.4-2, would deviate from the proposed route near MP 11 just south of the Coos River, continuing southwest across Catching Slough, turning south/southeast, generally co-located with an existing utility right-of-way before rejoining the proposed route near MP 25. Table 3.4.2.2-1 compares the variation to the corresponding segment of the proposed route. Additional details regarding the assessment of this variation can be found in appendix F.

When compared to the corresponding segment of the proposed route, the Blue Ridge Variation would require clearing less (about 32 acres less) LSOG forest (late-successional forest stands greater than 80 years old); would substantially reduce the number of occupied and presumed occupied (3 and 14 less, respectively) MAMU stands affected as well as acres of suitable MAMU habitat removed (about 29 acres less); and cross five fewer miles of LSRs and 0.47 mile less of NSO home range. As discussed in more detail in section 4.4.2.1, LSOG forest stands have a well-defined, multi-tiered canopy, which creates microhabitats for many species (Bingham and Sawyer, Jr. 1991; Spies and Franklin 1996), including the federally listed NSO and MAMU. Additionally, the variation would affect 3 fewer acres of designated Riparian Reserves on BLM-managed lands and about 15 acres less of NSO High NRF and NRF habitat. However, the variation is longer and would affect about 14 additional acres of land. It would also more than double the number of private parcels (24 to 53) and miles of private lands crossed (6.46 to 13.76). The variation would also increase the number of perennial waterbodies crossed by 27, and would increase the number of known and assumed anadromous fish-bearing streams crossed from 4 to 18, which would also increase the clearing of upland riparian vegetation associated with each crossing.

As indicated in the comparison table, the above discussion, and the analysis contained in appendix F, the primary trade-offs between the proposed route and the variation are between terrestrial (e.g., LSOG forest and MAMU stands/habitat) and aquatic resources (e.g., waterbody crossings and anadromous fish habitat), as well as public and private lands. With respect to terrestrial and aquatic resources, the measures that would be implemented to avoid or minimize these impacts differs considerably. Constructing and operating the pipeline along the proposed route would result in a permanent loss of LSOG forest and would adversely affect MAMU (see sections 4.4 and 4.6 for discussions regarding these resources); the applicants have very minimal options available for avoidance and minimization measures to address these permanent effects to upland resources (i.e., LSOG and MAMU), and have not proposed mitigation for these permanent effects. In contrast, some of the impacts on aquatic resources, waterbodies, and anadromous fish are expected to be temporary to short-term with implementation of Jordan Cove's and Pacific Connector's proposed impact minimization and waterbody restoration measures (e.g., Jordan Cove's *Plan, Procedures,* and ECRP), as well as our recommendations (see sections 4.3 and 4.5 for discussions regarding these resources). The applicants have also proposed some mitigation for the effects to waterbodies and anadromous fish as part of the BLM's right-of-way grant application and proposed plan amendments (see appendix F). However, some permanent unmitigated effects on waterbodies and anadromous fish would occur in the form of the permanent loss of mature riparian areas associated with affected waterbodies.

Our experience from reviewing stream crossings by FERC-regulated pipelines constructed in numerous habitats across the U.S. has confirmed that the short duration of the crossing and the prompt restoration of the stream bed and stabilization of the stream banks results in very few impacts on waterbodies that extend in time beyond the construction and initial restoration of the right-of-way. This is in part due to implementation of best management practices such as dry crossing methods, timing and duration, and restoration methods that are required by the FERC's *Plan* and *Procedures*, which are methods that the applicants have incorporated into their proposal. By comparison, the removal of LSOG habitat is a permanent impact for the operational right-of-way and, even in temporary work areas, recovery of the habitat would take at least 80 years.

We acknowledge that the variation would increase the number of private parcels crossed. Numerous public comments in the Commission's administrative record express concerns about how these lands would be affected. However, we note that although many additional private parcels are affected by the variation, only one residence is located within 50 feet of the construction right-of-way. This EIS addresses numerous measures to be employed during and following construction that would reduce impacts and facilitate restoration of the right-of-way.

We also acknowledge the concerns expressed by the NMFS and the COE regarding the increased impacts on waterbodies, threatened and endangered aquatic species, and adjacent riparian vegetation; and the BLM, FWS, and Tribes regarding the impacts on LSOG forest, threatened and endangered terrestrial species, and other upland managed resources. As stated previously, there are considerable trade-offs between the proposed route and the variation.

In the alternatives methodology described at the beginning of this section, we state that an alternative would be preferable if it meets the stated purpose of the Project; is technically and economically feasible and practical; and if implemented would result in a significant environmental advantage when compared to the proposed action. We also state that when making an alternatives determination we attempt to balance the overall impacts (and other relevant considerations) of the alternative and the proposed action. Therefore, recognizing the trade-offs between the proposed route and the variation; the differences between terrestrial and aquatic resource impacts in regard to temporal effects, as well as the scope of avoidance, minimization, and mitigation for these effects; and the magnitude of the effects, we have determined that the Blue Ridge Variation would result in an overall environmental advantage when compared to the corresponding segment of the proposed route. Our conclusion is based primarily on the variation's ability to reduce long-term to permanent impacts on particularly valuable LSOG habitat affected by the proposed route. Both the sensitivity and value of this habitat and the duration of the impact contribute to this finding. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary, for review and written approval by the Director of OEP, revised alignment sheets that incorporate the Blue Ridge Variation into its proposed route between MP 11 and MP 25.**

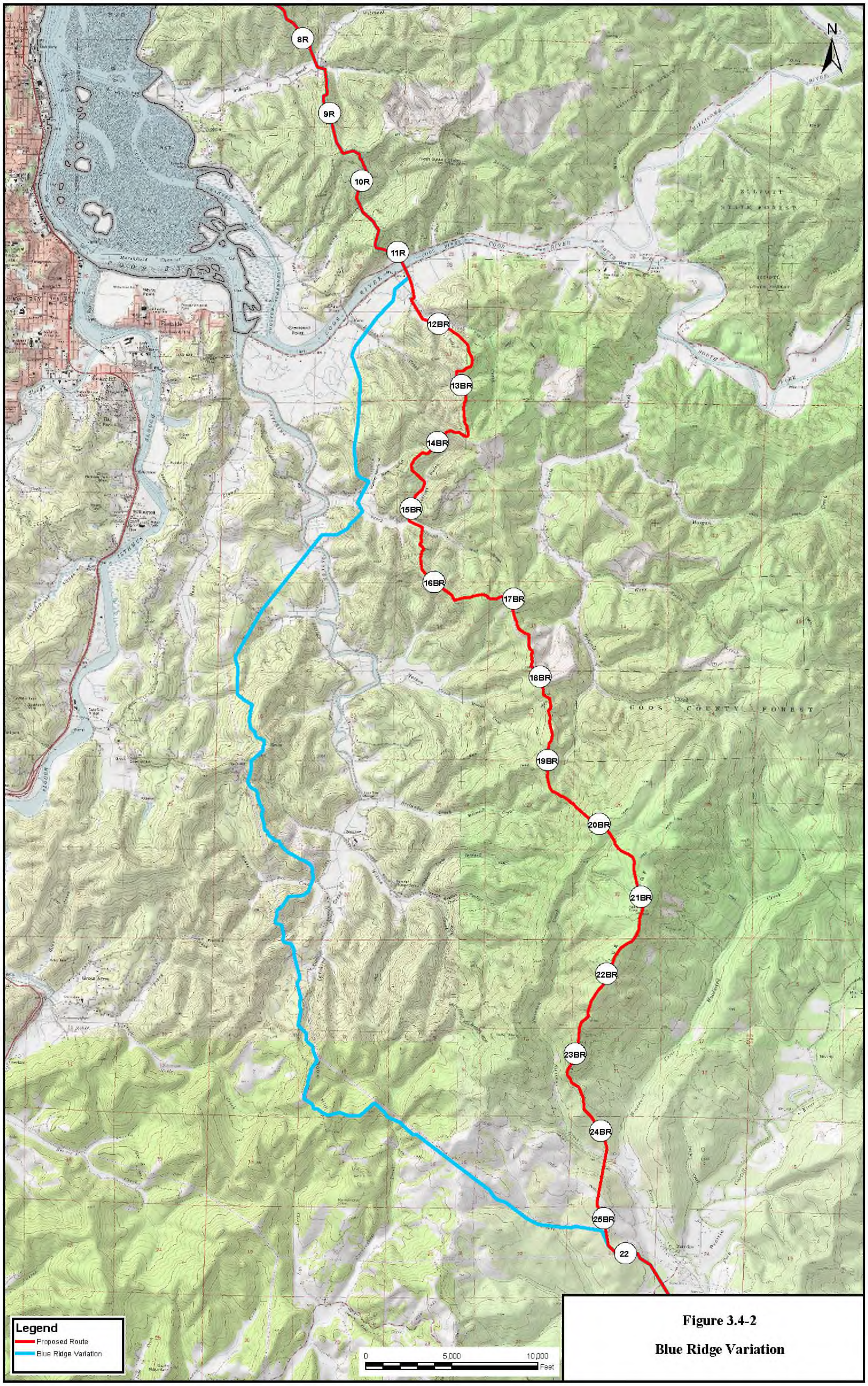

Figure 3.4-2

Blue Ridge Variation

TABLE 3.4.2.2-1

Comparison of Blue Ridge Variation with the Proposed Route

Impact/Issue		**Proposed Route**	**Blue Ridge Variation**
Length (miles) a/		14.0	15.2
Construction right-of-way (acres)		161.4	175.5
Temporary extra work areas (TEWA) (acres)		37.0	57.0
Uncleared storage areas (acres)		45.4	1.5
Temporary access roads (TARs)		0	1 (TAR 13.8)
Permanent access roads (PARs)		0	1 (PAR 15.6)
Operational easement (acres) b/		85.0	92.1
Land ownership (miles)	Private	6.5	13.8
	BLM	7.5	1.4
	State	0.0	0.1
Number of landowner parcels crossed	Private	24	53
	BLM	11	0
	State	1	2
Number of residences within 50 feet of the construction right-of-way		0	1
Water supply wells within 50 feet of the construction right-of-way c/		0	0
Number of waterbodies crossed	Field survey data	3 perennial 5 intermittent d/ e/ (6.5 unsurveyed)	30 perennial 29 intermittent (4.6 unsurveyed)
Length of wetland crossings (miles)		2.0	1.9
Designated Riparian Reserves on BLM-managed lands Impacted (acres)		12.3	9.1
Agricultural pastures affected (acres construction right-of-way)		8.4	11.1
Coniferous forest (acres construction right-of-way) f/	LSOG	40.5	8.8
	Mid-seral	41.8	47.3
	C – R	77.1	113.3
LSRs/ Unmapped LSRs crossed (miles/acres)		5.5 mile / 12.3 acres	0.44 mile / 5.16 acres
Northern Spotted Owl (NSO) home range (1.5-mile radii)		1 / 1.22 miles	1 / 0.75 mile
High NSO NRF and NRF habitat removed (acres) g/		23.8	8.8
Number of marbled murrelet (MAMU) stands crossed by right-of-way		3 occupied stands; 18 presumed occupied stands h/	4 presumed occupied stands
MAMU suitable habitat removed (acres) i/		32.2 (5.8 acres occupied; 26.4 acres presumed)	3.0
Number of anadromous fish-bearing streams crossed j/	Known	4	9
	Assumed	0	9
Fisheries critical habitat (streams crossed)	Coho k/	4	7
	Green Sturgeon l/	0	0
Landslide prone areas m/		2 landslide areas (totaling 3,267 feet)	5 landslide areas (totaling 7,137 feet)
Number of known cultural resources sites		1 n/ o/	0
Number of newly identified cultural resources		1 n/	0 p/
Right-of-way adjacent to existing rights-of-way (miles and percent of route length) q/		8.3 (59 percent)	7.1 (47 percent)

General: All values are rounded (acres to nearest whole acre, miles to nearest tenth of a mile, feet to nearest whole foot).

a/ Route Alternative lengths are measured from the point where they deviate from and then return to the proposed route. Lengths cannot be accurately calculated by comparing mileposts due to shifts in the alignment.
b/ Acres of permanent easement calculated based on a 50-foot-wide permanent easement.
c/ OWRD (2017).
d/ Includes waterbodies not crossed by the centerline but within the right-of-way.
e/ Field surveys on BLM lands and desktop analysis on private lands.
f/ Evergreen Forest: LSOG (late successional/old-growth forest) = 80+ years; Mid-seral = 40 to 80 years; C-R (Clear-cut/regenerating forest) = 0 to 40 years.
g/ Acreage is based on 2017 updated NSO habitat coverage for the pipeline project (nesting, roosting, and foraging habitat: NRF, High NRF).
h/ “Presumed occupied stands” have not been surveyed following the species-specific survey protocol (Mack et al. 2003). “Occupied stands” are confirmed occupied based on the species-specific survey protocol.
i/ Acreage is based on 2017 updated MAMU habitat coverage for the pipeline.
j/ ODF (2017). Each crossing would include clearing of some riparian vegetation.
k/ NMFS (2008a).
l/ NMFS (2009).

TABLE 3.4.2.2-1 (continued)
Comparison of Blue Ridge Variation with the Proposed Route
m/ Based on published sources, including the Oregon Department of Geology and Mineral Industries (DOGAMI) open file report 0-11-01 and Statewide Information Database for Oregon (SLIDO). n/ Surveys are incomplete on approximately 6.0 miles (43 percent) of the route on private lands.). o/ The historic Barker-Morris Families Cemetery, dating to 1872, is located on private land in Township 27 S, Range 12 W, Section 14. The historic cemetery is situated at MP 24.3 of the proposed route. The cemetery is shown on the McKinley 7.5-minute quadrangle approximately 24 meters east of the construction right-of-way. However, cultural surveys have not been conducted on this privately-owned parcel, and the exact location of the cemetery has not been verified. The cemetery is listed in the Oregon Burial Site Guide but has not been recorded as an archaeological site with the Oregon State Historic Preservation Office. p/ Surveys are incomplete on route deviations that are outside the cultural survey corridor for the 2015 FEIS Route. q/ Approximately 5.3 miles (35 percent) of the Blue Ridge Variation is co-located/adjacent to a BPA Powerline corridor, whereas the proposed route is adjacent/co-located with logging roads.

3.4.2.3 Weaver Ridge Variations

At the request of the BLM, we evaluated several route variations between MPs 42.7 and 49.8 to determine if impacts on MAMU and NSO critical habitat could be reduced. As illustrated in figure 3.4-3, we evaluated the Deep Creek Variation, Weaver Ridge Variation 1, Weaver Ridge Variation 2, Weaver Ridge Variation 2a, Weaver Ridge Variation 3, Weaver Ridge Variation 3a, and Weaver Ridge Variation 4.

The Weaver Ridge Variation 1 would deviate from the proposed route around MP 46.0 crossing the logging spur road north of a reservoir and head almost due east on the north side of a tributary of Wildcat Creek over ridges, reconnecting with the proposed route at about MP 49.8. This alternative would be slightly shorter than the proposed route. However, the Weaver Ridge Variation 1 would cross more miles of critical habitat for MAMU and NSO, and would cross two MAMU occupied stands (compared to one along the proposed route) and five NSO home ranges (compared to four along the proposed route).

The Weaver Ridge Variation 2 would start at the same location as Variation 1 but deviate from Variation 1 east of the proposed route at about MP 46, crossing a logging spur road, pass the Signal Tree Quarry, then follow Signal Tree Road for about 3 miles. It would head south over ridges, then join Variation 3 along Wildcat Creek. Weaver Ridge Variation 2a would deviate from Variation 2 just across the Coos County line along Signal Tree Road, cutting diagonally along Wildcat Creek to rejoin Variation 2 Route across the Douglas County line.

The Weaver Ridge Variation 3 would deviate from the proposed route at about MP 42.6. It would follow ridges for about 3.5 miles, crossing Signal Tree Road and Upper Rock Creek. The variation would then turn east and follow ridges for almost 4 miles, crossing Wildcat Creek before rejoining the proposed route at about MP 48.5. Weaver Ridge Variation 3a would deviate from Variation 3 and follow Wildcat Creek for 1.5 miles to join the proposed route at about MP 49.0.

A comparison of the environmental features of the Weaver Ridge Variations and the corresponding segment of proposed route are shown in table 3.4.2.3-1. Weaver Ridge Variations 2, 2a, 3, and 3a are all longer than the corresponding segment of proposed route and would cross more miles of MAMU and NSO critical habitat. Variations 3 and 3a would cross six NSO home ranges, while Variations 2 and 2a would cross five NSO home ranges (compared to four for the corresponding segment of proposed route). Compared to the proposed route, these variations would require clearing more LSOG and affect more acres of LSR on lands managed by the BLM. As a result, none of these variations within this area would ultimately reduce impacts on MAMU and NSO critical habitat. Therefore, we have determined that implementation of Weaver Ridge Variations 2, 2a, 3, and 3a would not result in a significant environmental advantage and are not preferable to the proposed route.

Weaver Ridge Variation 1 would be shorter than the corresponding segment of proposed route and would cross less waterbodies than the proposed route; however, it would have greater impacts on forested habitats, cultural resources, as well as MAMU and NSO critical habitat. Therefore, we have determined that implementation of Weaver Ridge Variation 1 would not result in a significant environmental advantage and is not preferable to the proposed route.

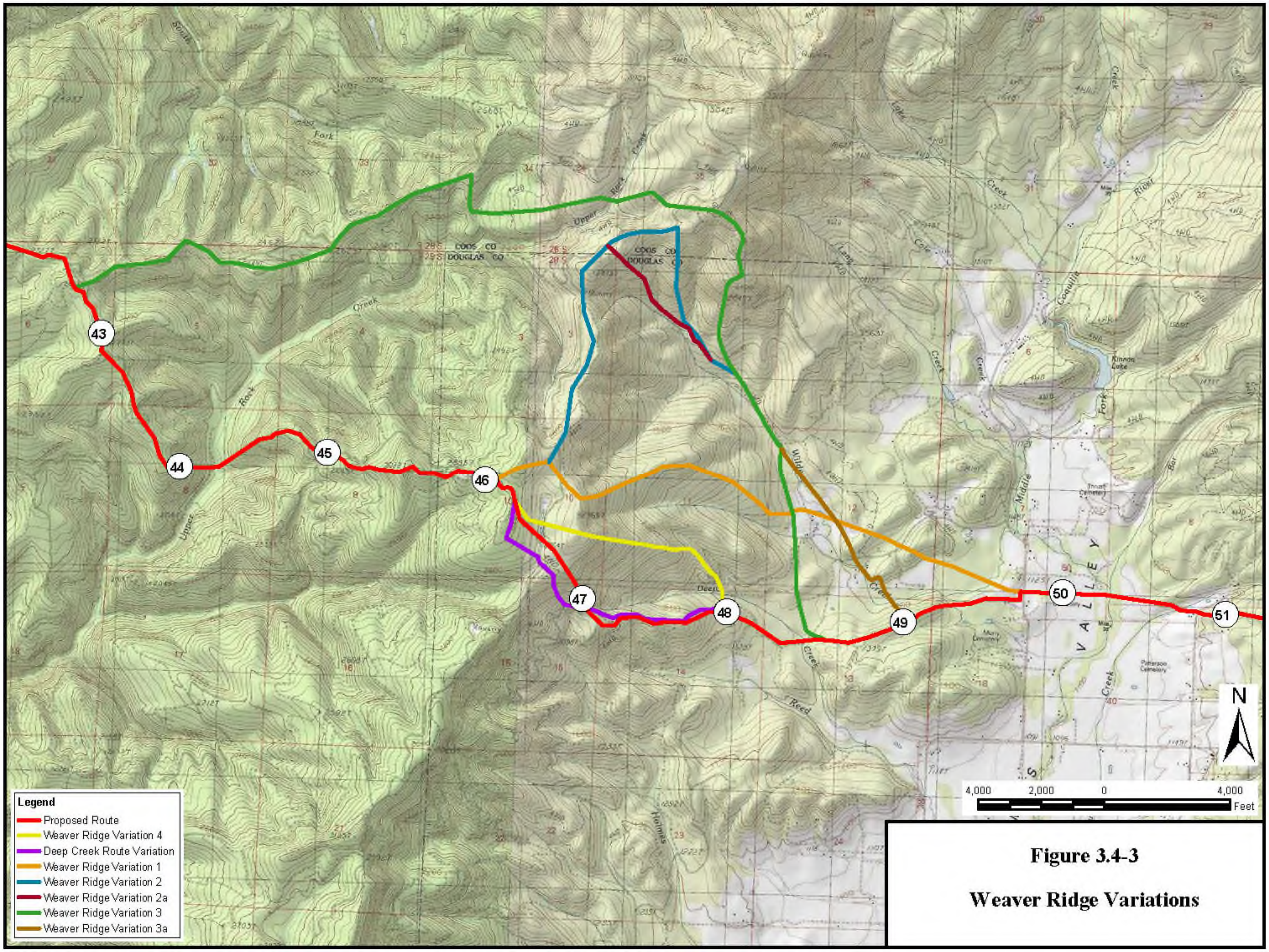

Figure 3.4-3

Weaver Ridge Variations

TABLE 3.4.2.3-1

Comparison of Weaver Ridge Variations with the Proposed Route

Alternatives Analysis		Proposed Route	Deep Creek Variation	Weaver Ridge Variations 4	1	2	2a	3	3a
General									
Total length (miles) a/		7.3	7.4	7.2	7.0	9.3	9.0	8.6	8.2
Construction right-of-way (acres) b/c/		84	85	82	80	107	103	99	94
Operational easement (acres) d/		44	45	43	42	56	54	53	50
Number of Parcels Affected	BLM	4	4	4	3	5	4	4	4
	Private	12	12	11	11	15	14	12	13
	State	0	0	0	0	0	0	0	0
Land ownership (miles)	BLM	2.7	2.8	3.3	2.5	3.4	2.8	3.6	3.2
	Private	4.6	4.6	3.9	4.5	6.0	6.2	5.0	5.0
	State	0	0	0	0	0	0	0	0
Waterbodies and Wetlands									
Number of waterbodies crossed e/		5	5	5	2	7	7	11	11
Total wetland crossing length (feet) f/		0	0	0	0	0	0	0	0
Land Use									
Land Allocations (miles)	Matrix	2.1	2.1	2.1	1.1	1.4	1.4	0.7	0.4
	LSR	0.6	0.7	1.2	1.4	1.9	1.4	2.9	2.9
	Riparian Reserves	0.5	0.7	0.5	<0.1	0.5	0.3	0.6	0.5
Evergreen forest, Mixed conifer (late successional/old-growth) (miles)		0.4	0.7	0.4	1.8	2.2	1.7	1.2	1.7
Regenerating/mid-seral forest (miles)		3.7	5.4	3.9	3.4	4.5	4.5	6.3	5.2
Total forest lands affected (miles)		6.0	7.1	5.9	6.3	8.5	8.1	8.0	7.4
Other land use types (miles)		1.3	0.3	1.3	0.7	0.8	0.8	0.7	0.8
Right-of-way parallel or adjacent to existing rights-of-way (miles)		3.2	3.8	3.6	2.4	3.6	3.2	2.7	2.3
Number of previously identified cultural resources along the route f/		0	0	0	1	0	0	0	0
Newly identified cultural resources along the route (number) f/		0	0	0	0	0	0	0	0
Endangered Species									
MAMU critical habitat crossed (miles)		0.6	0.7	1.2	1.4	2.0	1.4	2.9	2.9
Number of MAMU occupied stands crossed		1	1	2	2	1	1	0	0
MAMU occupied stands crossed (miles)		<0.1	<0.1	0.4	1.0	<0.1	<0.1	0	0
NSO critical habitat crossed (miles)		0.9	1.0	1.0	1.1	1.7	1.3	2.5	2.5
Number of NSO home ranges crossed		4	4	4	5	5	5	6	6
NSO home ranges crossed (miles)		5.9	6.0	5.8	6.0	8.1	7.8	7.3	7.0
Number of NSO 500-acre core areas crossed		1	1	0	1	2	2	2	2
NSO core areas crossed (miles)		0.6	0.6	0	1.1	1.4	1.0	1.9	1.9

TABLE 3.4.2.3-1 (continued)

Comparison of Weaver Ridge Variations with the Proposed Route

Alternatives Analysis	Proposed Route	Deep Creek Variation	Weaver Ridge Variations 4	1	2	2a	3	3a
Number of 30-acre nest patches crossed	0	0	0	1	1	0	0	0
NSO 30-acre nest patches crossed (miles)	0	0	0	0.1	0.4	0	0	0

General: All values are rounded (acres to nearest whole acre, miles to nearest tenth of a mile, feet to nearest whole foot).
a/ Variation lengths are measured from the point where they deviate from and then return to the proposed route. Lengths cannot be accurately calculated by comparing mileposts due to shifts in the alignment.
b/ Assumes a 95-foot-wide construction right-of-way for all variations.
c/ TEWAs for all route variations have not been designed and are not included in the total acres of disturbance.
d/ The assumed operational easement is 50 feet; however, Pacific Connector would only maintain vegetation within 15 feet of the pipeline centerline for a total of 30 feet during operation.
e/ Waterbodies from PNW Hydrography Framework Clearinghouse.
f/ NWI CONUS data.

Weaver Ridge Variation 4 would deviate from the proposed route at about MP 46.3 and head southeast over ridges on the north side of Deep Creek, crossing the logging spur road south of the reservoir and reconnecting with the proposed route at about MP 48.0. The Deep Creek Variation would deviate from the proposed route at about MP 46.3 and follow a ridge north of Holmes Creek Spur Road and an unnamed four-wheel-drive road back to the proposed route at about MP 47.0 and cross to the north side of the proposed route and parallel that route for about 1 mile before reconnecting with the proposed route near MP 48.0. The Deep Creek Variation would be about 0.1 mile longer than the corresponding segment of proposed route. Based on a geotechnical review, a high risk of landslides and surface erosion were identified where the Deep Creek Variation would cross the eastern flank of Weaver Ridge above a first order stream. Similarly, where Weaver Ridge Variation 4 would cross Weaver Ridge, it would traverse an extremely steep, narrow rock outcrop that would require blasting. These areas would be avoided by the proposed route where it would ascend Weaver Ridge westward from a forest plantation near MP 46.5 up the slope to the north avoiding the rock outcrop. For these reasons, we have determined that implementation of the Deep Creek Variation and Weaver Ridge Variation 4 would not result in a significant environmental advantage and are not preferable to the proposed route.

3.4.2.4 Camas Valley Northern Variation

Pacific Connector had initially identified a potential variation through the Camas Valley between MPs 50 and 53 to minimize impacts on MAMU habitat (i.e., the Camas Valley Northern Variation), and we evaluated this variation to see if it would be environmentally preferable to the proposed route. This variation is illustrated on figure 3.4-4 and compared in table 3.4.2.4-1.

The Camas Valley Northern Variation would deviate from the proposed route at about MP 50.2 and head northeast across the Camas Valley then turn southeast over forested hills before rejoining the proposed route near MP 53.0. This variation would cross habitat and one occupied stand for MAMU and habitat for NSO on BLM-managed lands. For this reason, the BLM found it unacceptable. We agree and have determined that implementation of the Camas Valley Northern Variation would not result in a significant environmental advantage and is not preferable to the proposed route.

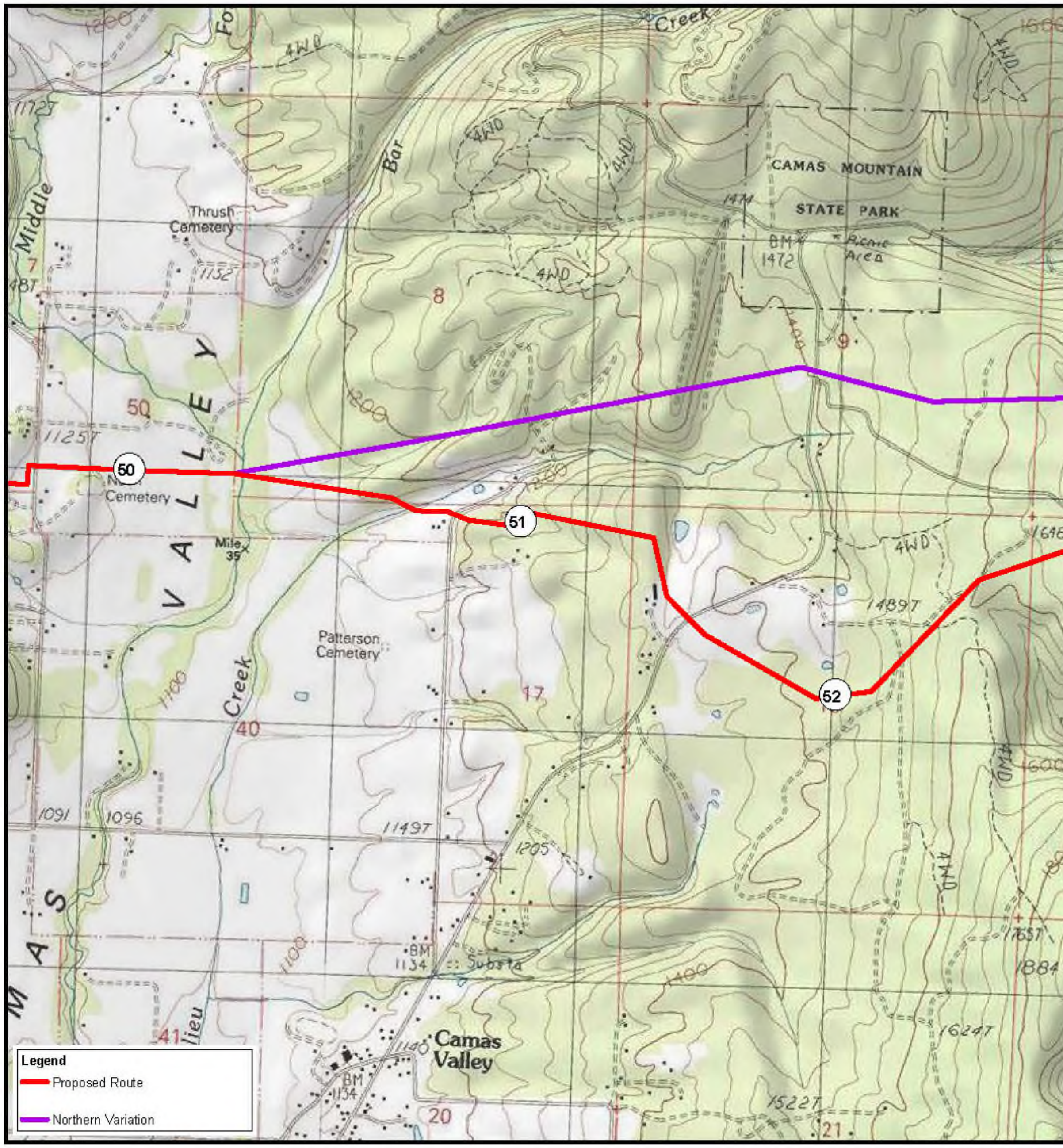

Figure 3.4-4

Camas Valley Northern Variation

TABLE 3.4.2.4-1

Comparison of Camas Valley Northern Variation with the Proposed Route

Alternatives Analysis		Proposed Route		Camas Valley Northern Variation
General				
Length (miles) a/		2.9		2.7
Construction right-of-way (acres)		33		31
Permanent easement (acres) b/		17		16
Land Use				
Land Ownership (miles)	Private	2.3		2.0
	State	0		0
	Federal (BLM/NFS lands)	0.6		0.8
Number of landowner parcels crossed		15		8
Number of residences within 50 feet of construction right-of-way		0 c/		0
Right-of-way parallel or adjacent to existing rights-of-way (miles)		0.1		0.1
LSR - Federal land use designation (acres)		5 d/		0
Riparian Reserves - federal land use designation (acres)		1		3
Waterbodies and Wetlands				
Number of waterbodies crossed e/		4		11
Length of wetland crossings (feet) f/		0		0
Vegetation				
Agricultural lands affected (acres)		8		2
Total forest clearing (acres)		28		39
Clearcut/ Regenerating (0 to 40 years) (acres) g/		14		22
Mid-Seral Forest (40 to 80 years) (acres)		8		10
Late-Successional Forest (80 to 175 years) (acres)		6		2
Old-Growth Forest (175 years +) (number)		0		4
Biological Resources				
MAMU suitable habitat crossed (feet) h/		5		18
MAMU stands		No known stands	Occupied	Alignment crosses 1,043 feet of Occupied Stand R3027
		No known stands	Presumed	Alignment crosses 350 feet of potential MAMU Stand B12 not likely to be occupied based on 2-year survey protocol.
MAMU critical habitat (acres)		5 Pacific Connector made a minor adjusted to the Southern Route Variation to avoid crossing approximately 175 feet of the old-growth forest within this Critical Habitat Unit.)		0
NSO suitable habitat crossed (acres) i/		20		33
NSO nest patch/cores		No known nest patch/cores		None
NSO critical habitat crossed (feet)		0		0
Area affected by habitat category (acres) j/			Category	
		2	1	5
		13	2	5
		17	3	15
		16	4	18
		2	5	2
		3	6	2

TABLE 3.4.2.4-1 (continued)

Comparison of Camas Valley Northern Variation with the Proposed Route

Alternatives Analysis	Proposed Route	Camas Valley Northern Variation
Kincaid's lupine	Approximately 1.1 miles of habitat may be suitable for Kincaid's lupine.	Approximately 2.2 miles of potential habitat crossed; 0.8 mile surveyed of which 0.3 mile was considered suitable.
ESA fish species present/habitat k/	1 stream crossing known, 3 stream crossings unknown. 1 stream crossing - Oregon Coast ESU Coho, assumed.	1 stream crossing known, 3 stream crossings unknown. 1 stream crossing - Oregon Coast ESU Coho, assumed.
StreamNet – anadromous fish distribution l/	None	None
Geotechnical		
Steep or difficult terrain (miles) m/	0.0	0.0
Highly erosive soils (miles) n/	0.2	0.2
Cultural Resources		
Number of previously recorded cultural resources	2 sites	3 - Isolated finds; 2- sites
Number of newly identified cultural resources o/	1- isolated find	N/A

General: All values are rounded (acres to nearest whole acre, miles to nearest tenth of a mile, feet to nearest whole foot).
a/ Variation length is measured from the point where it deviates from and then returns to the proposed route. Length cannot be accurately calculated by comparing mileposts due to shifts in the alignment.
b/ Assumes 50-foot-wide operational easement.
c/ There are 2 outbuildings (barns/sheds) in the vicinity of the proposed route that are within 50 feet of the construction right-of-way (MP 51.4 and MP 51.9). Neither of these structures is suspected of being residences; however, during the right-of-way acquisition phase, Pacific Connector would attempt to locate the construction right-of-way at least 50 feet from any residences, where feasible.
d/ Approximately 5 acres of LSR would be affected, with 3 acres occurring within clear- cut/regenerating forests (0 to 40 years) and 2 acres occurring within mid-seral forest (40 to 80 years).
e/ Waterbodies from PNW Hydrography Framework Clearinghouse.
f/ NWI CONUS data.
g/ Forest Age Classes: Includes recent clearcut forests and areas of inroad construction where forest clearing would be reduced.
h/ Huff et al. (2006).
i/ Forest Service (2005a).
j/ Based on surveys completed by Pacific Connector.
k/ FWS, NMFS, and StreamNet (http://www.streamnet.org).
l/ ODFW (2000, 2006a); StreamNet.
m/ Based on Soil Mapping Units that have slopes of 50-75 percent and have a water erosion rating of high or severe (NRCS 2004).
n/ Based on Soil Mapping Units that have a water erosion rating of high or severe (NRCS 2004).
o/ Variation has not been completely surveyed.

3.4.2.5 Umpqua National Forest Variations

In consultation with the Forest Service and to evaluate potential options to reduce impacts on forested lands, we evaluated three route variations within the Umpqua National Forest between MPs 104.8 and 111.5. The proposed route and variations are shown on figure 3.4-5.

Variation 1 would generally follow along Wildcat Ridge close to the proposed route between MPs 105 and 109, where it would then turn east and then southeast, crossing near Long Prairie, then south before rejoining the proposed route near MP 111.2. Environmental features crossed or affected by Variation 1, and a comparison to the corresponding segment of proposed route, are included in table 3.4.2.5-1.

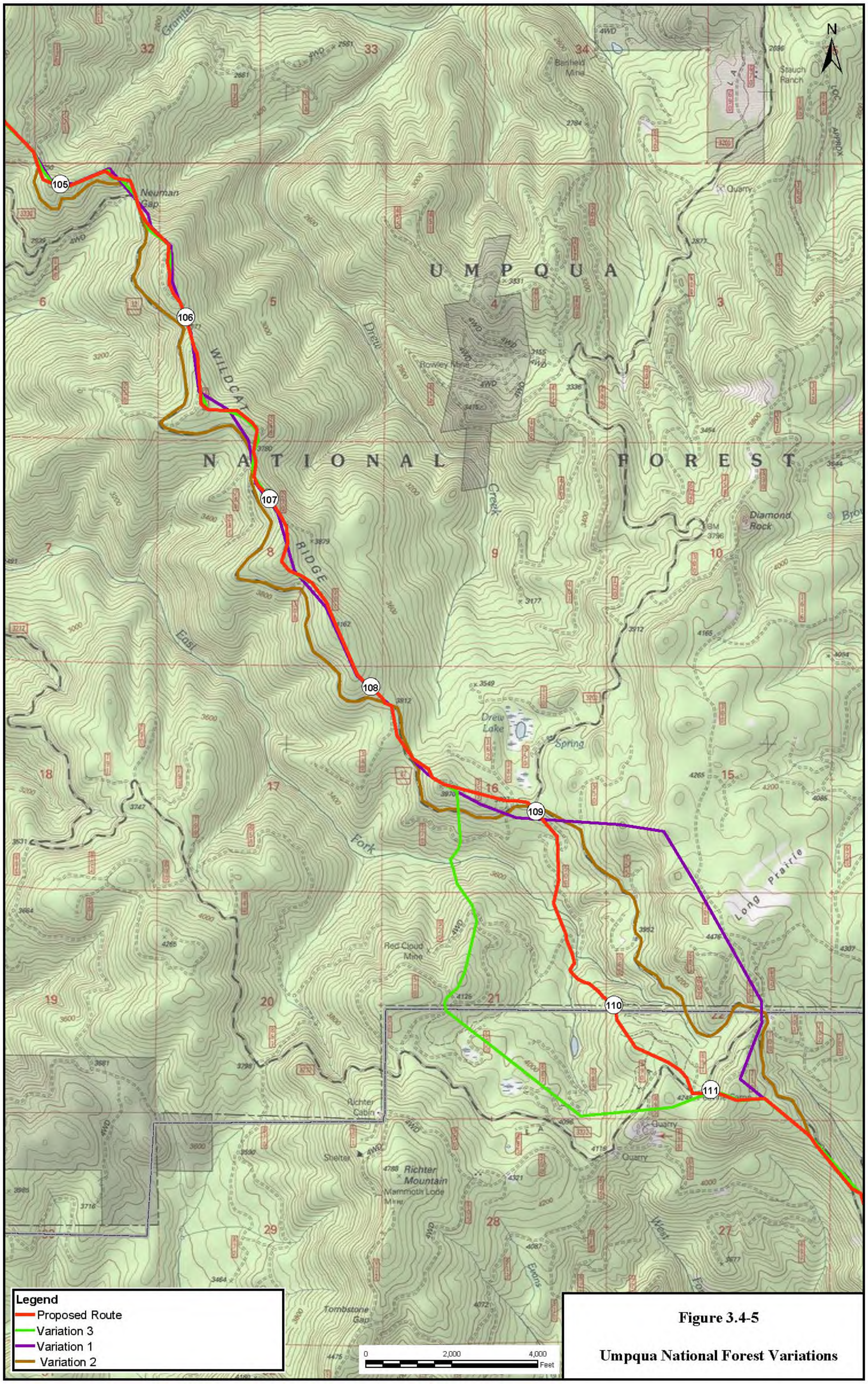

Figure 3.4-5

Umpqua National Forest Variations

TABLE 3.4.2.5-1

Comparison of Umpqua National Forest Variations with the Proposed Route

Impact/Issue	Proposed Route	Variation 3	Variation 1	Variation 2
General				
Total length (miles) a/	6.4	6.7	6.4	7.5
Construction right-of-way (acres) b/	73	77	73	86
Total construction disturbance (acres)	110	117	110 c/	129 c/
Operational easement (acres) d/	45	41	45	45
Land Ownership (miles)				
Forest Service	6.4	6.7	6.4	7.5
Geotechnical				
Steep or difficult terrain crossed (miles) e/	0.2	0.4	0.1	7.5 (side hill along existing road)
Waterbodies and Wetlands				
Number of waterbodies crossed f/	5	6	1	13
Wetlands crossed (feet) f/	150	120	0	30
Waterbody and wetland disturbance during construction (acres)	0.2	0.3	0	0
Land Use				
Land allocations crossed (miles):				
Matrix	2.9	3.3	3.1	3.3
LSR	3.5	3.4	3.3	4.2
Riparian Reserves	0.5	0.2	0.0	0.3
Evergreen Forest, Mixed conifer (miles)	4.2	3.9	3.4	5.6 h/
Regeneration Forest (miles)	1.8	2.3	2.7	1.8 h/
Clearcuts (miles)	0.0	0.0	0.1	0.0 h/
Total forest lands crossed (miles)	6.0	6.2	5.9	7.4 h/
Other land use types	0.4	0.5	0.4	0.1 h/
Parallel or adjacent to existing rights-of-way (miles)	5.6	5.1	5.4	7.3
Cultural Resources				
Number of previously identified cultural resources along route	0	1 – site 2 – isolated finds	3	0
Number of newly identified cultural resources along route	3 – site 1–isolated find	Information not available	1	Information not available
Critical Habitat g/				
Federally listed critical habitat for NSO affected (acres)	52	33	34	40 (95-foot ROW only)
Federally listed critical habitat for NSO crossed (miles)	6.4	6.7	6.3	7.5
Number of NSO core areas crossed (0.5-mile buffer of nest site)	3	4	3	3

General: All values are rounded (acres to nearest whole acre, miles to nearest tenth of a mile, feet to nearest whole foot).
a/ Variation lengths are measured from the point where they deviate from and then return to the proposed route. Lengths cannot be accurately calculated by comparing mileposts due to shifts in the alignment.
b/ Assumed construction right-of-way 95 feet wide.
c/ TEWAs for the variation have not been designed but are estimated assuming they would be comparable to the proposed route.
d/ The assumed operational easement is 50 feet.
e/ Based on slopes that are greater than 50 percent (based on 10-meter digital elevation model).
f/ Waterbodies identified using USGS National Hydrography Dataset, and wetlands identified using FWS National Wetland Inventory mapping.
g/ Includes acres of impact associated with the construction right-of-way and TEWAs. This analysis used the final revised critical habitat designation (2008).
h/ Variation 2 follows existing Forest Service Road 3200 which is assumed would require extensive side-cuts, therefore, miles crossed considered habitat adjacent to the road.

Most environmental impacts from Variation 1 would be similar to those from the proposed route. The primary environmental advantage would be fewer waterbodies crossed (1 compared to 7), and less NSO critical habitat affected (34 compared to 52 acres) than the corresponding segment of proposed route. The primary disadvantage of the variation is that it has the potential to impact an important traditional cultural property as identified by the Forest Service and Cow Creek Tribe.

Based on this concern, we have determined that implementation of Variation 1 would not result in a significant environmental advantage and is not preferable to the proposed route.

Variation 2 would follow a route suggested by the Forest Service that would follow existing Forest Service Road 3200 between about MPs 104.8 and 111.5 of the proposed route. The rationale for this variation is to utilize the existing cleared road corridor to minimize forest fragmentation and reduce impacts on LSRs. Variation 2 would be about 1.1 miles longer and result in about 19 additional acres of construction disturbance and would follow 7.3 miles of existing roadway (97 percent) compared to 5.6 miles (88 percent) along the proposed route. Environmental features crossed or affected by Variation 2, and a comparison to the corresponding segment of proposed route, are included in table 3.4.2.5-1.

Most environmental impacts from Variation 2 would be similar to those of the proposed route. The primary environmental advantage would be its location along an existing roadway which would reduce creation of a new linear forest clearing. The primary disadvantages of Variation 2 would be that more perennial waterbodies would be crossed (13 compared to 7) and that the route would be located adjacent to steep sideslopes along the existing narrow Forest Road 3200. A high risk of landslide occurrence from pipeline installation has been identified along Forest Service Road 3200 headwall swales and constructed fill slopes that would be required to create a working surface for pipeline installation. Steep side slopes along Forest Road 3200 would require significant excavations to construct a 95-foot-wide construction corridor. Pacific Connector estimates the cut slope required to create the work space would be between 100 to 135 feet in height and extend at least 50 feet upslope of the existing cut slope along the road. The required extra cut and fill construction impact area would negate any advantage from following the existing roadway. For these reasons, we have determined that implementation of Variation 2 would not result in a significant environmental advantage and is not preferable to the proposed route.

Variation 3 would begin at MP 108.5 where it would turn south from the proposed route, and then turn southeast and then east, rejoining the proposed route at MP 111.1. Environmental features crossed or affected by Variation 3, and a comparison to the corresponding segment of proposed route, are included in table 3.4.2.5-1.

The Forest Service has stated that Variation 3 would cross an area planned for expansion of the Peavine rock quarry and therefore considers the variation an incompatible use, and identified concerns with potential slope instability and aquatic impacts at the crossing location of the East Fork Cow Creek. The Peavine quarry is the largest and most extensively developed quarry within the upper reaches of the watershed and is of strategic importance to the Umpqua National Forest. For these reasons, we have determined that implementation of Variation 3 would not result in a significant environmental advantage and is not preferable to the proposed route.

3.4.2.6 Rogue River National Forest Variations

To evaluate potential alternatives that may reduce impacts on LSR and Riparian Reserves, we consulted with the Forest Service and evaluated two route variations within the Rogue River National Forest in the vicinity of Robinson Butte and Cox Butte between about MPs 155.1 and 168.9. Table 3.4.2.6-1 provides a comparison of Variation 1 and Variation 2, and the corresponding segment of proposed route. These variations and the proposed route are shown on figure 3.4-6.

TABLE 3.4.2.6-1

Comparison of Rogue River National Forest Variations with the Proposed Route

Impact/Issue		Proposed Route	Variation 1	Variation 2
General				
Total Length (miles) a/		13.8	12.9	15.7
Construction right-of-way (acres) b/		159	148	180
Total construction disturbance (acres)		209	194 c/	236 d/
operational easement (acres) e/		84	78	95
Land ownership crossed (miles)	Forest Service	12.5	11.5	14.3
	Private	0.5	0.5	0.6
	State	0.0	0.0	0.0
Waterbodies and Wetlands				
Number of waterbodies crossed f/		6	2	14
Land Use				
Land allocations crossed (miles)	Matrix	0.0	0.0	0.0
	LSR	12.5	11.5	14.3
	Riparian Reserves	0.4	1.5	1.1
Evergreen Forest, Mixed Conifer crossed (miles)		6.1	6.8	6.0
Regeneration Forest crossed (miles)		5.6	5.9	5.4
Clearcuts crossed (miles)		0.3	0.1	0.0
Total Forest lands crossed (miles)		12.0	12.8	11.4
Right-of-way parallel or adjacent to existing rights-of-way (miles)		4.4	1.6	14.0
Visual Resources				
Visual Impacts along existing Forest roads		Moderate where parallel to existing roads (4.4 miles)	Minimal except at existing road crossings	Existing road corridors expected to be significantly altered from 95-foot-wide construction footprint along 13.6 miles of Forest roads.
Cultural Resources				
Number of previously identified cultural resources along route		1	1	0 g/
Habitat for Federally Listed Species				
Federally listed critical habitat for the NSO (acres) h/		159	148	180
Number of NSO activity centers crossed		2 - ½ mile buffer of site	2 - ½ mile buffer of site	2 - ½ mile buffer of site

General: All values are rounded (acres to nearest whole acre, miles to nearest tenth of a mile, feet to nearest whole foot).

a/ Route Alternative are measured from the point where they deviate from and then return to the proposed route. Lengths cannot be accurately calculated by comparing mileposts due to shifts in the alignment.

b/ The construction right-of-way for the preferred route and original proposed alignment is 95 feet.

c/ Pacific Connector estimates that the Variation 1 would likely require more TEWAs compared to the compromise route because of side slope construction between approximately MPs 149 and 152.9 and because of the increased number of stream crossings along the Variation 1. However, because they have not been designed, we have estimated the area of TEWAs based on a comparable length of the proposed route.

d/ TEWAs have not been designed for this route; however, we have estimated the area based on a comparable length of the proposed route.

e/ The assumed operational easement for all routes is 50 feet. However, Pacific Connector would only maintain vegetation within 15 feet of the pipeline centerline for a total of 30 feet in the long term.

f/ Waterbodies from PNW Hydrography Framework Clearinghouse.

g/ Surveys are incomplete or in progress on the proposed route.

h/ Includes acres of impact associated with the construction right-of-way.

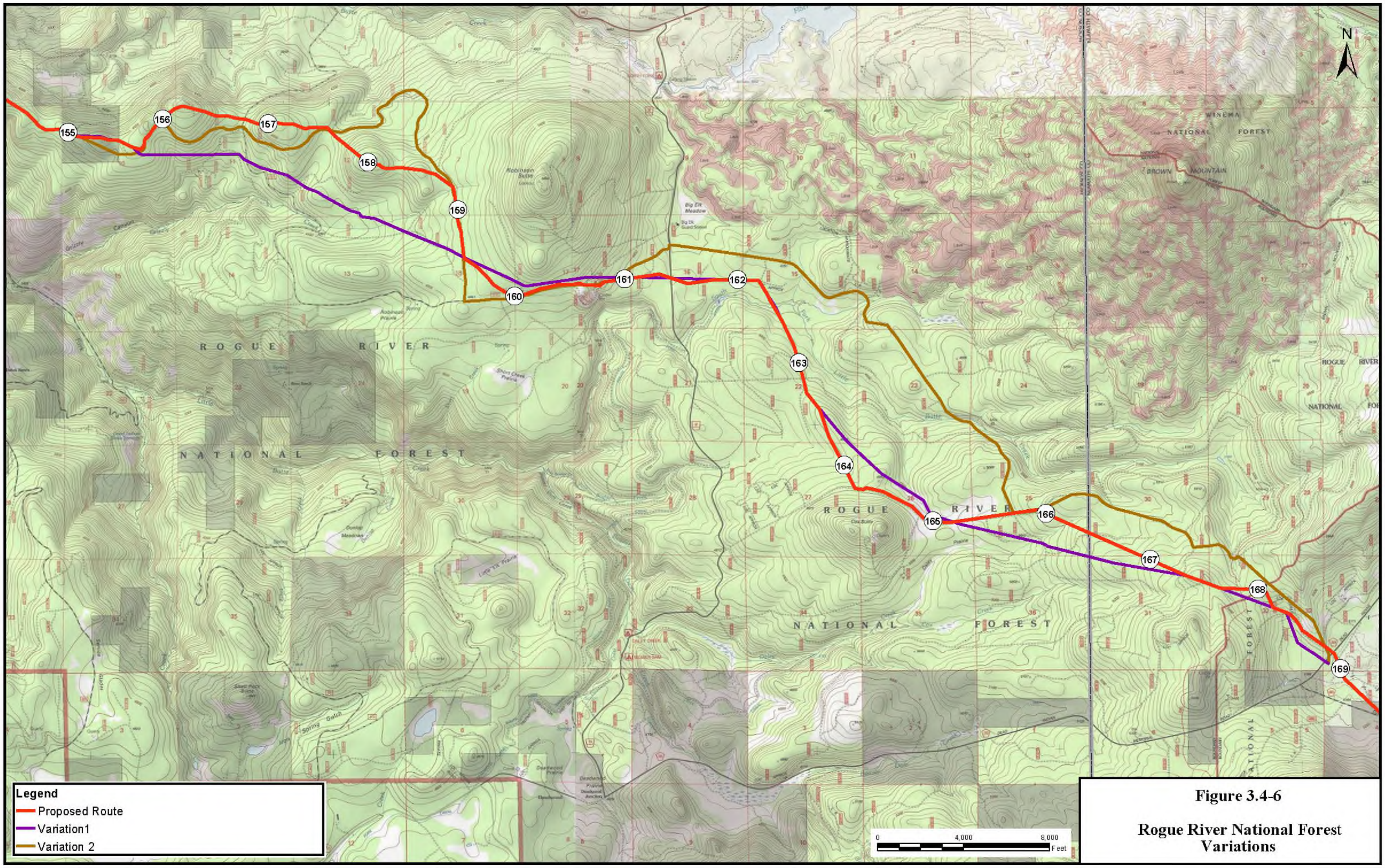

Figure 3.4-6

Rogue River National Forest Variations

Variation 1 would deviate from the proposed route at about MP 155 and remain south of it on the south side of Robinson Butte near MP 159. From that point, Variation 1 would closely follow the proposed route but would be straighter and cross through older forests, which provide NSO habitat. Variation 1 would cross Big Elk Road, cross northeast of Cox Butte, and would cross Daley Prairie, then cross into Klamath County and rejoin the proposed route near MP 169. Variation 1 would be about a mile shorter than the corresponding segment of proposed route. The variation would be adjacent to existing rights-of-way for 1.6 miles (12 percent) compared to 4.4 miles (32 percent) for the corresponding segment of the proposed route.

The primary advantage of Variation 1 is it would require less construction disturbance (194 compared to 209 acres), cross fewer waterbodies (2 compared to 6), cross less LSR (11.5 compared to 12.5 miles), and affect less critical habitat for NSO (148 compared to 159 acres) than the corresponding segment of the proposed route.

The primary disadvantages of Variation 1 are that it would affect more forest (12.8 compared to 12.0 acres) and more riparian reserves (1.5 compared to 0.4 acres) than the corresponding segment of proposed route. As described above, the variation would have some environmental advantages and some environmental disadvantages over the corresponding segment of proposed route. Overall, we do not believe that the advantages overcome the disadvantages, and for this reason we have determined that implementation of the Rogue River National Forest Variation 1 would not result in a significant environmental advantage and is not preferable to the proposed route.

The rationale for evaluating Variation 2 was to evaluate the potential for reducing forest vegetation clearing by utilizing the existing cleared roadways as part of the construction corridor, thereby reducing some of the forest fragmentation and habitat loss in LSR 227. Also, this variation would cross the Pacific Crest Trail (PCT) along an existing road, reducing potential impacts on trail users by eliminating a separate crossing. Variation 2 would deviate from the proposed route at about MP 155, north of Grizzly Canyon, and head east along Forest Service Roads 410 and 300, around the south side of Robinson Butte along Forest Service Road 3730, south of Big Elk Guard Station along Forest Service Road 3705, across the South Fork Little Butte Creek, turn east along Forest Service Road 3720, entering Klamath County, to Forest Service Road 700, cross the PCT several miles south of Brown Mountain, then head southeast cross-county into the Winema National Forest, across Dead Indian Memorial Highway, and would rejoin the proposed route along Clover Creek Road north of Burton Butte just east of MP 169.

Variation 2 would be about 3 miles longer than the proposed route and would require widening the existing roads, which are generally between 20 and 30 feet wide. This would require cutting mature forest in portions of the right-of-way. Based on input from the engineering review conducted by Pacific Connector, the pipeline would not be constructible along portions of some roads due to the steep terrain and side slope and the tight radius turns. For this reason, we have determined that implementation of the Rogue River National Forest Variation 2 is not technically feasible and do not consider it further.

3.4.2.7 Survey and Manage Species Variation

In consultation with the Forest Service, we evaluated a route variation between MPs 111.5 and 111.6 to avoid impacts on *Sarcodon fuscoindicus,* a Survey and Manage fungi species). This variation would provide a no-disturbance buffer for *Sarcodon fuscoindicus*. The buffer is necessary to protect these sites to comply with the 2001 Survey and Manage Record of Decision to maintain the persistence of the affected species within the range of the NSO (see section 4.6.4.3, Survey and Manage).

Under this variation, the construction right-of-way between MPs 111.5 and 111.6 would be shifted at least 25 feet to the northeast, and the UCSA on the southwest side of the construction right-of-way would be eliminated. As a result, at least one of the two known occurrences of this species within the site would be at least 100 feet from any Project-related disturbance (see figure 3.4-7).

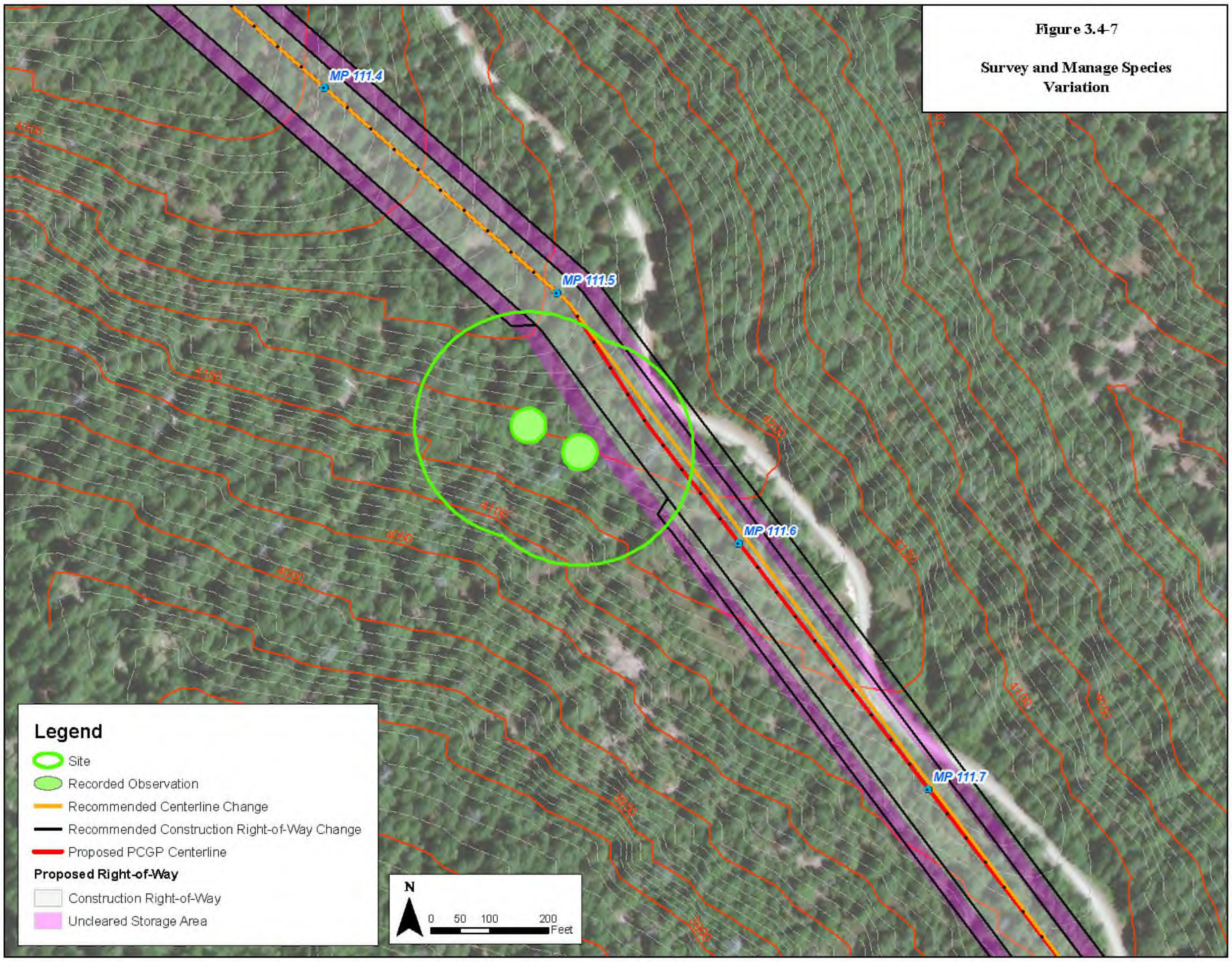

Figure 3.4-7

Survey and Manage Species Variation

The primary advantage of this variation is that a buffer would be provided to protect known sites of *Sarcodon fuscoindicus*. No disadvantages have been identified for this variation. As a result, this variation would result in an environmental advantage and is preferable to the proposed route. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary, for review and written approval by the Director of OEP, revised alignment sheets that incorporate the Survey and Manage Species Variation into the proposed route between MPs 111.5 and 111.6, and provide documentation of consultation with the Forest Service.**

3.4.2.8 East Fork Cow Creek Variation

In consultation with the Forest Service, we evaluated a route variation between MPs 109.7 and 109.8 that considered a modified crossing of the East Fork Cow Creek (EFCC) to avoid the parallel pipeline alignment between the upper reaches of the perennial streams in this area. In the EFCC Variation, the pipeline from MP 109.6 would proceed southeasterly crossing a reach of the EFCC and then continue east crossing an upper reach of the EFCC. The variation then follows a gentle ridgeline to the south rejoining the proposed route at MP 109.9 (see figure 3.4-8). This variation would negate the need for amendment UNF-2 on the Umpqua National Forest.

The primary advantage of the variation is that it would reduce the amount of pipeline (about 535 feet) parallel to tributaries to EFCC between MPs 109.7 and 109.8 (see figure 3.4-8). In this area between the tributaries, the proposed route alignment also traverses a narrow ridgeline that supports old-growth forest/high NRF habitat within Riparian Reserves. Avoidance of this area would reduce the potential for long-term restoration and monitoring of hydrologic features affected during construction. The route variation incorporates crossings that are perpendicular to the hydrologic features, reducing the risk of site destabilization and increasing the likelihood of successful stream channel restoration.

The EFCC Variation is the same length as the proposed route and would result in less disturbance (0.12 acre) than the proposed route because of neck-downs along the construction right-of-way at the crossings of EFCC (see table 3.4.2.8-1). The EFCC Variation would also affect slightly less old growth and northern spotted owl suitable habitat than the proposed route. No environmental disadvantages have been identified for this variation.

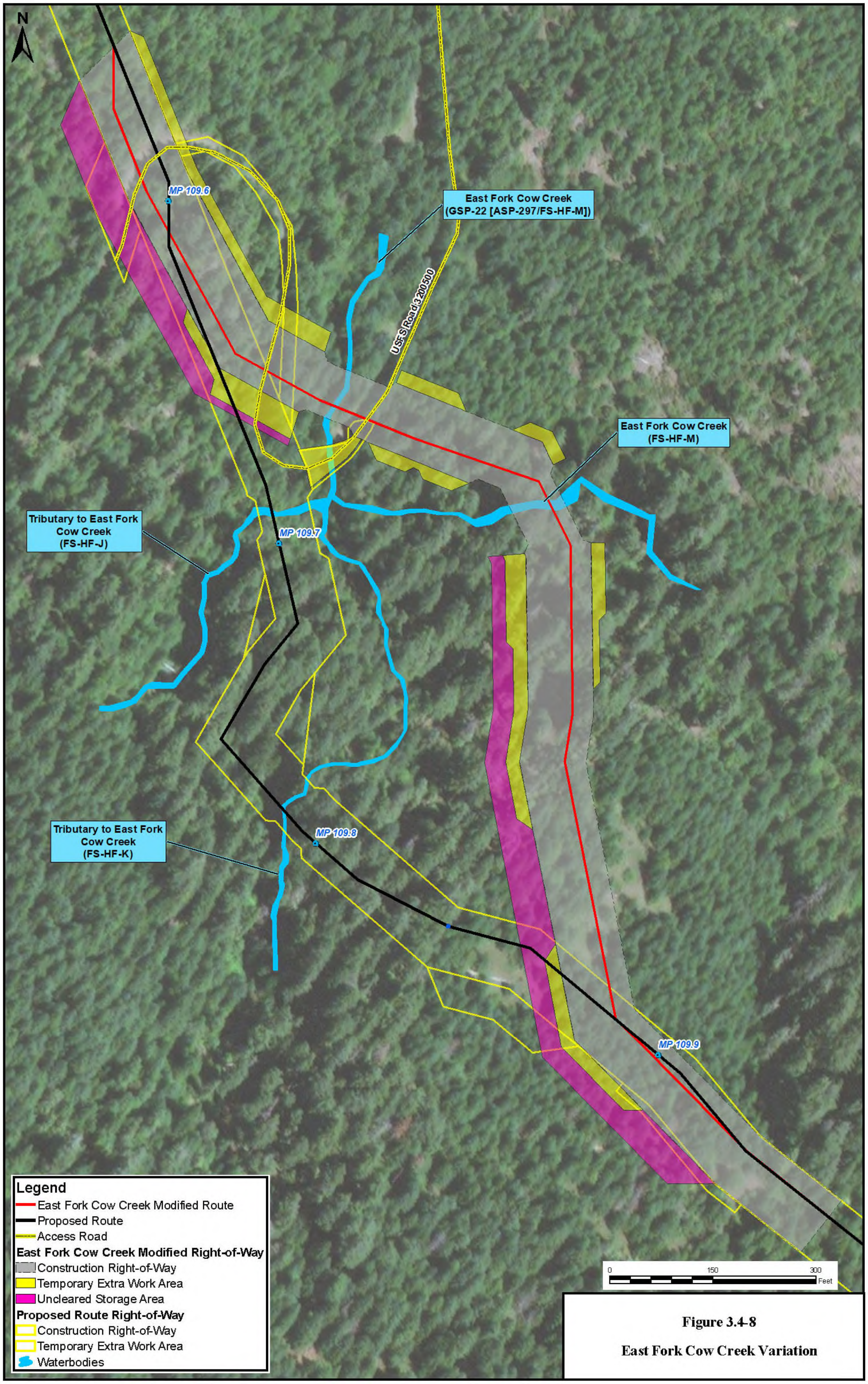

Figure 3.4-8

East Fork Cow Creek Variation

TABLE 3.4.2.8-1

East Fork Cow Creek Variation

Alternatives Analysis	Proposed Route	EFCC Variation
General		
Length (miles)	0.42	0.42
Construction right-of-way (acres)	4.75	4.63
Number of temporary extra work areas (TEWAs)	7	9
Acres of TEWAs	0.91	1.0
Number of Uncleared Storage Areas (acres) a/	0 (0.00)	2 (1.34)
Permanent Easement (acres) b/	2.55	2.55
Land Use		
Miles of right-of-way parallel or adjacent to existing rights-of-way (percent of alternative length) c/	0.02 (6.7%)	0.00 (0.00)
Riparian Reserves - Federal Land Use Designation (acres)	4.26	4.41
Waterbodies and Wetlands		
Number of waterbodies crossed d/	2	2
Length of waterbody crossings (feet) e/	17	12
Alignment parallel to waterbody (feet) d/	535	0
Vegetation		
Total forest clearing (acres)		
Acres clear-cut/regenerating (0-40 years)	2.22	2.19
Acres mid-seral forest (40-80 years)	0.26	0.51
Acres Late Successional Forest (80-175 years)	0.00	0.00
Old Growth Forest (175 +)	2.70	2.65
Biological Resources		
Northern Spotted Owl Suitable Habitat Crossed (High NRF & NRF) (acres) f/	2.70	2.65
Northern Spotted Owl nest patch/cores (NSO)	0	0
Northern Spotted Critical Habitat Crossed (acres)	5.66	5.64

General: All values are rounded (acres to nearest whole acre, miles to nearest tenth of a mile, feet to nearest whole foot).
a/ Acres of Uncleared Storage Areas are not included in the impact comparison (acres) of the various resources because grading and tree clearing will not occur in these areas.
b/ Acres of permanent easement calculated based on a 50-foot width.
c/ Based on inventoried roads included in Umpqua NF Road data and BLM GTRN data (https://www.blm.gov/or/gis/data.php).
d/ Based on field surveys (see Table A.2-3 to Appendix A.2 to Pacific Connector's Resource Report 2 and supplemental wetland delineation report filed in May 2018).
e/ Based on the proposed alignment between the tributaries to EFCC (FS-HF-J and FS-HF-K) (MPs 109.7 to 109.8). In this area the alignment follows a narrow ridge.
f/ See Section 3.3.4.2 in Applicant-Prepared Draft Biological Assessment.

The EFCC variation would result in a significant environmental advantage and is preferable to the proposed route. Therefore, **we recommend that**:

- **Prior to construction, Pacific Connector should file with the Secretary, for review and written approval by the Director of OEP, revised alignment sheets that incorporate the East Fork Cow Creek Variation into its proposed route between MPs 109.6 and 109.9, and provide documentation of consultation with the Forest Service.**

3.4.2.9 Pacific Crest Trail Variation

In consultation with the Forest Service, we evaluated a variation that would include an alternative crossing location of the PCT. The variation would co-locate the pipeline with an existing Forest Service Road (3720-700) north of MP 167.8 (see figure 3.4-9). This variation would minimize potential impacts on trail users by realigning the pipeline to an area of the trail that is adjacent to existing disturbance/intrusion from Forest Service Road 3720-700.

The primary advantages of the PCT Variation are that it would minimize potential visual impacts on PCT trail users by locating the crossing at an existing road, and it would be co-located with existing road rights-of-way for 1.37 miles (77.4 percent of its length). The variation would avoid crossing the PCT in an old-growth forest stand and corresponding recreation corridor that lies between Peterson Snow Park and the Brown Mountain Shelter, thereby reducing visual impact from pipeline clearing on trail users. This would also alleviate the need for a multiple-year revegetating/screening plan at the proposed crossing location, which is expected to require ongoing monitoring to ensure new vegetation is successfully established post construction. The PCT Variation would also be located about 1,000 feet farther from the Brown Mountain Shelter, which would minimize potential noise disturbance to shelter users during construction and potentially during restoration efforts. The water well at the shelter is proposed as an irrigation source for replanted trees for restoration of the trail crossing along the proposed route. Further, the PCT Variation would minimize potential construction-related traffic effects because traffic would follow the construction right-of-way at the trail crossing, which is co-located with the existing Forest Service Road 3720-700. The PCT Variation would also cross approximately 0.5 mile less of northern spotted owl nest patch and core areas and would impact less old growth habitat (175 + years old) than the proposed route (see table 3.4.2.9-1). The PCT Variation would also avoid the potential impacts from geotechnical borehole investigation that would be required for the HDD crossing along the proposed route.

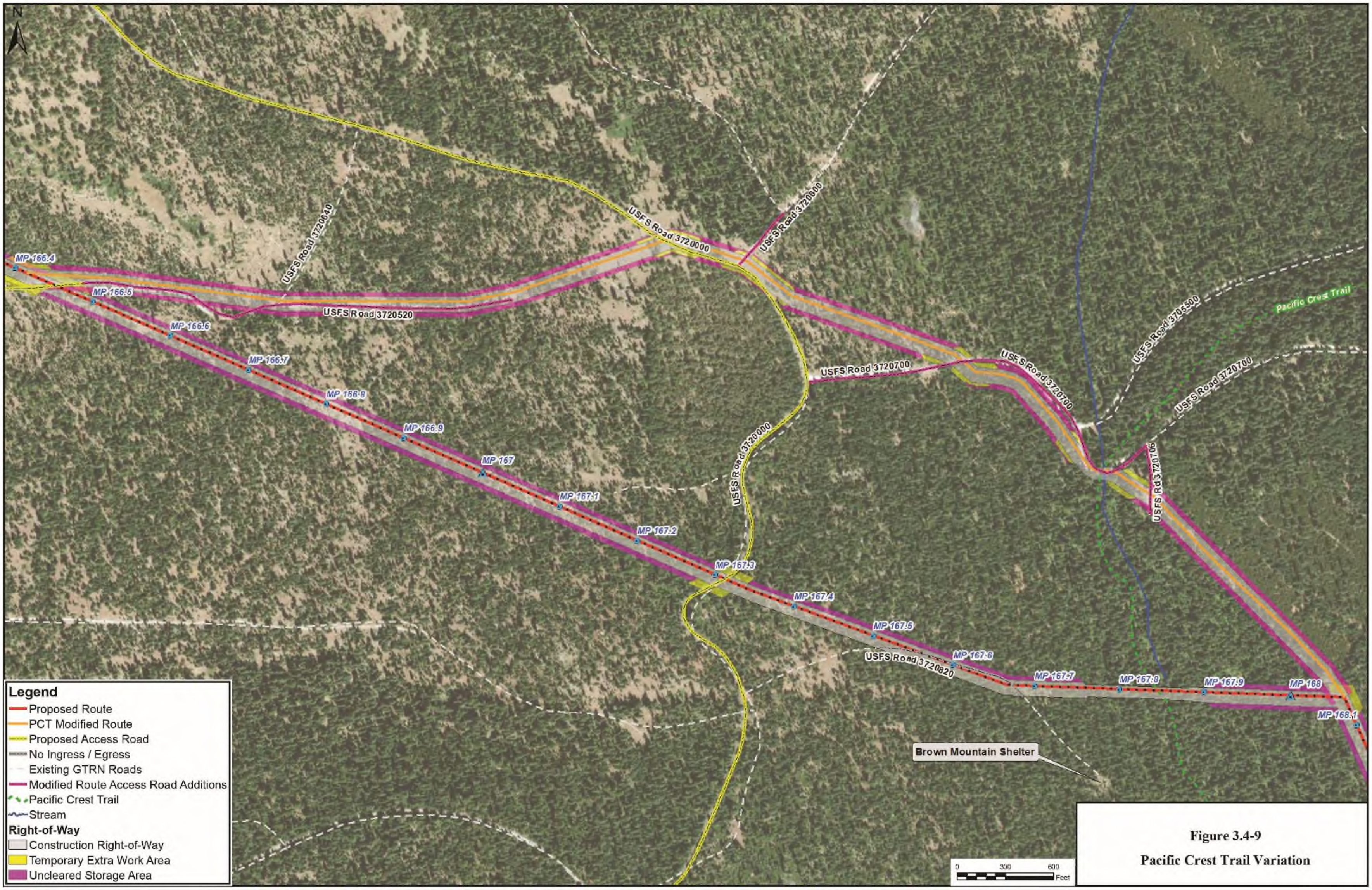

Figure 3.4-9. Pacific Crest Trail Variation

TABLE 3.4.2.9-1

Comparison of the PCT Variation with the Proposed Route

Alternatives Analysis		**Proposed Route**	**PCT Variation**
General			
Length (miles)		1.65	1.77
Construction right-of-way (acres)		18.64	20.14
Number of temporary extra work areas (TEWAs)		7	18
Acres of TEWAs		1.36	1.81
Number of Uncleared Storage Areas (acres) a/		5 (8.52)	10 (10.73)
Permanent Easement (acres) b/		10.00	10.73
Land Use			
Land Ownership (miles)	Private	0	0
	State	0	0
	Federal (Rogue River-Siskiyou NF)	1.59	1.73
	Federal (Fremont-Winema NF)	0.06	0.04
Number of landowner parcels crossed		1	1
Number of road crossings (centerline) c/		3	6
Miles of right-of-way parallel or adjacent to existing rights-of-way (percent of alternative length) d/		0.19 (11.52)	1.37 (77.40)
Late Successional Reserve - Federal Land Use Designation (acres)		18.96	21.52
Riparian Reserves - Federal Land Use Designation (acres)		0	0.94
Visual Quality Objective (miles) e/		0.52-FGPR	0.55-FGPR 0.13-FGR
Waterbodies and Wetlands			
Number of waterbodies crossed f/		0	1
Length of waterbody crossings (feet) f/		0	4
Vegetation			
Total forest clearing (acres)			
Acres clear-cut/regenerating (0-40 years)		16.95	8.70
Acres mid-seral forest (40-80 years)		0.00	5.64
Acres Late Successional Forest (80-175 years)		0.00	2.77
Old Growth Forest (175 + years)		2.75	0.68
Biological Resources			
Northern Spotted Owl Suitable Habitat Crossed (High NRF & NRF) (acres) g/		2.75	4.94
Northern Spotted Owl nest patch/core area (NSO) (acres)		3.39	2.87
Northern Spotted Critical Habitat Crossed (acres)		20.01	21.95

General: All values are rounded (acres to nearest whole acre, miles to nearest tenth of a mile, feet to nearest whole foot).
a/ Acres of Uncleared Storage Areas are not included in the impact comparison (acres) of the various resources because grading and tree clearing will not occur in these areas.
b/ Acres of permanent easement calculated based on a 50-foot width.
c/ Based on inventoried roads included in Rogue River-Siskiyou NF travel route data and BLM GTRN data (https://www.blm.gov/or/gis/data.php).
d/ Based on inventoried roads included in Rogue River-Siskiyou NF travel route data and BLM GTRN data (https://www.blm.gov/or/gis/data.php), as well as non-inventoried roads identified during civil surveys (June 2018).
e/ FGPR = Foreground Partial Retention; FGR = Foreground Retention
f/ Based on field surveys (see Table A.2-3 to Appendix A.2 to Pacific Connector's Resource Report 2 and supplemental wetland delineation report filed in May 2018) and subsequent site visit (May 31, 2018). The pipeline centerline stream crossing on the PCT Modified Route would occur within the FS 3720700 Road, where the stream is culverted.
g/ Rogue River-Siskiyou National Forest (Forest Service 2017a)

The primary disadvantages of the PCT Variation are that it would be slightly longer than the proposed route (0.12 mile) resulting in slightly larger construction right-of-way impacts (1.5 acres), and would cross one headwater stream and lands designated as Riparian Reserve. It would also affect more acres of NSO suitable habitat (High NRF & NRF) (4.94 acres) compared to the corresponding segment of proposed route (2.75 acres).

As described above, the PCT Variation would include some environmental advantages and some disadvantages compared to the proposed route. Overall, because the variation reduces impacts on old growth forests greater than 175 years old and would move the pipeline crossing of the PCT to be co-located with Forest Service Road 3720-700, the PCT Variation would result in a significant environmental advantage and is preferable to the proposed route. Therefore, **we recommend that**:

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary, for review and written approval by the Director of OEP, revised alignment sheets that incorporate the Pacific Crest Trail Variation into the proposed route between MPs 166.4 and 168.1, and provide documentation of consultation with the Forest Service.**

3.5 CONCLUSION

We reviewed alternatives to the proposed action based on our independent analysis and comments received. Although many of the alternatives appear to be technically feasible, we identified only four alternatives that would provide a significant environmental advantage over the Project. We have included recommendations that these modifications be adopted. Based on these findings, we conclude that the proposed Project, as modified by our recommendations, is the preferred alternative that can meet the Project purpose.

4.0 ENVIRONMENTAL ANALYSIS

In this section, we describe the existing natural and human environment, and assess the impacts on it resulting from construction and operation of the Project. Our independent analysis and discussion prepared in consultation with the NEPA cooperating agencies considers the affected environment, the applicants' proposed construction methods, their impact minimization and mitigation measures, and, as appropriate, makes recommendations (boldface and bulleted text) to avoid or further reduce/minimize impacts on the environment. This analysis also considers cumulative impacts that may result when the Project's impacts are added to those of past, present, and reasonably foreseeable future projects. The analysis is organized by resource, includes as appropriate information pertaining to federal lands, and by resource concludes with a determination of significance.

For the purposes of this analysis, we discuss four impact durations: temporary, short-term, long-term, and permanent. A temporary impact generally occurs during construction with the resource returning to preconstruction condition almost immediately afterward. A short-term impact could continue for up to three years following construction. An impact is considered long-term if the resource would require more than three years to recover. A permanent impact would occur if an activity modifies a resource to the extent that it would not return to preconstruction conditions during the life of the Project. Permanent impacts may also extend beyond the life of the Project. For example, we consider the clearing of mature forests a permanent impact because it would take several decades for these habitats to attain their pre-construction condition. The construction and operation of aboveground facilities would also cause permanent impacts. When determining the significance of an impact(s), we consider the duration of the impact; the geographic, biological, and/or social context in which the impact would occur; and the magnitude and intensity of the impact. The duration, context, and magnitude of impacts vary by resource and therefore significance varies accordingly. Lastly, our analysis considers and addresses direct and indirect; and primary and secondary impacts on resources collectively.

The structure of this EIS follows the standard format used by the Commission with respect to the order and content of the resources affected by the Project. Each resource section in chapter 4 includes a focused discussion of effects on federally managed lands (i.e., lands managed by the BLM, Forest Service, and Reclamation). As described in chapter 2, the BLM and Forest Service have identified the need to amend their respective land and resource management and resource management plans in order to ensure any action authorized by FERC would be compliant with these plans. While specific effects on federally managed lands are addressed in each resource section, section 4.7.3 of this chapter provides a detailed discussion of consistency with these management plans and evaluations of the proposed plan amendments.

The Project would cross ecologically diverse areas from Coos Bay to the Klamath Basin (see figure 4-1). The Project lies within four ecoregions: (1) the Coast Range; (2) the Klamath Mountains; (3) the Cascades; and (4) the Eastern Cascades Slopes and Foothills (Bryce et al. 2003). This diversity in ecoregions crossed results in a wide variety of conditions, habitats, and environments that could be affected by the Project.

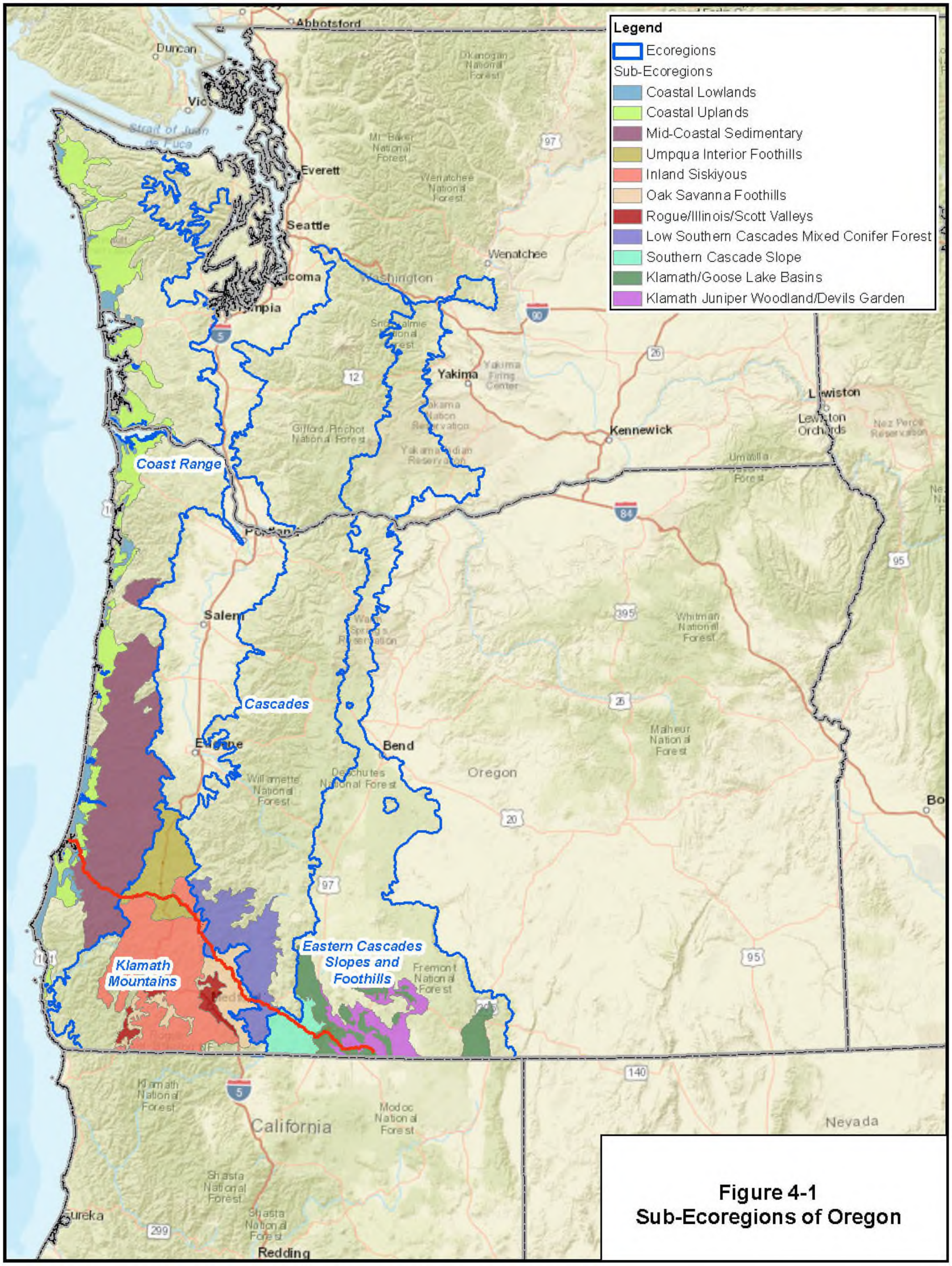

Figure 4-1
Sub-Ecoregions of Oregon

4.1 GEOLOGICAL RESOURCES

The following section describes geological resources and potential impacts related to the various aspects of the Project, including the Jordan Cove LNG terminal and the Pacific Connector pipeline and associated facilities.

4.1.1 Jordan Cove LNG Project

4.1.1.1 Geologic Setting

The Jordan Cove LNG Project site is located within the Pacific Border physiographic province at the western edge of the coastal headlands of the Central Coast Mountain Range, on the North Spit of Coos Bay. The North Spit of Coos Bay marks the southern edge of the Holocene-age Coos Bay Dune Sheet (Peterson et al. 2005).

The LNG terminal site is underlain by loose to dense fill and a relatively clean, fine-grained sand, which is in turn underlain by a weathered sandstone. Fill depths are typically 10 to 15 feet at the Ingram Yard and up to 25 feet at the mill site. The clean, fine-grained sand is a dune sand of Holocene and Pleistocene age (Peterson et al. 2005) with thicknesses of over 100 feet. Sand fill is also present to a depth of about 15 feet at the location of the Trans-Pacific Parkway/U.S. 101 intersection. The lower-lying portions of the Kentuck project site are mantled and underlain by soft alluvial deposits to depths of more than 100 feet in some areas.

Bedrock underlies these sands and includes Eocene marine interbedded siltstones and sandstones of the Coaledo Formation (Baldwin et al. 1973). The upper member of the Coaledo Formation is composed of gray, coarse to fine-grained weathered, very dense, weakly cemented sandstone with silt and minor amounts of coal. Weathered sandstone is generally encountered beneath the dune sands to a depth of about 125 feet (GRI Geotechnical and Environmental Consultants [GRI] 2007a).

Jordan Cove completed 11 deep borings GRI (2007a) at the location of the LNG storage tanks to obtain geotechnical information for the design of the LNG terminal. These subsurface explorations identified sand extending to depths of 124 to 133 feet. Organic mill waste was encountered in the fill at the ground surface at the Ingram Yard and also in several landfills in the vicinity of the mill site. A geotechnical report by GRI (2017a) provides additional geotechnical subsurface investigations performed in 2012 and 2013, and more recently continuing into 2017, at the Jordan Cove site. As noted in the geotechnical report, Jordan Cove plans to conduct additional subsurface investigations to support detailed design.

Jordan Cove also conducted two overwater geophysical seismic reflection surveys between the LNG terminal site and the Southwest Oregon Regional Airport located on the east side of the Coos Bay navigation channel. The subsurface profile indicates shallow bedrock, which becomes progressively deeper toward Pony Slough (southeast of the airport), to a depth of approximately 150 feet below the bay floor (GRI 2007a), and to a depth of approximately 120 feet near the south edge of the proposed slip (DEA 2017a).

Effects on surface geology would be limited primarily to the construction phase of the LNG terminal, when the topographic features at specific locations on the site would be altered by clearing, mechanical excavation, dredging, and fill placement. Construction of the slip and access channel would change the surface geology of the site as a result of excavation and dredging. No blasting would be required during any phase of construction of the LNG terminal because the entire site consists of unconsolidated material. Any shoreline areas disturbed by construction would be armored to protect against erosion or shifting beyond the Jordan Cove project design limits.

4.1.1.2 Mineral Resources

The principal mineral production of Oregon in order of value was crushed stone, construction sand and gravel, Portland cement, diatomite, and crude perlite (USGS 2013a). Mineral resources available in Coos County, Oregon, include chromium, gold, clay, manganese, sand and gravel, silica, stone, and titanium. Coal was mined historically in Coos Bay, starting in 1855 until the early decades of the twentieth century. Coal deposits are known to occur in the upper and lower members of the Coaledo Formation (Newton 1980). The Steva coal seam and the Hardy coal seam have been identified within the vicinity of the Kentuck project site (Diller 1914). The closest major productive coal mine was known as the Libby, which operated until about 1920, located south of city of Coos Bay at the head of Coalbank Slough.

Based on the State of Oregon Mineral Information Layer for Oregon-Release 2, there are no permitted coal mines or oil and gas wells within 0.25 mile of the LNG terminal site (DOGAMI 2017). There are three permitted sand and gravel mines within 0.25 mile of the LNG terminal site; however, all three of these mines are closed and are not producing material (DOGAMI 2017). Based on available database information, construction and operation of the LNG terminal is not anticipated to have effects on identified mineral resources, active mines, or oil and gas production facilities.

4.1.1.3 Seismic and Related Hazards

Seismic-related hazards including earthquakes, ground-shaking, volcanic hazards, surface rupture, soil liquefaction, lateral spreading, tsunamis, subsidence, and scour hazards are addressed in section 4.13 of this DEIS (i.e., the Reliability and Safety section).

4.1.1.4 Paleontological Resources

There are no state or federal laws or regulations that protect paleontological resources on private lands (Niewendorp, DOGAMI, personal communication, 2008). The Antiquities Act of 1906 protects “objects of antiquity” on federal lands. The Paleontological Resources Preservation Act of 2009 applies to federal lands including BLM and NFS lands, as well as “Indian” lands, but does not apply to private land. See section 4.1.3.

4.1.2 Pacific Connector Pipeline Project

The pipeline would be constructed by conventional cross-country techniques as described in chapter 2. Typical pipeline trench depth would range from 6 to 10 feet, although it would be deeper at stream crossings with scour concerns or areas with geological hazards. In Class 1[49] areas, the pipeline would have 36 inches of cover and 24 inches of cover in Class 1 areas with consolidated rock. Excavation

[49] Pipeline Class designations are described in 49 CFR § 192.5 as locations within 220 yards of the pipeline centerline. A Class 1 location has 10 or fewer buildings intended for human occupancy; and a Class 2 location has more than 10 but fewer than 46 buildings intended for human occupancy.

of the trench would encounter a range of soil and rock materials. Special construction methods for crossing rugged terrain were also previously discussed in chapter 2.

The proposed route would cross a wide variety of terrain and geological conditions. The proposed route was evaluated for seismic, landslide, erosion and scour, mine, and volcanic hazards that may potentially occur across or near the alignment and that could adversely affect the pipeline. In addition, an evaluation was made of the potential impact that pipeline construction and operation could have on the natural geological environment and geological processes in the pipeline vicinity. During route planning, Pacific Connector identified and attempted to avoid geological resource areas and hazards.

Pacific Connector selected the proposed route with input from agencies, stakeholders, and land managers/owners to avoid areas with high risk of geological hazards. The initial proposed route was changed in numerous locations to avoid high hazard areas as more detailed data were collected. During construction, Pacific Connector would implement site-specific construction techniques and BMPs to mitigate local geological hazards that could not be completely avoided. The following sections discuss these hazards and how they would be mitigated.

4.1.2.1 Geologic Setting

The proposed route crosses four regional physiographic provinces in Oregon: the Coast Range, Klamath Mountains, Cascade Range, and Basin and Range. The proposed route begins within the Klamath Basin, which is part of the larger Basin and Range physiographic province of the Great Basin; an area characterized by ridges and valleys that are separated by faulting (Burns 1998). The route would then head westward over the High Cascades sub-province, a chain of geologically active volcanoes with high andesitic peaks, and the Western Cascades sub-province, an ancestral range of deeply eroded (extinct) volcanoes. The proposed route then passes through the Klamath Mountains physiographic province, which consists of several complex geological terrains composed of metamorphosed and fractured volcanic and marine sedimentary rocks. The proposed route would proceed over the Coast Range physiographic province, an area underlain by estuarine and alluvial deposits in lowland areas and sedimentary rocks in the uplands and terminate at the Oregon Coast. Between the mountain ranges are several valleys, predominantly filled with recent alluvial materials. Some of the major river valleys and their tributaries crossed by the proposed route heading west to east include the Coquille River Valley, Umpqua River Valley, Rogue River Valley, and Klamath River Valley (see section 4.3 of this EIS for more information about waterbodies).

The pipeline alignment is located within varying soil and lithologic units ranging from soft sediments to hard granite and basaltic rock. Unconsolidated silt, sand, and cobbles occur locally in streambeds, alluvial fans, and valley floodplains in all four physiographic provinces. Detailed descriptions of geology along the proposed route are included in Table B-1 in Appendix B of the *Geologic Hazards and Mineral Resources Report* (GeoEngineers 2017a) filed with Resource Report 6 of Pacific Connector's application to the FERC. Below is a west to east description of the physiographic provinces crossed by the pipeline.

Coast Range

The proposed route passes through the southernmost part of the Coast Range province for approximately 71 miles (approximately MP 0 to MP 71). The Coast Range is 30 to 60 miles wide and averages 1,500 feet in elevation, although the highest point (Mary's Peak) reaches an altitude of 4,097 feet (Orr and Orr 2012).

The Coast Range is composed of relatively soft marine sedimentary rock units that overlie basalt at depth. The wet conditions of the western slopes of the Coast Range, along with steep terrain composed of relatively weak rock, contribute to an active erosional environment with frequent landslides.

Uplift of the Coast Range deposits has deformed the bedrock units with folds and faults. Coastal uplift of the present Coast Range over the past 10 to 15 million years has been simultaneous with stream incision and coastal erosion and depositional processes. Ocean-cut terraces exist near the shoreline, some of which have been elevated to altitudes of up to 1,600 feet (Orr and Orr 2012). Low-lying areas near the coast are underlain by modern beach deposits, sand dunes, estuarine mud and alluvial sediments.

Klamath Mountains

The proposed route passes through the northeast corner of the Klamath Mountain physiographic province for approximately 49 miles (approximately MP 71 to MP 120). The province has a rugged landscape of high peaks and deep canyons, with a total local relief of 2,000 to 5,000 feet (Baldwin 1964). The highest peak of the Klamath Mountains in the state of Oregon is Mt. Ashland, at 7,530 feet (Burns 1998). Most of the Klamath Mountain physiographic province is composed of highly deformed volcanic and marine sedimentary rocks, as well as metamorphic terranes. The physiographic province also contains deformed pieces of the oceanic crust (accreted terrain from the Cascadia subduction zone [CSZ]) and granitic intrusive bodies (Walker and MacLeod 1991). Bedrock is often intensely metamorphosed and fractured.

The proposed route passes through three tectonic geological terranes in the Klamath Mountain segment of the alignment. West to east and youngest to oldest, these terranes are: (1) the Franciscan and Dothan belt; (2) the Western Jurassic terrane; and (3) the Western Paleozoic and Triassic terrane. The alignment crosses through the northernmost part of the Franciscan and Dothan belt, an area composed of turbidite sandstone, mudstone, and chert formed on the continental slope and subsequently scraped off the ocean floor during accretion. East of the Franciscan and Dothan belt, the alignment passes through the northern section of the Western Jurassic terrane, an area composed of volcanic flows and ash altered to greenstone, ophiolite, and metamorphosed ocean sediments, including conglomerate, siltstone, and sandstone. Between the Western Jurassic terrane and the Western Paleozoic and Triassic terrane, the alignment crosses the White Rock pluton (a large body of intrusive igneous rock that solidified within the crust). The Western Paleozoic and Triassic terrane is composed of metamorphosed pieces of ocean crust (ophiolites) and metamorphosed ocean-island basalt (Orr and Orr 2012).

Cascade Range

Approximately 40 miles (approximately MP 120 to MP 160) of the route crosses Oregon's southern Cascade Range. The Cascades consist of two north-south trending mountain chains: (1) the older, more weathered Western Cascades; and (2) the younger, higher-elevation High Cascades. The Western Cascades drain westward and reach altitudes of 5,800 feet. The southern High Cascades drain toward the east and the west and reach altitudes of up to 9,493 feet at the summit of Mt. McLoughlin (USGS 2006).

Precipitation of 60 to 100 inches annually on the western side of the Cascades results in extreme weathering of bedrock and soil deposits and the existence of larger rivers in the physiographic province (Orr and Orr 2012). Both the Western Cascades and the High Cascades consist primarily of volcanoes formed as a result of the subduction of the Juan de Fuca oceanic plate beneath the North American continental plate. The Western Cascades terrain consists of deeply dissected volcanoes that formed between about 42 and 8 to 10 million years ago (USGS 2006). The volcanoes of the High Cascades began erupting about 5 million years ago. As the High Cascades volcanoes erupted, their magma chambers emptied and collapsed, creating calderas (large craters). Crater Lake, north of the pipeline alignment in Klamath County, is one of these caldera lakes. During the Quaternary, andesitic cones formed the range's notable high peaks.

After the formation of the high-altitude andesitic peaks, volcanic activity in the High Cascades has continued intermittently to the present. Minor volcanic vents manifest near the pipeline alignment. These include Brown Mountain, which is a Quaternary-aged volcano situated about 3 miles north of the proposed route near MP 167.

Repeated glaciation of the High Cascades during the Pleistocene Epoch produced glacial U-shaped valleys, cirques, and jagged mountain ridges. No active glaciers exist along or near the pipeline alignment.

Basin and Range

Approximately the easternmost 45 miles (approximately MP 160 to MP 224) of the pipeline alignment pass through the southwestern corner of the Basin and Range province in Oregon, a geographic area named the Klamath Basin. The Basin and Range province contains the Upper Klamath Lake and Lower Klamath Lake National Wildlife Refuge, which, unlike the rest of the province, drain to the Pacific Ocean via the Klamath River.

The Basin and Range is a complex series of alternating uplifted mountain blocks (horsts) and down-dropped basins (grabens). These mountain ranges and valleys are separated by generally north-south trending normal (extensional) faults. The altitude of the Basin and Range province is generally over 4,000 feet, and the summit of Steens Mountain in southeast Oregon reaches 9,670 feet.

Crustal extension is responsible for development of the Basin and Range physiographic province. The extension occurred in two phases, the first of which happened between 20 and 10 million years ago and produced widespread volcanic activity resulting in thousands of feet of basaltic flows and tuffs. The second phase of extension occurred in the last 10 million years and produced the distinct horst and graben block faulted topography.

The low precipitation and runoff rates east of the Cascades restrict the amount of erosional debris that can be transported from watersheds. As a result, sediment has accumulated in the basins, in thicknesses greater than 1,000 feet in some places. Eroded material is deposited in alluvial fans and channels around the margins of the basins and as marsh and lake deposits in the lower elevations. During the wetter and cooler periods of the ice ages, the basins were occupied by much larger lakes; at maximum extent, Pluvial Lake Modoc extended over the pipeline alignment from Klamath Marsh, north of Upper Klamath Lake, to the Tule Lake basin in northern California (Orr and Orr 2012:304).

4.1.2.2 Mineral Resources

Mineral resources that occur in the pipeline area include the following metals: chromite, copper, gold, manganese, mercury, and silver. Other rock and mineral resources include basalt, cinders, coal, conglomerate, limestone, natural gas (including coal bed methane), sand and gravel, sandstone, shale, silica, talc, and tuff/breccia (DOGAMI n.d.). Most of the non-metal minerals are mined to produce aggregate. Mineral resources, surface and subsurface mines, mining claims and leases, mineral material disposals, and oil and gas fields located within one-half mile of the Pacific Connector pipeline construction right-of-way were identified from USGS topographic maps, BLM and Forest Service mineral resource databases (including oil and gas leases, geothermal leases, and mining claims), ODOT aggregate resources Geographic Information System (GIS) data, DOGAMI GIS data, published reports, published and unpublished maps, county mineral overlay maps, and the updated Oregon MILO-2 mineral information layer (DOGAMI n.d.).

Portions of the pipeline alignment cross six areas with county zoning that recognizes the potential for future mineral resource development. This zoning implies that mines and oil and gas wells could be sited at any location within these areas in the future as long as the zoning remains compatible with the resource extraction operations.

Table B-5 of Appendix B from GeoEngineers (2017a) identified the active, inactive, and planned mineral resources or mining sites (organized by MP) within 0.25 mile of the pipeline. Twenty-nine mineral or mine locations were identified as within 500 feet of the pipeline. Sixteen of these mines identified within 500 feet of the alignment are aggregate or quarry-related mines. The aggregate or quarry-related mines generally consist of open excavations and the primary potential hazards at these mines would be related to failure of steep slopes and/or high walls. Pacific Connector's civil survey crews did not observe such conditions along or adjacent to the alignment. Pacific Connector would provide a more comprehensive evaluation of such conditions during the final detailed design.

The remaining seven non-aggregate-related mines were investigated by Pacific Connector through field reconnaissance on January 23 and 24, 2007, and June 13 and 15, 2007. The reconnaissance of the seven mines did not identify any apparent mine workings located within 500 feet of the pipeline alignment. However, adits associated with the Nivinson Prospect/Mars Fraction Lode and Thomason mines were identified within 500 feet of the proposed pipeline. Therefore, Pacific Connector conducted a site-specific mine hazards assessment for those prospects as well as the nearby Red Cloud Mine, and the findings of that study were provided in a stand-alone report dated August 23, 2007, and its 2009 addendum (GeoEngineers 2007a, 2009a). The reports document the existence of naturally occurring mercury in the vicinity of the mines. Six samples were collected along a previous pipeline route and indicated that very low concentrations of naturally occurring mercury mineralization exists. Mercury was not detected in any of the samples at levels that exceed applicable ODEQ and EPA screening levels for protection of worker health. However, a 2,000-foot section of the pipeline route was moved 2,500 feet to avoid the area of the mines.

No mine hazards related to subsidence or slope stability have been identified by the research and investigations completed by Pacific Connector to date. Pacific Connector's ECRP includes erosion and sediment control measures that would be employed to avoid potential impacts from the naturally occurring mercury concentrations identified in the vicinity of the Nivinson Prospect/Mars Fraction (MP 108.7).

Pacific Connector also identified areas where the pipeline would cross: (1) areas where county land-use zoning allows mineral resource extraction, or (2) federal land that has been or is available for mineral resource or geothermal leases (GeoEngineers 2017a). The BLM & Mineral Legacy Rehost 2000 System, LR 2000, was accessed on April 26, 2013 and again in September 2017 by Pacific Connector to include the more recent information. The BLM would review and verify the validity of this database query by Pacific Connector during their right-of-way permit review. Coos County recognizes three coal-basin resource areas between MPs 0 and 7.6; and one between MP 13.2BR and 13.4BR. Eighteen oil and gas areas are located between MP 10.4R and 45.7 in Coos County. Two mining claims are located between MPs 0 and 1.4 in Coos County. Seven oil and gas areas, two placer mining claims, one mine, four lode mining claims, a chromite resource, and a quarry are located in the vicinity of the pipeline alignment between MPs 46.9 and 110 in Douglas County. Ten oil and gas areas and two lode mining claims are located in the vicinity of the pipeline alignment between MPs 115.4 and 166.4 in Jackson County. One lode mining claim, one oil and gas area, and two geothermal resources areas are located in the vicinity of the pipeline alignment between MPs 170.1 and 216.8 in Klamath County.

Constructing and operating the pipeline could affect future mineral extraction operations. Surface mining activities (including materials storage) across the permanent pipeline easement would be prohibited and heavy equipment crossings of the pipeline would be restricted to specific crossing locations. Sub-surface mining could occur, but would require coordination between the pipeline and the mining company, and the implementation of measures to ensure pipeline integrity.

Mine Hazards

Mine hazards potentially exist in areas underlain by or adjacent to underground mine workings and surface mines that have not been properly stabilized, closed, and made safe in accordance with applicable local, state, and federal laws. Pacific Connector identified surface and subsurface mines within 0.5 mile of the proposed construction right-of-way from USGS topographic maps, BLM and Forest Service databases, and LR 2000 (2017). DOGAMI GIS data, published reports, published and unpublished maps, and county mineral overlay maps. No mine hazards, were identified at the aboveground facilities locations.

The primary hazards involve the potential for:

- subsidence in areas underlain by or adjacent to air shafts, tunnels, underground workings, and mine tailings;
- rockfalls and slides caused by the failure of unstable benches, slopes, and tailing piles in nearby surface mines, including those benches and slopes occurring within water-filled pits; and
- the presence of tailings or waste piles containing naturally occurring metals.

According to Pacific Connector's application (Table B-5 of Appendix B from GeoEngineers 2017a), the pipeline alignment was identified as being located within 500 feet of potential mine hazards based on the information provided in the databases at 29 locations. Sixteen of the 29 mines identified within 500 feet of the alignment are aggregate or quarry-related mines. Aggregate or quarry-related mines generally consist of open excavations. The primary potential hazards at these mines would be related to failure of steep slopes and/or high walls. These are expected to be localized conditions. Civil survey crews involved with surveying the right-of-way did not observe these conditions along or adjacent to the alignment. Consequently, these potential hazards are not expected to pose a threat to the pipeline.

The remaining non-aggregate-related mines were investigated by field reconnaissance on January 23 and 24, 2007, and June 13 and 15, 2007. The database indicated that these mines are located at MPs 9.8, 10.0, 16.2, 58.8, 75.3, 105.6, 108.7, 109.3, 109.4, 110.7 142.6, and 150.5. The reconnaissance of these mines did not identify any apparent mine workings located within 500 feet of the pipeline alignment. Adits[50] associated with the Nivinson Prospect/Mars Fraction Lode and Thomason mines were identified within 500 feet of the pipeline location. Therefore, a site-specific mine hazards assessment was completed for those prospects as well as the nearby Red Cloud Mine, and the findings of that study were provided in a stand-alone report dated August 23, 2007, and its 2009 addendum (GeoEngineers 2007b, 2009a). The following summarizes the report findings with regard to the proposed route.

Nivinson Prospect/Mars Fraction Mercury Mine

The pipeline alignment at MPs 108.6-108.7 does not cross the Nivinson Prospect mercury mine but is approximately 200 feet upslope from mine adits. Based on documented excavated depths, trends, and distances from the pipeline, it was concluded from the field investigation that the adits of the Nivinson Prospect mercury mine likely do not extend into the right-of-way and do not pose a risk to the pipeline. However, the pipeline route was moved 2,500 feet from these areas to avoid potential risks.

Red Cloud Mercury Mine

The pipeline alignment is approximately 400 feet west of the Red Cloud mercury mine at MP 109.3. No evidence of the mine was observed during site reconnaissance of the alignment.

Thomason Mine (Inactive)

The pipeline alignment at MP 109.4 crosses the mapped location of the Thomason Mine. No evidence of the Thomason Mine was observed during site reconnaissance of the alignment. Approximately 260 feet downslope of the mapped Thomason Mine location at MP 109.4, the proposed route crosses East Fork Cow Creek. The proposed route crosses the East Fork Cow Creek outside of the Thomason Mining Group boundaries and all other mining groups mapped by Brooks (1963).

Heppsie Quarry

The proposed alignment at MP 150.5 is located within approximately 80 feet northeast of the Heppsie quarry, and parallels the length of the quarry. The Heppsie quarry is a regional hard rock quarry and to utilize this rock quarry it is necessary to blast the rock. The BLM and Pacific Connector determined that due to the proximity of the pipeline to the quarry and the incompatibility of production blasting the rock quarry near the pipeline; that 70,000 cubic yards of rock would be blasted at the expense of Pacific Connector and left on site. The BLM is requiring this blasting because the BLM will not assume unknown risk associated with complications, limitations, or liability associated with utilizing this quarry in the future. Based on aerial

[50]A horizontal passage leading into a mine for the purposes of access or drainage.

photographs and the BLM data Pacific Connector has shown that the pipeline parallels the quarry. Pacific Connector has told the BLM that it would use this quarry to purchase approximately 70,000 cubic yards of rock to crush, per 43 CFR 3600. The BLM has provided Pacific Connector with core drill logs, maps, and a development plan for use of the quarry.

4.1.2.3 Seismic and Related Hazards

The proposed route crosses a complex geological area that has developed through extensive crustal deformation and volcanic activity. Two primary mechanisms for generating earthquakes of design significance exist along the pipeline alignment: (1) a major, regional earthquake associated with the CSZ; and (2) local earthquakes associated with a seismic hot spot near Klamath Falls. Based on the catalogs of recorded earthquakes from the Pacific Northwest Seismograph Network, 1872 to September 2017, and the Earthquake Database for Oregon, 1833 to 1994 (Wong and Bott 1995; Johnson et al. 1994), 336 earthquakes have been recorded within 100 miles of the Pacific Connector pipeline alignment. Table 4.1.2.3-1 lists the recorded historical earthquakes by magnitude range and by epicentral distance to the nearest segment of the Pacific Connector pipeline. Major historical earthquakes near the proposed route include two events in 1873: (1) an estimated magnitude 7.0 earthquake at the southwestern tip of Oregon; and (2) a magnitude 6.3 earthquake near Coos Bay. In addition, a magnitude 6.0 event occurred in 1938 approximately 75 miles south of Coos Bay. Closer to the planned alignment, two earthquakes occurred within about 2 hours of each other on September 21, 1993 that had epicenters located about 15 miles northwest of Klamath Falls: both were magnitude 6.0 earthquakes (Yelin et al. 1994; Braunmiller et al. 1995). However, most of the pipeline construction area has experienced very few earthquakes during the period of historical record.

Geological maps of the pipeline area show many faults that cross the pipeline alignment or are located near the pipeline corridor (Walker and MacLeod 1991). However, with the exception of the Klamath Falls area, these mapped surface faults are not considered active based on evidence of recent Quaternary tectonic activity and are not believed to be capable of renewed movement or earthquake generation (USGS 2009a, 2010). Many earthquakes of magnitude 2.0 and larger have occurred during historical times in the Klamath Falls area. Most earthquake epicenters are clustered northwest of Klamath Falls, near the southwest shoreline of Upper Klamath Lake. Epicenters of these earthquakes are typically at depths of about 3 to 5 miles. These events seem to be associated geographically with the boundary between the Basin and Range province and the Cascade Range province. The earthquake clusters also may be associated with volcanic activity (Cole and Bugni 1993).

TABLE 4.1.2.3-1

Historical Earthquakes within 100 Miles of the Proposed Pacific Connector Pipeline a/

Magnitude Range b/	Number of Earthquakes	Epicenter Distance From Alignment (miles)
3.0 to 3.99	174	5 to 100
4.0 to 4.99	143	3 to 99
5.0 to 5.99	15	8 to 100
6.0 to 6.99	3	9 to 74
7.0 to 7.99	1	82

a/ Earthquake catalog data from the USGS Earthquake (i.e. the Comcat database) Search (January 1, 2006, to August 28, 2013), Pacific Northwest Seismograph Network (2006) and the Earthquake Database for Oregon, 1833 to 1993 (Johnson et al. 1994).
b/ Earthquakes with less than magnitude 3.0 are termed micro-earthquakes and are not usually felt (Reiter 1990). Earthquakes of magnitude 5.0 and greater are generally considered to have engineering significance.

The primary seismic hazards to pipelines include potential strong ground shaking, surface fault rupture, soil liquefaction (and related lateral spreading), earthquake-induced landslides, and regional ground subsidence. The degree of risk from these hazards varies and depends on several factors, including the magnitude (or size) of the earthquake, the distance of the earthquake origin from the pipeline facilities (lateral and vertical), soil/rock conditions, and slope angle of the ground.

Empirical reviews of historical earthquakes demonstrate that welded steel pipelines are not prone to failure due to earthquakes. Modern buried pipes with welded joints have low vulnerability to elastic ground displacement related to earthquake shaking. Ground displacements from wave propagation occur over widespread areas and lack the local strain concentrations necessary to damage a modern welded pipeline. A 1996 study of earthquake performance data for steel transmission lines and distribution supply lines operated by Southern California Gas over a 61-year period found that post-1945 arc-welded transmission pipelines in good repair have never experienced a break or leak during a southern California earthquake and are the most resistant type of piping, vulnerable only to very large and abrupt ground displacement (e.g., severe landslides), and are generally highly resistant to traveling ground wave effects and moderate amounts of permanent deformation (O'Rourke and Palmer 1994). The study included evaluation of pipeline performance during the 1933 Long Beach earthquake (magnitude 6.4), the 1952 (magnitude 7.3) and 1954 Kern County earthquakes (magnitude unknown) the 1971 San Fernando earthquake (magnitude 6.5-6.7) and the 1994 Northridge earthquake (magnitude 6.7). A study of water transmission pipeline response to the 2011 Tohoku earthquake (magnitude 9) indicated that steel pipe over 137 kilometers required 12 repairs – a rate of approximately 0.1 repair per kilometer (Wakamatsu et al. 2016). Similar studies for large (magnitude 8 and greater) earthquakes were not available for natural gas transmission pipelines.

In addition to ground shaking, subsidence and ground rupture from seismic activity, tsunamis can be generated by strong ground motions associated with offshore earthquakes or submarine landslides. Coastal areas of Oregon, including Coos Bay, could experience the effects of tsunamis. The portion of the pipeline near the LNG terminal occurs in the relatively sheltered areas of Coos Bay, where the effects of a tsunami on the pipeline would be expected to be relatively minor (GeoEngineers 2017a).

Seismic hazards for the pipeline were evaluated by reviewing available historical data, by researching geological evidence of prehistoric earthquakes for the Pacific Northwest, and by qualitatively evaluating the potential risk to the pipeline along the overland sections of the alignment. Quantitative evaluation of the potential for liquefaction, lateral spreading, and tsunami inundation was accomplished for the Coos Bay crossing, where liquefaction and lateral spreading hazard were identified during the initial assessment (GeoEngineers 2017a).

Cascadia-type earthquakes are discussed in section 4.13 (i.e., the Reliability and Safety section) for the Jordan Cove LNG Project. If a Cascadia-type earthquake of magnitude 8 or greater occurred during the operating life of the pipeline, the ground shaking and possible ground subsidence would be strongest in the Coast Range province and in low-lying areas near Coos Bay. Although ground shaking would likely be felt throughout the length of the pipeline from a Cascadia event, hazards would diminish in the eastward direction, with increasing distance from the offshore epicenter. Documented subsidence zones associated with the 1960 subduction zone earthquake in Chile (Plafker and Savage 1970) indicate subsidence on the order of 3 to 6 feet vertically distributed over a wide trough of approximately 60 miles. Pacific Connector studies (GeoEngineers 2017a) have indicated that the resultant strain accrual on a welded steel pipeline distributed over that length of pipe would not pose a substantial risk to the integrity of the pipeline.

Ground Shaking and Peak Horizontal Ground Acceleration

Earthquake magnitude and ground motion are two different parameters discussed in relation to CSZ events. Earthquake magnitude describes the earthquake source, and peak horizontal ground acceleration (PGA) describes the effect of the earthquake at a certain distance from the source and based on the geological conditions. The PGA used to design for a certain earthquake is therefore based on the earthquake magnitude as well as other factors. As described below, the pipeline would be designed using PGA values that correspond with an 8-9 magnitude CSZ earthquake and the specific return period.

Using the historical seismicity record including the records for CSZ earthquakes and the available data on Quaternary faults in the United States, the USGS (2009a) has produced probabilistic seismic hazard mapping for the United States in general, and for the region that would be crossed by the pipeline in particular. This mapping has generally been used to address two risk levels: (1) a 10 percent probability of exceedance in 50 years (475-year return period); and (2) a 2 percent probability of exceedance in 50 years (2,475-year return period). The output from the seismic hazard mapping includes estimates of the PGA and spectral accelerations for 0.2 and 1.0 second structural periods. The PGA values are given in percentages, or decimal fractions, of the acceleration of gravity (g). The acceleration resulting from gravitational forces (g) is defined as 32 fps2. PGAs for the Project were calculated for the specific 475-year and 2,475-year return periods and the site-specific PGA of 0.5g for each corresponding milepost interval of the pipeline alignment (GeoEngineers 2017a).

The 10 percent probability of exceedance in 50 years (475-year return period) is defined by the American Society of Civil Engineers (ASCE) Technical Council on Lifeline Earthquake Engineering as the contingency design earthquake for pipeline design (ASCE 1984). The highest 475-year return period PGAs expected along the pipeline alignment are about 17 percent (MP 0 to 2.0 and MP 9R to 16BR) of gravity. The University of Washington (2001) noted that these intensities are moderate and relate Instrumental Intensity VIII and a “Moderate to Heavy” potential damage to aboveground structures as described by the Modified Mercalli Intensity scale as follows:

> *Steering of cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.* (USGS 1931)

The USGS (1931) indicates that instrumental intensities of IX up to XII are seismic conditions where damage to pipelines may occur. It is noted that the intensity scale was created in 1931 and that modern pipeline materials and design protocols have improved considerably, as discussed in the following section. The potential damage to buried pipelines from the ground-shaking intensity at the site (intensity of VIII or greater) is, therefore, considered to be low. The pipeline would be designed to shut down automatically if a mechanical failure poses risk to the equipment or otherwise constitutes a hazard. Additional discussion of public safety concerns related to potential earthquake damage to the pipeline is provided in section 4.13 (i.e., the Reliability and Safety section).

Surface Rupture Potential from Faulting

Differential, or shear, movements of fault surfaces can be entirely subsurface, or they can extend to the ground surface as surface fault rupture. The nature of the shear movements at the surface depend on the character of fault movement. In general, surface fault rupture across a pipeline alignment can result in rapid differential ground displacements across the pipe, with displacement magnitudes ranging from a few inches to several feet. The typical mechanics of fault movement in the Basin and Range province (crossed by the pipeline between MP 160 to MP 224) is normal faulting at near-vertical inclinations (dip angle) caused by crustal extension. This extension forms grabens, or down-dropped blocks of the earth's crust bounded on both sides by normal faults. Although deep earthquakes occur beneath the continent within the subducting Juan de Fuca Plate in association with the CSZ, there is no risk of fault offsets at the ground surface associated with these deep earthquakes.

Based on the USGS Faults and Folds Database (USGS 2014b) and the DOGAMI geologic mapping (Black and Madin 1995; Personius 2002a; Mertzman et al. 2007; Mertzman 2008; Hladky and Mertzman 2002), and review and interpretation of light detection and ranging (LiDAR) data available from DOGAMI (http://www.oregongeology.org/lidar/), the pipeline alignment crosses the following regional Quaternary and Holocene age fault zones:

- Sky Lakes fault zone (includes Lake of the Woods Fault), near MPs 172 to 182;
- West Klamath Lake fault zone, near MP 187;
- Lower Klamath Lake section of the Klamath Graben Fault system near MPs 204 to 206 (4-5 crossings); and
- The South Klamath Lake section of the Klamath Graben Fault system near MPs 212 to 213 (Stukel Mountain fault).

The mapped Holocene age fault (defined by the USGS as active within the last 10,000 years) that would be crossed by the pipeline alignment occurs within the South Klamath Lake section of the Klamath Graben fault system, in the vicinity of Klamath Falls near MP 213. This fault is specifically named the Stukel Mountain Fault. Review of USGS data sources (Personius 2002a, 2002b) does not provide potential earthquake magnitude along this fault, but provides other information about slip rate and fault length. LiDAR imagery of recent alluvial sediments in this area does not show linear features typical of fault movements at the ground surface. Recently acquired color stereo aerial photographs do not show linear features or changes in soil color indicative of fault movement at the ground surface.

The location of the Stukel Mountain Fault was evaluated further by completing a seismic reflection survey (NORCAL Geophysical Consultants 2015) in the vicinity of the mapped fault location. The survey confirmed that a near-vertical normal fault extends southeastward from Stukel Mountain into the valley fill area and that the structural offset in bedrock is large—about 1,800 feet to 850 feet—and indicates that the graben is increasing in depth to the north. The disturbed zones from the two seismic lines align well with the USGS and DOGAMI interpretations of fault extensions into the valley fill. The fault offset extends from the bedrock surface (at about 325 feet deep) to shallower than 60 feet, the shallowest depth that could be explored by the seismic reflection survey. Thin alluvial cover over the disturbed sediments indicates that little time has passed since the fault displaced, supporting a conclusion that the Stukel Mountain fault is active.

The data generated by NORCAL indicates that the faulting in bedrock and valley fill commenced long ago and has continued intermittently into the Holocene; this affirms the published classification that the fault is active and has the potential for surface rupture. Based on the NORCAL survey locational information, a fault crossing assessment and design is needed between about MP 212.8 and MP 212.9, a 600-foot-wide zone of potentially active faulting.

Pacific Connector conducted a detailed hazard assessment and mitigative design for the fault crossing (SSD, Inc. 2017). The design fault displacement was computed using a simple and conservative MCE approach, which neglects probabilistic seismic hazard methods and assumes that the entire fault is capable of rupturing all at once. The fault is relatively short and is capable of, at most, about 3.3 feet of differential movement. The force on the pipe would be limited to the weight of backfill on top of the down-dropped side based on the nature of the fault. Therefore, detailed numerical simulation of the pipe-soil interaction of a potential maximum 3.3-foot offset was performed using a proprietary software called PIPLIN. The preliminary results of the Stukel Mountain numerical simulation analyses indicate that mitigative construction is not necessary.

Pacific Connector would further evaluate and select specific designs for fault mitigation during the final detailed design. In general, Pacific Connector would follow published guidance to estimate the potential amount and direction of fault offsets as well as the magnitude of strain accumulation at the pipe crossing location (Takada et al. 2001; Honegger and Nyman 2004). Based on trench observations during pipeline construction by EIs, if mitigation becomes necessary at any of the suspected Quaternary fault crossings, it is anticipated that the mitigation design would consist of trenches with shallow-angled sidewall slopes that are backfilled with loose, cohesionless sand and/or gravel. Site-specific numerical simulation would be used to develop optimum trench geometry for the pipeline alignment where the mitigation is implemented. If backfill material is obtained from federal land and not sourced from within the right-of-way itself, 43 CFR 3600 regulations must be followed. This applies to any material required for constructing access roads and pads. This mitigation option would use trenches with shallow-angled sidewall slopes that are backfilled with loose, cohesionless sand and/or gravel material. Pipeline load reduction with low-strength backfill is likely the most cost-effective mitigation approach for fault rupture hazards. This mitigation option also involves the use of isolation valves on opposite sides of a fault crossing. In the event of a fault-induced rupture or leak of the pipeline, the isolation valves would detect the pressure loss and close automatically, thus preventing flow of gas to the location of the rupture. Such mitigation options are typically only utilized if warranted by site conditions.

The performance of a buried pipeline subjected to fault rupture can be improved further by using different backfill material surrounding the pipe, such that the pipeline is less restrained to movement, thereby reducing shear and bending stresses (ALA 2001, 2002). Also, a coating material can be applied to the pipe to reduce the soil-pipe interface friction, such that the tensile and compressive stress of the pipe can be reduced. This technique has been used by All American Pipe Line Company for its pipeline that crosses the San Andreas Fault in California, by the Sakhalin II Pipeline (Sakhalin Energy Investment Corp. 2008) that crosses multiple active faults in Russia, and by the BTC Pipeline in the Republic of Georgia. In addition, use of stronger material (additional wall thickness) would increase the load capacity of the pipeline, hence increasing the amount of ground movement tolerable by the pipeline. Pacific Connector would consider, evaluate, and implement the best mitigation options for specific conditions during the final detailed design in coordination with the FERC.

Liquefaction and Lateral Spreading Potential

The potential for soil liquefaction from an earthquake is a function of the intensity or strength of the earthquake shaking (high PGA), the duration of strong earthquake shaking, the nature of the soil (it must generally be loose to medium dense and granular such as silt or sand), and groundwater conditions (the soil must be saturated with a shallow groundwater table). In general, liquefaction that results in permanent ground deformation or buoyant displacement of buried pipelines has the potential to result in pipeline damage (O'Rourke and Liu 1999). Pipeline damage associated with liquefaction typically occurs where a sharp transition exists between liquefiable and non-liquefiable materials. Shear or bending movements at such sharp transitions can damage pipelines. In addition, liquefaction can change the buoyancy forces such that the pipeline may float if not mitigated during design. The evaluation of liquefaction potential is complex and depends on numerous site parameters, including soil grain size, soil density, age of soil deposit, depth of the water table, site geometry, static stresses, and design accelerations.

In addition to settlement or pipeline buoyancy, the possibility exists that liquefaction could result in lateral spreading. Lateral spreading involves lateral displacement of surficial blocks of non-liquefied soil as the underlying soil layer liquefies. Lateral spreading generally develops in areas where sloping ground is present, such as along the banks of rivers, sloughs, canals, or lakes. Because lateral spreading is associated with liquefaction of soils, the potential for lateral spreading along the pipeline alignment was evaluated based on the same criteria as liquefaction potential.

The potential for liquefaction along the Pacific Connector pipeline was evaluated based on topography and soil conditions obtained from geological maps, NRCS soil surveys, and, at some sites, limited geotechnical boring data. Areas along the proposed pipeline that are subject to being under water-saturated soils within the pipeline depth are generally limited to valley floors. The groundwater table is not expected to be encountered within the trench depth along mountainous terrain. Excavation depths within the gently sloping valley floors crossed by the pipeline would be limited to the pipeline trench. The pipeline trench backfill is not considered to be of sufficient volume to liquefy during an earthquake. Additionally, trench breakers would be installed in the pipeline trench at regular intervals to prevent the trench from capturing and conveying near surface groundwater.

Liquefaction potential was identified for portions of the proposed route that would be expected to encounter loose to medium dense sandy soils (generally occurring in alluvial valleys or near rivers, streams, sloughs, lakes or other waterbodies). The characteristics were incorporated by Pacific Connector into a numerical liquefaction analysis used to characterize the potential risk of liquefaction. Based on an initial numerical analyses, sites that were underlain by strata with a safety factor against liquefaction of less than 1 are shown as having a "High" risk for potential liquefaction. These areas are listed in table 4.1.2.3-2 as having potential for liquefaction and/or lateral spreading. Those listed as low potential include sites with subsurface conditions of fine-grained soils that are not susceptible to liquefaction or soils that are not expected to be saturated. Those listed as high potential include sites that are underlain by potentially saturated loose to medium dense granular soils. The unknown potential site is an area of private property where no site-specific subsurface information is available due to lack of access.

TABLE 4.1.2.3-2

Summary of Potential Liquefaction and Lateral Spreading Hazards

From MP	To MP	Feature	Liquefaction Potential/ Lateral Spreading Potential	Ownership
1.4R	3.0R	Coos Bay	High/Low	Private, State
3.00R	6.50R	Kentuck Inlet	High/High	Private, State
8.26R	8.47R	Willanch Slough	High/High	Private, State
11.0R	11.3R	Coos River	High a/	Private, State
10.10	10.40	Stock Slough	Low/Low	Private
10.80	11.40	Catching Slough	Low/Low	Private, State
15.72	15.77	Boone Creek	Low/Low	Private
22.60	23.10	North Fork Coquille River	Low/Low	Private
27.00	27.15	Park Creek (aka Middle Creek)	Low/Low	BLM, Private
29.41	30.20	East Fork Coquille River	Low/Low	Private
48.02	48.40	Deep Creek	Low/Low	County, Private, BLM
49.70	50.45	Middle Fork Coquille River	Low/Low	Private
55.80	56.60	Alluvial Valley	Low/Low	Private
56.90	59.00	Olalla Creek	Low/Low	Private
66.85	67.05	Willis Creek	High/High	Private
68.95	69.80	South Umpqua River #1	High a/	ODOT
88.20	88.65	Days Creek	Low/Low	Private
94.55	94.80	South Umpqua River #2	High a/	Private
122.55	122.75	Rogue River	High a/	Private, State
128.50	128.70	Indian Creek	Unknown b/	Private
131.80	132.00	Neil Creek	Low/Low	Private
191.60	199.00	Klamath Valley	High/Low	Private
199.00	201.00	Klamath River	High a/	Private, State, Reclamation
201.00	214.00	Lost River Valley	Low/Low	Private, State, Reclamation
217.10	218.33	Alluvial valley	Low/Low	Private
221.80	224.40	Alluvial valley	Moderate/Low	Private

a/ A potential for occurrence may exist, but hazard would be mitigated.
b/ Landowner permission to evaluate site was not granted.

Mitigation for liquefaction conditions can include avoidance by routing around or under the potentially liquefiable materials, by reinforcing the pipe with thicker walls, and/or by weighting the pipe with a concrete coating. Potential ground improvement measures would also be considered including vibroflotation [51], stone columns, compaction grouting, and deep dynamic compaction. Primary geotechnical factors involved in selecting the type of mitigation include: the depth of liquefiable soils, fines content, groundwater depth, the potential for obstructions (i.e., buried logs), and the density of overburden soils over the liquefiable soils.

Pacific Connector proposes to cross four river crossings (Coos River, Rogue River, Klamath River, and South Umpqua River) using trenchless crossing methods including HDD and DP technologies in order to minimize the environmental impacts of construction and to install the pipeline below

[51] Vibroflotation is a technique for improving the strength and bearing capacity of unsaturated, granular soils.

zones of potentially liquefiable soil. Regardless of the performance standard that is established Kentuck Slough and Coos River sites would be constructed with special backfill placed around the pipeline in areas where the pipeline transitions from rock to soil to alleviate potential stress resulting from differential movement in accordance with the pipeline operator's design basis specifications. For the pipeline segments that transition from the alluvial soils to rock, the special backfill would extend approximately 40 feet into the rock from the soil/rock interface. The special backfill material would consist of clean, imported, processed sand of alluvial origin (crushed materials would not be used). The special backfill material would completely surround the pipe, with a minimum of 1 foot of sand backfill covering the crown of the pipe. This backfill would help to alleviate stresses induced by differential settlement between the rock and the alluvial soils. The pad of special sand backfill beneath the pipe and the sand backfill adjacent to and above the pipe would be placed in lifts not greater than 12 inches in loose thickness and lightly tamped with hand-operated vibratory equipment; and the native backfill above the imported sand would be lightly compacted with mechanical equipment.

4.1.2.4 Landslide Hazards and Slope Stability

Many types of landslides occur that can affect property and public safety. However, most landslides can be placed in two general categories: (1) shallow-rapid landslides (debris slides/flows) and (2) deep-seated landslides. Shallow-rapid, or rapidly moving, landslides generally originate on very steep slopes, often where no prior indications of movement are present. In the Coast Range, especially in the Tyee formation, recurring debris flows produce debris chutes. These are evident by narrow concave gullies containing activity indicators such as bare rock, soil generation, and vegetation stratification. Fans and coalescing fans (from multiple chute discharges) form plains. Mass-movement of rapid-shallow landslides is typically triggered by large, infrequent storm events.

Deep-seated landslide movement can occur where no previous movement is evident, but commonly occurs where topographic and vegetative indications of past or chronic slope movements are present. Deep-seated landslides range in depth from tens to hundreds of feet and can occur anywhere on a hill slope. The larger deep-seated landslide complexes may occupy several square miles of terrain. These features can usually be identified on topographic maps or aerial photos based on distinctive contour or vegetative patterns. Slope movement can vary from rapid to nearly imperceptible and may entail small to large displacements. The greatest risk of deep-seated landslide movement arises from existing (dormant) features that can reactivate in response to land management practices, seismic activity, stream erosion and/or prolonged periods of precipitation. Movement can be complex, ranging from slow to rapid, and may include small to large slope displacements. The greatest risk of deep-seated landslide movement is from existing (dormant) deep-seated landslides reactivating in response to human activity, seismic activity, stream erosion, or heavy precipitation. Assuming unchanged conditions, it is much less common for a deep-seated landslide to occur on a previously undisturbed and intact slope than reactivation of an existing landslide feature.

Risk is greatest where the direction of slide movement is across (perpendicular to) the pipeline alignment. This typically occurs where the pipeline crosses a slope instead of descending straight down the fall line. Although the greatest risk is where a pipeline crosses a landslide, headward (upslope) expansion of the slide could eventually involve a pipeline located upslope of an active landslide. Strain within a pipeline can develop slowly from a deep-seated landslide as a result of long-term slow movement, or it can develop quickly as a result of a single movement event. Shallow-rapid landslides are unlikely to induce long-term strain to a pipeline, but rather more likely to expose the pipe and result in a loss of support where it crosses a debris slide source area. Once mobilized into a debris flow, shallow-rapid landslides often have tremendous erosional potential. Debris flows that originate upslope of the pipeline also have the potential to scour, expose, and damage the pipeline by debris impact; however, as discussed in the following sections, moderate and high-risk landslide areas have been avoided during routing of the pipeline.

Construction along side slopes can also result in instability during construction, restoration, and operation, and could be a source of debris flows. Construction factors that may increase the potential for slope failure and debris flow could include trenching along slopes and the burden of construction equipment on unstable surfaces. Cut slopes and fill slopes along the pipeline right-of-way could be a source of debris flow in the Project area triggered by intense and/or prolonged rainfall events. A typical debris flow pathway consists of an upper initiation site or source area, a main path down a slope and then into and down a stream channel, and then a lower depositional area or run out zone on an alluvial fan at the base of the mountain. Fill slopes, especially inadequately constructed and maintained fill slopes, are a potential source of debris flows. Fill slope failures could become debris flows that damage not only the pipeline corridor but also the slopes, stream channels, or other resources hundreds or thousands of feet downslope from the corridor. Cut slope or fill slope failures pose a risk to pipeline construction workers, the public, and natural resources. As a result, the cut-and-fill slopes would be designed for slope stability by taking into account slope percent and other engineering geology and geotechnical engineering factors such as the orientation of the bedrock surface as well as geologic structure. The ODF has developed guidelines for the identification of high risk areas for rapidly moving landslides (including debris flows) that have a substantial risk to public safety (ODF 2000). Additional discussion of public safety concerns related to potential landslide hazards is provided in section 4.13 (i.e., the Reliability and Safety section).

An initial landslide hazards evaluation was conducted in three phases: initial office review, aerial reconnaissance, and surface reconnaissance. The purpose of the first phase study was to identify existing landslides as well as areas susceptible to landslides within one-quarter mile of the initial alignment by reviewing published maps and digital data (Burns et al. 2011a, 2011b), aerial photographs and LiDAR-generated hillshade models. The purpose of following two phases was to further evaluate only those landslide hazard sites that represent potentially moderate or high risk to the pipeline, based on the results of the previous phase of evaluation. These initial evaluation phases are described in greater detail below. No landslide hazards were identified at the aboveground facility locations.

Rapidly Moving Landslide Risk Assessment

An assessment of rapidly moving landslides (RMLs) was conducted based on available detailing mapping, risk assessment methods, and on follow-up site reconnaissance in areas of concern. DOGAMI, in cooperation with other agencies, produced a map of Potential Rapidly Moving Landslide Hazards in Western Oregon (Hofmeister et al. 2002). This map was limited to western Oregon because the vast majority of historical RML occurrence has been within that portion of the state. Pacific Connector has provided geologic hazards maps in Appendix F of the *Geologic Hazards and Minerals Resources Report* (GeoEngineers 2017a) that show the slopes in and around the pipeline alignment in western Oregon that have been mapped as potential RML hazards.

Creation of the map involved the use of GIS modeling, checking and calibration with limited field evaluations, and making comparisons with historical landslide inventories. The intent was to identify areas that have some potential to be affected by RMLs so that they would be considered and evaluated appropriately.

The Blue Ridge Reroute was identified and evaluated after the RML mapping by DOGAMI had been discontinued and is no longer being used to evaluate RML hazard risk. Other methods were used to evaluate RML hazards (such as LiDAR hillshade and aerial photograph interpretation). No RML hazards were identified along the Blue Ridge Reroute that pose a threat to the proposed pipeline alignment.

The portion of the pipeline alignment that crosses the Coast Range physiographic province has the greatest risk of being affected by rapidly moving landslides because of rugged terrain composed of relatively weak sedimentary bedrock and relatively high precipitation rates. In particular, studies indicate that the Tyee Core Area within this province has a higher susceptibility to rapidly moving landslides than other areas of the pipeline (Robinson et al. 1999).

The potential for rapidly moving landslides to occur east of MP 166 (east of the Cascade Range) generally is considered to be relatively low based on geological conditions, relatively little rainfall, and statistically fewer past historical rapidly moving landslide occurrences (Hofmeister et al. 2002). Climate change models predict a drier climate east of the Cascade Range, including less snowpack (and snowmelt), more rain instead of snow in low elevation basins, lower summer and early fall streamflows, and decreased soil moisture (University of Oregon 2008). These conditions are not likely to increase the potential for rapidly moving landslides in this region. Slopes east of MP 166 were reviewed to identify high-risk sites based on general guidelines of the ODF (ODF 2000). Based on available topographic mapping, no slopes along the pipeline alignment east of MP 166 exceed 65 percent or appear to be at high risk of rapidly moving landslide occurrence.

Pacific Connector conducted an initial risk assessment to evaluate the potential risk (high, moderate, and low) where the pipeline alignment crosses the mapped hazard areas using some of the input parameters used for the DOGAMI model (Hofmeister et al. 2002). Using LiDAR where available, 10-meter digital elevation model, and aerial photography, Pacific Connector identified moderate and high risk RML sites along the proposed route. Pacific Connector then conducted a surface reconnaissance of these sites to further evaluate potential risk. In general, the risk of landslide occurrence and mobilization increases with slope gradient and with the degree of convergence (concavity).

A total of 304 pipeline segments were initially identified within rapidly moving landslide hazard areas. Based on the risk assessment, approximately 128 of these sites were considered to be a potentially moderate or high risk and were selected for further study. Site-specific reconnaissance was conducted in certain areas with the potential for shallow-rapid landslide hazards, as documented on Tables B-3a and B-3b of Appendix B in GeoEngineers (2017a).

Deep-seated Landslide Risk Assessment

Larger, deep-seated landslides can usually be identified from topographic maps (including LiDAR) and aerial photographs. Areas susceptible to deep-seated landslide movement were identified from existing geological maps and from topographic or photographic indications of historical or ancient landslide movement.

Table B-2 from GeoEngineers (2017a) lists the identified deep-seated landslides, the data source, and the initial risk to the pipeline. High hazard landslides were identified where the alignment crosses landslide mass or is located on the slope such that the slide could move or expand to involve the pipeline. Surficial, geomorphic, and vegetative features suggest that the landslide is active or dormant historic (past movement less than 100 years ago) (Keaton and DeGraff 1996). Moderate hazard landslides were identified where the alignment crosses landslide mass or is located on the slope such that the slide could move or expand to involve the pipeline, and where surficial, geomorphic and vegetative features suggest that the landslide is dormant-young (last movement 100 to 5,000 years ago) (Keaton and DeGraff 1996). Fifteen of the landslides were judged to pose a moderate to high potential risk to the pipeline. In these instances, Pacific Connector either rerouted the pipeline route to avoid the hazard or assessed the feature further through aerial reconnaissance and risk assessment. The subsequent aerial reconnaissance of the deep-seated landslides identified as moderate to high risk included assessments of geomorphic and vegetative conditions. These data were incorporated into a model of potential risk related to each deep-seated landslide. Pacific Connector then identified potential alternative routes around moderate- to high-risk landslides that appeared to be active or to have the potential to reactivate. Six landslides were identified as posing a moderate to high potential risk and were evaluated further in the field. Five of these six landslides are located in Coos County within the Coast Range physiographic province (at MPs 14.7-14.8, 23.8-24.2, 24.4-24.6, 65.2-65.5, 65.3-65.5, and 72.7-72.9).

Seismically Induced Landslides and Rockfalls

Strong ground shaking associated with an earthquake may induce landslide failures at great distances from the earthquake source (Keefer 1984). The potential exists, at least locally along portions of the proposed route, for ground shaking to induce rockfalls, landslides, or soil slumps (USGS 2010, 2002). Potential areas of seismically induced landslides include the mapped existing landslides summarized in Table B-2 of GeoEngineers (2017a) Geologic Hazards and Mineral Resources Report from Pacific Connector's application to the FERC.

Areas of potential ground shaking of sufficient intensity to initiate landslides or rockfalls include the areas of greatest seismic activity: the Klamath Falls region (with relatively recent events of magnitudes 5.9 and 6.0) and the Coos Bay region (with the potential for very large, long recurrence interval, Cascadia megathrust events).

Landslide Hazards Avoidance and Minimization of Adverse Effects

For the purposes of landslide hazard evaluation in this report, a distinction is made between the hazard associated with a landslide and the risk associated with that hazard. In the following discussions, statements of risk apply to the potential for damage or failure of the pipeline from earth movements. It is recognized that the consequences of a pipeline failure may be catastrophic and involve fire and/or explosion. However, those consequences are location-specific and are not considered in the following evaluations of risk to the pipeline. Pacific Connector has worked to avoid landslides along the proposed route. Ridgetops are generally considered to be stable and, therefore, an attempt has been made to route the vast majority of the pipeline along ridgetops.

Risks associated with landslides include both the risk that installation of the pipeline may adversely affect slope stability, and that post-construction land movements could damage the pipeline. Pacific Connector selected its proposed route to avoid existing landslides and areas susceptible to landslides (i.e., unstable slopes where construction-induced landslides could occur). In addition, the potential for construction-induced landslides would be avoided through appropriate construction techniques and BMPs included in the ECRP. Appendix B, Table B-2 from GeoEngineers (2017a) identifies where Pacific Connector's initial proposed route was changed to avoid identified landslides and landslide hazard areas.

Table B-2 from the GeoEngineers (2017a) indicates where reroutes were completed to avoid identified landslides. Tables B-3a and B-3b from the same report indicate where reroutes were incorporated into the proposed route to avoid moderate- and high-hazard RML hazard areas. All of the moderate- and high-hazard deep-seated landslides identified along the alignment were avoided where feasible during final route selection.

All known hazardous landslides thought to pose a risk to the pipeline have been avoided through routing. At this time, no sites have been identified (through the use of LiDAR interpretation, helicopter-based reconnaissance, and ground-based reconnaissance) as requiring additional monitoring beyond the standard monitoring protocols for the entire pipeline. Pacific Connector would develop monitoring protocols and/or mitigation measures prior to construction if warranted based on findings from the ground-based reconnaissance. There are two primary ways in which pipeline construction has the potential to adversely impact slope stability: (1) deep excavation into and across the slope where the pipeline is oriented in the "side-slope" direction; and (2) capturing, concentrating and conveying surface or near surface water along the pipeline right-of-way surface or within the pipeline trench and routing it to potentially unstable slopes. The current proposed pipeline alignment generally avoids traversing steep slopes perpendicular to slope direction (side-hill) to the extent practicable.

GeoEngineers identified segments along the proposed pipeline centerline that are oriented at an angle of 45 degrees or less from contour and where slope gradients are greater than 30 percent. The slope gradients were analyzed using GIS software and a combination of LiDAR-based digital elevation model (DEM) and publicly available 10-meter DEM. Following Pacific Connector's proposed BMPs described in the ECRP would limit potential adverse impacts on slope stability for those side slopes segments that are less than 30 percent gradient. In general, these BMPs include using well-drained structural fill placed in lifts and compacted for the side slope sites with gradients of 30 percent or greater oriented perpendicular to the pipeline. At sites where import of large volumes of structural fill is not practical, alternative methods would be implemented to construct the fill slopes with native soils. For example, perforated drain pipes can be installed within the inside edge of the construction right-of-way prior to placement of the fill to improve drainage of the native soils. Perforated drains would be surrounded by 12 inches of drain rock, all of which would be wrapped in a geotextile filter fabric. After drains are installed, the fills would be placed in horizontal lifts and compacted.

Pacific Connector would further identify steep side slope pipeline construction segments during the final design phase. Fill slope construction details and specifications would be designed for all identified pipeline segments that traverse steep side slopes (30 percent or greater).

Pipeline Construction BMPs for Landslides and Slope Stability

Pacific Connector has prepared and would implement the ECRP included in its POD to avoid and minimize impacts from pipeline construction, including reducing the potential for construction to adversely affect slope stability. Because the pipeline would cross extensive areas of rugged terrain, there is potential for previously unidentified landslides or new landslides to affect the pipeline after it is installed. Monitoring higher-risk areas along the pipeline can aid in detecting landslide occurrence and movement so that action can be taken to prevent damage to the pipeline. Monitoring can range from visual surface observations from the air or ground to the use of strain gauges and subsurface instrumentation, such as inclinometers, to detect and measure slope movements (typically, these instrumentation methods are used only on pipeline segments affected by active slope movement). Monitoring is further described in the section below.

Pacific Connector's ECRP includes several BMPs that are intended to reduce the potential for pipeline construction to change or alter natural stormwater runoff and/or near surface groundwater. The following summarizes these BMPs:

1. Trench breakers would be installed in the pipeline trench on slopes prior to backfilling to prevent water from flowing along the pipeline and eroding trench backfill materials (see ECRP, Section 4.2.1). Spacing of trench breakers would be based on slope gradient. Slopes greater than 30 percent in mountainous terrain would receive trench breakers spaced at least every 100 feet. Pacific Connector would utilize sandbags (foam trench breakers may be used if approved by the State of Oregon) for trench breaker construction (see Section 4.2.1 of the ECRP for additional trench breaker details).
2. Pacific Connector would install temporary slope breakers to reduce runoff velocity, concentrated flow and to divert water off the construction right-of-way to avoid excessive erosion. Temporary slope breakers may be constructed of materials such as soil, silt fence, staked straw bales, straw wattles, or sand bags. The outfall of each temporary slope breaker would be to a stable, well-vegetated area or to an energy dissipating device at the end of the slope breaker and off the construction right-of-way. Pacific Connector would install temporary slope breakers on all slopes greater than 5 percent according to the spacing in Table 4.1-1 of the ECRP, unless the EI determines that a closer spacing is required.
3. Permanent slope breakers (waterbars) would be installed across the right-of-way on slopes. The purpose of these structures is to minimize erosion by reducing runoff velocities, by shortening slope lengths, preventing concentrated water flow, and by diverting water off the construction right-of-way. Slope breakers would be constructed with a 2 to 8 percent outslope so that water does not pool or erode behind the breaker. Outflow would be diverted to a stable area off the right-of-way consistent with FERC's Plan. Slope breakers would be installed along the right-of-way based on slope gradient and soil characteristics (see Table 4.2-2 of the ECRP.) All slopes greater than 30 percent gradient would receive slope breakers spaced at least every 50 feet.
4. Project-wide, slash from timber clearing would be stockpiled at the edge of the right-of-way and scattered/redistributed across the right-of-way during final cleanup and reclamation according to the BLM and Forest Service fuel loading specifications to minimize fire hazard risks. However, much of the slash generated during timber-clearing operations would remain on the ground and in place to provide cover to minimize erosion over the winter following construction. Pacific Connector has designated UCSAs that would not be cleared of trees along the route. Generally, slash would not be stored in UCSA in riparian reserves on federal lands. Minimizing overall disturbance would reduce the potential for erosion, especially on steep slopes.

Pipeline Monitoring

Pacific Connector intends to implement a like level of landslide and pipeline easement monitoring currently performed on existing Williams-owned pipeline facilities in southwestern Oregon. Monitoring would consist of weekly air patrol, annual helicopter survey, and quarterly class location. Class location consists of land patrol (including leak detection), semi-annual class 1 and class 2 location land patrol, and annual cathodic protection survey. All the identified ancient landslides crossed by the proposed pipeline fall within class 1 or 2 areas. Observed areas of active third-party activities such as logging or development and areas affected by unusual events such as landslides, severe storms, flooding, earthquake or tsunami may require additional inspection and monitoring determined on an individual basis.

The purpose of the monitoring would be to detect potential movement or pipe strain before it compromised the structural integrity of the pipeline. If movement were detected, immediate action would be taken to reduce the risk to the pipeline. Every landslide is unique, and there are no standard methods for reducing or eliminating landslide-related risks to buried pipelines. However, in concept, initial response actions generally include measures to reduce the stresses in the pipeline caused by slide movements. Secondary response actions are directed at improving the stability of the slide so that movements in the vicinity of pipeline are halted or the impacts on the pipeline are minimized. Tertiary response actions involve rerouting the pipeline to avoid landslide hazards by relocating the pipeline to a safer location.

Although the pipeline route does not cross active or recently active landslides, if any landslides do occur or become reactivated after the pipeline is installed, Pacific Connector would monitor the slide movement so that mitigation can be identified and implemented prior to damage occurring to the pipeline. The frequency of landslide monitoring would be based on the activity level (rate of movement) of each landslide and also includes consideration of precipitation. High-risk landslides (active or dormant-young) that pose a hazard to a pipeline would be instrumented so that movement can be measured. Instrumentation typically includes installation of slope inclinometer casing to measure landslide movement, and installation of strain gages on the pipeline to measure strain induced by slope movement.

Response Actions

Exposure of the pipe by excavation is the initial response action typically taken to reduce stresses in the pipe. By exposing the pipe on both sides, the pipe is allowed to rebound to a position where it carries little residual stress.

Improvements in surface drainage also are important initial response measures. Typical drainage improvement measures include: (1) placement of impermeable liners over the ground surface to limit infiltration of precipitation and erosion; (2) ditching to divert surface water around landslide areas; and 3) routing surface flows across slide areas within tightline drain pipes. If surface drainage improvements would impact jurisdictional resources under Section 404 of the CWA these impacts would need to be permitted as appropriate. See section 4.3 of this EIS.

Once the landslide area is initially stabilized, a decision of permanent action must be made. Permanent mitigation can include repairs and stabilization of the landslide area. Permanent repairs can include drainage improvements, loading and/or stabilization of the toe of the slope, decreasing the load at the head of the slope, or retaining structures at the base or within the slope. If the landslide is large and complex and stabilization is not a reasonable option, rerouting the pipeline around the slide may be the preferred mitigation.

Specialized trench backfill is utilized where pipelines cross landslides or fault zones where differential movement or shearing across the pipeline is expected. For steep slopes, trench breakers and water bars are utilized to minimize the potential for erosion or mass wasting of trench backfill. Section 11.0 of the ECRP provides special backfill and compaction criteria for restoring site grades on slopes greater than 3H:1V. Specifications include use of structural fill, benching slopes to receive fill, and compaction of fill in lifts.

Because the geological and other natural hazards are important considerations for the design, construction, and operation of the facility, information on the final mitigation measures and monitoring protocols of the pipeline in areas which were not accessible during previous studies are required to evaluate slope stability conditions. Six moderate risk, deep-seated landslides were identified for additional surface inspection; the landslides are identified in Pacific Connector's Resource Report 6[52] (as #AM, #126, #127, #AV, #AW, and #AU) and are located at MPs 14.3-14.4, 23.8-24.2, 24.4-24.6, 65.2-65.5, 65.3-65.5, and 72.7-72.9. These areas represent approximately 1.2 miles of the pipeline route. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary, for review and written approval by the Director of OEP, the final monitoring protocols and/or mitigation measures for all landslide areas that were not accessible during previous studies.**

4.1.2.5 Rock Sources and Permanent Disposal Sites

Pacific Connector has identified 20 potential rock source and permanent disposal sites that total approximately 86 acres along the proposed route. Of these 20 rock source/disposal sites, all of the sites (5 of which are temporary extra work areas [TEWAs]) are existing quarries/gravel pits. These sites are listed in table 4.1.2.5-1. The table lists the rock source and disposal sites, their sizes, approximate mileposts in relation to the pipeline, jurisdiction, and existing land use. Only the disposal sites (and not the TEWAs) listed in table 4.1.2.5-1 are being proposed for use as permanent disposal sites.

Rock source sites may contain useable mineral deposits that may be extracted and/or purchased for use during construction. Disposal sites were identified for final placement of unusable, non-merchantable materials. These sites are typically exhausted areas within active quarries or abandoned quarries and may include commercial sites. Other permanent storage sites, including some TEWAs, were identified for permanent storage of excavated material. The material disposed of in these areas would be properly graded, drained (if necessary), and revegetated. The sites identified are not proposed for expansion beyond their proposed permitted or authorized boundaries. Use of any site would be permitted as required by the appropriate jurisdiction or landowner, and Pacific Connector would comply with applicable permits/stipulations. The disposal of mineral material to Pacific Connector from rock sources proposed to be utilized on BLM lands would follow regulations in 43 CFR 3600.

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[52] See Appendix B, Table B-2 in Resource Report 6 submitted as part of Pacific Connector's application to the FERC.

TABLE 4.1.2.5-1

Rock Source and/or Permanent Disposal Sites

Site	Size (acres)	Milepost	Land Use	Jurisdiction
Coos County				
TEWA 38.90-W/ Sandy Creek Quarry	4.50	38.90	Strip mines, quarries, and gravel pits, clearcut forest land, regenerating evergreen forest land, transportation, communication, utilities corridors	Private
Douglas County				
Signal Tree Road Quarry – Sec. 3	1.22	45.86	Quarries	BLM Roseburg District
Signal Tree Road Quarry – Sec. 35	1.09	47	Quarries	BLM-Coos Bay District
Weaver Road Quarry Site 1	1.62	47	Quarries	BLM-Coos Bay District
Weaver Road Quarry Site 2	1.30	47	Quarries	BLM-Coos Bay District
Private Quarry Benedict Road	1.49	56.75	Quarries	Private
Roth – Existing Quarry #1	0.77	72.61	Quarries	Private
Roth – Existing Quarry #2	0.34	72.76	Quarries	Private
TEWA 79.85-N (BLM Quarry Site)	3.61	79.85	Quarries, transportation, communication, utilities corridors, regenerating evergreen forest land	BLM-Roseburg District
Hatchet Quarry MP 102.30	2.00	102.30	Strip mines, quarries, gravel pit, transportation, communication, utilities corridors	FS-Umpqua
Rock Disposal MP 104.12	3.36	104.12	Mines, quarries, and gravel pits, transportation, communication, utilities corridors, regenerating forest land	FS-Umpqua
Jackson County				
TEWA 110.73 (Peavine Quarry)	15.87	110.54	Mines, quarries, gravel pit and evergreen forest	FS-Umpqua
TEWA 150.31-W (Heppsie Mountain Quarry)	5.56	150.31	Mines, quarries, and gravel pits, mixed rangeland, evergreen forest land, mixed forest land, transportation, communication, utilities corridors, regenerating evergreen forest land, clearcut forest land,	Private and BLM-Medford District
Rum Rye MP 160.41	4.91	160.41	Strip mines, quarries, and gravel pits	FS-Rogue River-Siskiyou
TEWA 160.54-W (Big Elk Cinder Pit) (Ichabod Rock Quarry)	15.26	160.54	Mines, quarries and gravel pits, transportation, communication, utilities corridors, evergreen forest land	FS-Rogue River-Siskiyou
Klamath County				
Rock Source and Disposal MP 180.56	7.76	180.56	Mines, quarries, gravel pit, transportation communication and utilities corridors, and regenerating forest land	Private
Rock Source and Disposal MP 180.71	2.95	180.71	Mines, quarries, gravel pits, Clearcut forest land	Private
Rock Source and Disposal MP 182.40	5.66	182.40	Quarries, gravel pits	Private
Rock Source and Disposal MP 201.61	4.96	201.61	Transitional areas, cropland and pasture, transportation communication and utilities corridors	Private
TEWA (5) Total			**44.80**	
TEWAs associated with existing quarries (5)			**44.80**	
Existing quarries and rock source and disposal sites—Total			**41.18**	
TOTAL			**85.98**	

Source: Pacific Connector's Resource Report 1, Table 1.2-3, filed with the FERC September 2017.

If Pacific Connector acquired rock from these sources or permanently disposed of excavated material, all available topsoil would be salvaged. The salvaged topsoil would be used to restore the site as required by landowner stipulations. Rock resource areas managed and developed by Pacific Connector would need quarry Operation and Reclamation Plans, to the extent required by DOGAMI's regulatory authority (OAR 632-030-0005 through 0070 and ORS 517.750 through 990). Appropriate BMPs would be implemented, such as those in Norman et al. (1998). No impacts are anticipated from the rock sources and permanent disposal sites.

4.1.2.6 Blasting During Trench Excavation

Blasting could be required for pipeline trench excavation in areas where hard, non-rippable bedrock occurs. The bedrock units where blasting could be necessary would consist primarily of volcanic and metavolcanic rocks in the Klamath Mountains and volcanic rocks in the Cascade Range as well as along the ridges in the Basin and Range physiographic province. In addition, local areas of well-lithified sedimentary rock may need to be blasted in the Coast Range.

Pacific Connector identified areas where blasting may be necessary by reviewing the NRCS soils maps and descriptions to identify soil units that typically contain bedrock within 5 feet of the ground surface. Soils data, geological maps, and topographic relief were used to rank the qualitative likelihood for blasting along the pipeline as follows:

- No Potential – Areas containing deep soils and alluvial, fluvial, lacustrine, and estuarine sediments that could be readily excavated. General occurrence: the coastal and Klamath basin lowlands and the major valleys and floodplains in all of the physiographic provinces.
- Low Potential – Areas containing soft sedimentary rock and tuff that can typically be excavated without ripping. General occurrence: Coast Range, and local areas of the Klamath Mountains, Cascade Range, and the Basin and Range physiographic provinces.
- Moderate Potential – Areas containing fractured, faulted, or weathered metamorphic or volcanic rocks that generally can be excavated with ripping, but that could require local blasting. General occurrence: local areas in the Klamath Mountains, Cascade Range, and the Basin and Range physiographic provinces.
- High Potential – Areas containing hard or fresh plutonic (for example, granitic) and volcanic rocks that could not be excavated without blasting. General occurrence: local areas of the Klamath Mountains physiographic province, portions of the Cascade Range physiographic province, and local areas in the Basin and Range physiographic province.

Table 4.1.2.6-1 provides a summary of the blasting potential along the pipeline. Blasting is less likely to be required to construct the first 78 miles of the pipeline because the materials are expected to consist of soil, sediments, and rippable sedimentary rocks. Although the blasting potential is classified as high for about 100 miles of the proposed route, this distance estimate includes local areas as much as 0.9 mile in length that contain valley fill, thick soils, and soft volcanic rocks (such as tuffs) that would not need to be blasted. In addition, some of the proposed route classified as having a high or moderate potential for blasting may contain weathered rock that could instead be ripped by conventional excavation equipment.

TABLE 4.1.2.6-1

Summary of Blasting Potential Along the Proposed Pacific Connector Pipeline

From MP	To MP	Blasting Potential	Material	Ownership (Federal Lands)
0.00	19.7BR	None to Low	Soil, sediments, sedimentary rocks and valley fill	BLM – Coos Bay
19.7BR	19.9BR	Moderate	Volcanic	BLM – Coos Bay
19.9BR	21.5BR	None	Sediments	BLM – Coos Bay
21.5BR	21.6BR	Moderate	Volcanic rocks	BLM – Coos Bay
21.6BR	21.9BR	None	Sediments	BLM – Coos Bay
21.9BR	22BR	None to Moderate	Sediments, volcanic rocks	BLM – Coos Bay
22BR	22.1BR	Moderate	Volcanic rocks	BLM – Coos Bay
22.1BR	22.3BR	None	Sediments	BLM – Coos Bay
22.3BR	23.6BR	Moderate	Volcanic rocks	BLM – Coos Bay
23.6BR	45.9	None to Low	Marine sedimentary rocks, sediments	BLM – Coos Bay
45.9	48.2	Moderate	Marine sedimentary rocks (hard)	BLM-Roseburg
48.2	59.2	None to Low	Marine sedimentary rocks, sediments, mélange rocks with valley floor sediments	BLM-Roseburg
59.2	59.3	Moderate	Mélange rocks	BLM-Roseburg
59.3	59.4	None	Sediments	BLM-Roseburg
59.4	59.5	Moderate	Mélange rocks	BLM-Roseburg
59.5	59.9	None	Sediments	BLM-Roseburg
59.9	63.9	Moderate	Mélange rocks	BLM-Roseburg
63.9	64	None	Sediments	BLM-Roseburg
64	65.6	Moderate	Mélange rocks	BLM-Roseburg
65.6	67	None	Sediments, mélange rocks	BLM-Roseburg
67	69.3	Moderate	Mélange rocks	BLM-Roseburg
69.3	70.4	None	Mélange rocks with valley floor sediments	BLM-Roseburg
70.4	71.1	moderate	Metamorphic rocks, sediments	BLM-Roseburg
71.1	71.3	High	Metamorphic rocks, sediments	BLM-Roseburg
71.3	75.1	moderate	Metamorphic rocks	BLM-Roseburg
75.1	78.5	None to Low	Marine sedimentary rocks, sediments	BLM-Roseburg
78.5	79	High	Volcanic rocks, intrusive rocks	BLM-Roseburg
79	79.2	none	Sediments	BLM-Roseburg
79.2	81.1	High	Intrusive rocks, volcanic rocks	BLM-Roseburg
81.1	81.6	None	Sediments	BLM-Roseburg
81.6	87.7	High	Volcanic rocks, intrusive rocks	BLM-Roseburg
87.7	88.3	Low	Marine sedimentary rocks	BLM-Roseburg
88.3	88.8	High	Volcanic rocks, intrusive rocks	BLM-Roseburg
88.8	89	Low	Marine sedimentary rocks	BLM-Roseburg
89	89.5	High	Volcanic rocks	BLM-Roseburg
89.5	89.9	Moderate	Marine sedimentary rocks	BLM-Roseburg
89.9	91.3	Low	Marine sedimentary rocks	BLM-Roseburg
91.3	94.5	Moderate	Marine sedimentary rocks, volcaniclastic rocks	BLM-Roseburg
94.5	95.3	None	Sediments	BLM-Roseburg
95.3	95.5	High	Intrusive rocks	BLM-Roseburg
95.5	97	Low	Marine sedimentary rocks	BLM-Roseburg
97	108.9	High	Intrusive rocks, metamorphic rocks, mélange rocks	BLM-Roseburg / Umpqua NF
108.9	109.4	None	Sediments	Umpqua NF
109.4	111	High	Volcaniclastic rocks, volcanic rocks	Umpqua NF
111	113.3	Low	Volcaniclastic rocks	Umpqua NF
113.3	113.6	High	Volcaniclastic rocks, volcanic rocks	-
113.6	113.7	Low	Volcaniclastic rocks	-
113.7	116.9	High	Volcaniclastic rocks, volcanic rocks, intrusive rocks	BLM-Medford

TABLE 4.1.2.6-1 (continued)

Summary of Blasting Potential Along the Proposed Pacific Connector Pipeline

From MP	To MP	Blasting Potential	Material	Ownership (Federal Lands)
116.9	118.2	Low	Volcaniclastic rocks	BLM-Medford
118.2	119.5	High	Volcanic rocks	BLM-Medford
119.5	119.6	Low	Volcaniclastic rocks	BLM-Medford
119.6	119.8	High	Volcanic rocks	BLM-Medford
119.8	120.2	Low	Volcaniclastic rocks	BLM-Medford
120.2	120.4	High	Volcanic rocks	BLM-Medford
120.4	121.7	Low	Volcaniclastic rocks	BLM-Medford
121.7	122.1	High	Volcanic rocks	BLM-Medford
122.1	122.4	Low	Volcaniclastic rocks	BLM-Medford
122.4	122.6	High	Volcanic rocks	BLM-Medford
122.6	123.1	none	Sediments	BLM-Medford
123.1	126	High	Volcanic rocks	BLM-Medford
126	126.7	Low	Volcaniclastic rocks	BLM-Medford
126.7	133.6	High	Volcanic rocks	BLM-Medford
133.6	134.1	Low	Volcaniclastic rocks	BLM-Medford
134.1	134.7	High	Volcanic rocks	BLM-Medford
134.7	140.2	None to Low	Volcaniclastic rocks, sediments	BLM-Medford
140.2	141.7	High	Volcanic rocks	BLM-Medford
141.7	141.9	Low	Volcaniclastic rocks	BLM-Medford
141.9	143.5	High	Volcanic rocks	-
143.5	143.9	None to Low	Volcaniclastic rocks, sediments	-
143.9	144.8	High	Volcanic rocks	-
144.8	145.2	Low	Volcaniclastic rocks	-
145.2	145.7	High	Volcanic rocks	-
145.7	145.7	None	Sediments	-
145.7	146.8	High	Volcanic rocks	-
146.8	147	Low	Volcaniclastic rocks	-
147	148.2	High	Volcanic rocks	-
148.2	148.3	Low	Volcaniclastic rocks	BLM-Medford
148.3	148.3	High	Volcanic rocks	BLM-Medford
148.3	148.4	Low	Volcaniclastic rocks	BLM-Medford
148.4	172	High	Volcanic rocks, vent and pyroclastic rocks	BLM-Medford / Rogue River-Siskiyou NF / Fremont-Winema NF
172	175.4	None	Volcanic rocks with overlying thick soil	Fremont-Winema NF
175.4	186.6	High	Volcanic rocks	BLM-Lakeview
186.6	186.7	None	Sediments	BLM-Lakeview
186.7	190.8	High	Volcanic rocks	BLM-Lakeview
190.8	212.6	None	Terrestrial sedimentary rocks, sediments	BLM-Lakeview
212.6	214.8	Moderate	Terrestrial sedimentary rocks	BLM-Lakeview
214.8	215	High	Volcanic rocks	BLM-Lakeview
215	215.2	None	Sediments	BLM-Lakeview
215.2	215.6	High	Volcanic rocks	BLM-Lakeview
215.6	216.4	None	Sediments	BLM-Lakeview
216.4	216.5	Moderate	Terrestrial sedimentary rocks	BLM-Lakeview
216.5	217.1	High	Volcanic rocks	BLM-Lakeview
217.1	217.5	Moderate	Terrestrial sedimentary rocks	-
217.5	217.9	None	Sediments	-
217.9	218.5	Moderate	Terrestrial sedimentary rocks	-
218.5	218.9	None	Sediments	-
218.9	218.9	Moderate	Terrestrial sedimentary rocks	-

TABLE 4.1.2.6-1 (continued)

Summary of Blasting Potential Along the Proposed Pacific Connector Pipeline

From MP	To MP	Blasting Potential	Material	Ownership (Federal Lands)
218.9	222.1	High	Volcaniclastic rocks, volcanic rocks	-
222.1	222.5	Moderate	Terrestrial sedimentary rocks	-
222.5	223.9	High	Volcaniclastic rocks, volcanic rocks	-
223.9	224.9	Moderate	Terrestrial sedimentary rocks	-
224.9	225.8	None	Sediments	-
225.8	227	Moderate	Terrestrial sedimentary rocks	-
227	227.7	None	Sediments	-
227.7	228.8	High	Volcanic rocks	-

Source: Table 2.1.2-9 of the Applicant Prepared Draft Biological Assessment, filed December 2017.

Pacific Connector would conduct all blasting in accordance with all federal, state, and local regulations and Pacific Connector Construction Specifications. Pacific Connector would include specifications in any blasting contract to control adverse impacts, including measures to minimize vibrations and flyrock, measures for safe blasting practices near active pipelines, and seasonal restrictions to protect wildlife, as needed. Pacific Connector would have blasting inspectors present to ensure that all specifications were met and to perform pre- and post-blast inspections of nearby structures and wells.

Drilling and blasting would be done with the Pacific Connector inspector present and with the inspector's approval to proceed prior to each blast. Blasting operations would be conducted by or under the direct and constant supervision of experienced personnel legally licensed and certified to perform such activity in the jurisdiction where blasting occurs. Pacific Connector would require their contractor to provide site-specific Blasting Plans at least 5 working days prior to any proposed blasting-related activity, and the contractor would be required to obtain Pacific Connector approval in writing prior to starting work. The Blasting Plan would include the following information:

- explosive type, product name and size, weight per unit, density, and equivalent energy release ratio (N) (the blasting agent Ammonium Nitrate and Fuel Oil [ANFO] would not be allowed);
- delay type, sequence, and delay (milliseconds);
- initiation method (detonating cord, blasting cap, or safety fuse);
- stemming material and tamping method;
- hole depth, diameter, and pattern;
- explosive depth, distribution, and maximum weight per delay;
- number of holes per delay;
- distance and orientation to nearest aboveground structure;
- distance and orientation to nearest underground structure, including pipeline;
- procedures for storing, handling, transporting, loading, and firing explosives, fire prevention, inspections after each blast, misfires, fly rock and noise prevention, stray current accidental-detonation prevention, signs and flagmen, warning signals prior to each blast, notification prior to blasting, and disposal of waste blasting material;
- seismograph company, personnel, equipment, and sensor location, if required;
- copies of all required federal, state, and local permits;
- blaster's name, company, copy of license, and statement of qualifications;

- magazine type and locations for explosives and detonating caps; and
- typical rock type and geology structure (solid, layered, or fractured).

Pre-blast inspections would be completed for structures and wells that are within the influence zone of the blasting. The pre-blast inspections would include but not be limited to an inventory of existing structural integrity and signs of structural distress such as cracks. Post-blasting inspections would include an inspection and comparison of the same elements observed for the pre-blast inspection. If blast related damage is identified by Pacific Connector inspectors and confirmed to be a result of the blasting activities, then damaged structures or wells would be returned to pre-construction conditions or better.

Blasting for grade or trench excavation would be utilized only after all other reasonable means of excavation have been used and are unsuccessful in achieving the required results. Pacific Connector may specify locations (foreign line crossings, near-by structures, etc.) where consolidated rock would be removed by approved mechanical equipment such as rock-trenching machines, rock saws, hydraulic rams, or jack hammers in lieu of blasting.

Every precaution would be taken to prevent damage to aboveground and underground structures during blasting operations; and every precaution would be taken to prevent injuries and damage to persons or inconvenience to the general public. Blasting mats or padding would be used on all shots where necessary to prevent scattering of loose rock onto adjacent property and to prevent damage to nearby structures and overhead utilities. Blasting would not begin until occupants of nearby buildings, residences, places of business, places of public gathering, and farmers have been notified sufficiently in advance to allow for protection of personnel, property, and livestock. Maximum ground motion velocities of 2 inches/second specified at the locations of structures would be required for any structures identified within 200 feet of the pipeline construction area.

Blasting for trench excavation could result in impacts on wells, wetlands, slopes, structures, and other adjacent buried utilities, as described below. The use of Pacific Connector's proposed monitoring and mitigation measures would avoid or reduce the likelihood of local failures of unstable rock and soil, and damage to structures or utilities from blasting vibrations.

Water Wells and Springs

Blasting could affect groundwater quality by temporarily increasing groundwater turbidity near the construction right-of-way. In addition, turbidity and blasting agent by-products could possibly temporarily degrade groundwater quality and potentially have temporary effects on wells in the immediate proximity of the blasting. In general, vibration effects on wells would be expected to be limited to the immediate proximity of the blasting. A common measurement unit for vibration is the peak particle velocity (PPV) of blasting-induced ground motion in inches per second. Siskind (1999) summarizes information on four blasting studies conducted to evaluate vibration effects on wells. One study showed, "There were no physical vibration effects on the wells even as close as 300 feet." The maximum velocities for this testing ranged from 0.84 to 5.44 inches per second, with four of the five sites exceeding 2 inches per second. In another study, a well was tested for casing cement bond damage. The study indicated initial bond losses occurred at 4.7 inches per second. A third study indicated that wells outside the blast pattern were exposed to as much as 8.7 inches per second at a distance of 31 feet and no damage occurred; however, the construction details for these wells are not described in the Siskind (1999) report.

A discussion of water supply wells within 150 feet of the construction right-of-way and measures proposed by Pacific Connector to avoid or minimize impacts on wells, including from blasting, is included in section 4.3. Pacific Connector would employ measures in the Blasting Plan including development of site-specific blasting operation and monitoring plans to address site variables (soil and rock types, etc.), which would incorporate known locations of existing groundwater wells or springs and seeps. Maximum ground motion velocities (or PPV) of 2 inches/second would be set for blast locations within 150 feet of water wells and springs.

Pacific Connector would request authorization from landowners to test and document the baseline condition, yield, and water quality of any private wells located within 200 feet of the pipeline construction right-of-way. This testing would occur before the pipeline construction starts in the nearby area, and the testing results would be shared with the property owner, if requested. Similar information would be gathered for any public water wells located within 400 feet of the pipeline construction right-of-way. Based on testing results, if it is determined after construction that there has been an impact on groundwater supply (either yield or quality), Pacific Connector would work with the landowner to ensure a temporary supply of water, and, if determined necessary by the landowner, Pacific Connector would provide a permanent water supply. Mitigation measures would be coordinated with the individual landowner in order to meet the landowner's specific needs. Mitigation measures for groundwater wells, springs, and seeps would be specific to each property and would be determined during landowner negotiations.

Wetlands

Blasting could potentially redirect surface water and groundwater flows to and from wetlands. In addition, turbidity and blasting agent by-products could possibly temporarily degrade surface water and groundwater quality.

Any turbidity resulting from blasting is expected to be temporary and to dissipate shortly after blasting. Water quality impacts on wetlands from blasting agents, if any, would be expected to be temporary and localized because only small amounts of blasting agents generally would be needed for trenching. Specific blasting agents would be listed in the *Blasting Plan*[53] prior to the initiation of any blasting. The use of ANFO would not be allowed.

Slopes

Unstable rock and soil slopes could locally fail as a result of blasting vibrations. Pacific Connector would complete a reconnaissance of slopes in the vicinity of the blasting, including measuring slope inclinations and observing areas adjacent to planned blasting locations for potential indicators of unstable slopes. Identified slope areas that could be impacted by blasting would be monitored and evaluated for hazards to people and property during the blasting operations.

Structures

Blasting vibrations and flying debris could potentially damage aboveground structures. If structures were present in areas where blasting was necessary, Pacific Connector would request authorization from landowners to inspect structures located within 200 feet of the pipeline construction right-of-way before and after blasting. Blasting mats or padding also would be used when blasting near structures to limit potential damage from flying rocks. To limit potential

[53] The *Blasting Plan* was included in Pacific Connector's January 2018 application to the FERC as Appendix C of the POD.

damage to structures, maximum ground motion velocities (or PPV) of 2 inches/second would be specified at the locations of structures, which is consistent with the language of the *Blasting Plan*.

As an additional precaution, Pacific Connector would require the contractor conducting blasting to limit the size of charges in accordance with the scaled distance factor (SD) guidelines developed by the Office of Surface Mining Reclamation and Enforcement (OSMRE). The SD is equal to the distance from the blast to an aboveground structure divided by the square root of the charge (pound per delay). For distances less than 300 feet, OSMRE states that the SD shall exceed 50 feet, which specifies a maximum blasting charge of 1.0 pound/delay.

Adjacent Pipelines and Buried Utilities

Blasting vibrations could potentially damage adjacent underground pipelines and utilities. In general, blasting would not be allowed within 10 feet of an existing pipeline or buried utility. In cases where blasting near an existing utility was necessary, the pipeline or utility owner would be notified in advance of the blasting, and measures would be taken to minimize the potential for utility damage (as outlined in the *Blasting Plan*).

4.1.2.7 Paleontological Resources

There are no known paleontological resources along the pipeline route.

4.1.3 Environmental Consequences on Federal Lands

4.1.3.1 Geologic Hazards on Federal Lands

The seismic hazard evaluation included surface rupture from faulting, liquefaction potential, and lateral spreading as discussed in section 4.1.2.3 above. In general, seismic hazard risks are low for the proposed pipeline. In addition, liquefaction potential and scour would be avoided by employing HDD construction of the pipeline across streams. The potential exists locally along portions of the proposed route on federal lands for seismically induced ground shaking to induce rockfalls, landslides, or soil slumps. Pacific Connector selected its proposed route to avoid existing landslides and areas susceptible to landslides to the extent practicable.

The pipeline would cross the BLM-Coos Bay District from MP 13.0BR to MP 27.5; and from MP 28.4 to MP 45.7. The western portion of this area is within the outer limit of the Cascadia event impact area. Evaluation of hazards for the design earthquake indicate that the pipeline (designed to standards) would not be susceptible to risks from seismic events. One landslide site located near MP 36.92 on land managed by the BLM Coos District could not be avoided. Additional investigation of this site resulted in a final risk determination of low (GeoEngineers 2017a). The landslide risk at this site is not considered hazardous enough to require additional mitigation or rerouting.

The pipeline would cross the BLM-Roseburg District from MP 46.9 to MP 102.3. Recent faults are not present in this area; and steep slopes and landslides have been avoided in this section of the pipeline route. The pipeline would cross the Umpqua National Forest from MP 99.3 to MP 113.2. Recent faults are not present in this section of the pipeline route; and steep slopes and landslides have been avoided in this section of the pipeline route. The pipeline would cross the BLM Medford District from MP 115.1 to MP 141.9; and from MP 148.3 to MP 153.8. Recent faults are not present in this section of the pipeline route. Steep slopes and landslides have been avoided in this section of the pipeline route. The pipeline would cross the Rogue River-Siskiyou

NF from MP 153.8 to MP 168. Recent faults are not present in this section of the pipeline route. Steep slopes and landslides have been avoided in this section of the pipeline route.

The pipeline would cross the Fremont-Winema National Forest from MP 168 to MP 175.4. The Quaternary-age Sky Lakes fault zone is located from MP 172 to MP 182. Some areas of this route section have a high potential for blasting during construction. Steep slopes and landslides have been avoided in this section of the pipeline route. The pipeline would cross the BLM Lakeview District from MP 176.2 to MP 216.8. The Quaternary-age Sky Lakes fault zone is located from MP 172 to MP 182; the Klamath Lake fault is located near MP 187; the Lower Klamath Lake fault system is located near MP 204 to MP 206; and the Stukel Mountain fault is located near MP 212 to MP 213. Some areas of this route section have a high potential for blasting during construction. Steep slopes and landslides have been avoided in this section of the pipeline route.

Mitigation for pipeline sections that cross recent faults has been discussed in section 4.1.2.3. During construction, Pacific Connector would have the pipeline trench carefully examined by a qualified professional for evidence of stratigraphic offsets potentially related to ground rupture. If such features are observed, Pacific Connector would implement additional mitigation measures, with the specific mitigation developed at that time. Such measures could include burying the pipe in a wide trench that was backfilled with loose gravel or sand, which would allow for relatively unrestrained movement of the buried pipe within the zone of fault movement.

Because the pipeline would cross a predominance of rugged terrain within BLM and NFS lands, there is potential for previously unidentified landslides or new landslides to affect the pipeline after it is installed. To minimize landslide risk, Pacific Connector would implement its ECRP during pipeline construction, which would reduce the potential for construction to adversely affect slope stability. As described in the ECRP, temporary construction BMPs would include sediment barriers, slope breakers, and application of mulch prior to seeding; permanent measures would include installation of permanent slope breakers and revegetation. In addition, as part of its pipeline operation, Pacific Connector would conduct regular monitoring of the pipeline right-of-way, which would aid in detecting landslide occurrence or slope movement. On federal lands, Forest Service and BLM representatives would conduct monitoring with Pacific Connector personnel. Mitigation could include the use of shutoff valves. If movement is detected, immediate action would be taken to reduce the risk to the pipeline. Actions would include initial response to reduce the stresses on the pipeline, and follow-up actions to stabilize the slide. If the slide is large and complex enough such that stabilization would not be feasible, the pipeline could be relocated around the slide area.

Pacific Connector intends to implement a level of landslide and pipeline easement monitoring like that currently performed on existing Williams-owned pipeline facilities in southwestern Oregon. Similar to the Williams-owned pipeline, monitoring would consist of weekly air patrol, annual helicopter survey, and quarterly class location. Class location consists of land patrol (including leak detection), semi-annual class 1 and class 2 location land patrol, and annual cathodic protection survey. Observed areas of active third-party activities such as logging or development and areas affected by unusual events such as landslides, severe storms, flooding, earthquake or tsunami may require additional inspection and monitoring determined on an individual basis.

4.1.3.2 Mineral Resources on Federal Lands

Sixteen oil and gas areas are located between MP 10.4R and 45.7, and two mining claims between MPs 0 and 1.4 in Coos County on BLM land. Seven oil and gas areas, two placer mining claims, one mine, two lode mining claims, and a chromite resource are located in the vicinity of the pipeline alignment between MPs 46.9 and 97 in Douglas County on BLM land. Two load mining claims and a quarry are located in the vicinity of the pipeline alignment between MPs 101.8 and 110 in Douglas County on NFS land. Nine oil and gas areas and two lode mining claims are located in the vicinity of the pipeline alignment between MPs 115.4 and 154.9 in Jackson County on BLM land. One oil and gas area is located in the vicinity of the pipeline alignment between MPs 155.4 and 166.4 and one between MPs 205.2 and 205.7 in Jackson County on NFS land. One lode mining claim in the vicinity of the pipeline alignment is located between MPs 170.1 and 171.1 in Klamath County on NFS land. Two geothermal resources areas are located in the vicinity of the pipeline alignment between MPs 192.7 and 216.8 in Klamath County on BLM land. It is noted that the status of these mining claims are all listed as “closed” or “unknown”, so they are not considered as active at this time.

The Green Butte Quarry was identified at MP 101.8 within the Umpqua National Forest. However, GeoEngineers (2017a) indicated that this quarry was never opened and there are no plans for its future development. The proposed route between MPs 108.6 and 110.9 avoids the Peavine Quarry within the Umpqua National Forest. The pipeline alignment at MP 150.5 is within approximately 100 feet northeast of the Heppsie Mountain quarry on BLM land and parallels the length of the quarry. The Heppsie quarry is a regional hard rock quarry and to utilize this rock quarry it is necessary to blast the rock. It was determined by the BLM and Pacific Connector that due to the proximity of the pipeline to the quarry and the incompatibility of production blasting the rock quarry near the pipeline, that 70,000 cubic yards of rock will be blasted at the expense of Pacific Connector and left on site. The BLM is requiring this blasting because the BLM will not assume unknown risk associated with complications, limitations, or liability associated with utilizing this quarry in the future.

Based on aerial photograph review of the quarry depths, trends, and distances from the pipeline, it was concluded that the quarry likely would extend into a stable rock outcrop that currently parallels the proposed route and does not pose a risk to the quarry or the pipeline project (GeoEngineers 2017a). POD attachments include the Blasting Plan, ROW Clearing Plan, and ROW Marking Plan, all of which would serve to ensure the avoidance of quarries.

Near MP 109, the pipeline would be about 0.3 mile and 0.5 mile east of the Nivinson and Red Cloud mercury mines, respectively. These mines are located within NFS lands. Construction and operation of the pipeline would not affect these mines. The proposed route would cross areas mapped as volcanic and volcanogenic rocks at the current crossings of the East Fork Cow Creek. These bedrock units have not been identified as a substantial source of naturally occurring mercury. Naturally occurring mercury in this area typically is associated with metamorphic bedrock units such as amphibolite.

The Forest Service reports that naturally occurring mercury exists in the vicinity of the Mars Prospect located near MP 108.7 (Broeker 2010). Broeker concluded that naturally occurring mercury is present in the disrupted soil regolith and underlying bedrock strata throughout the upper reaches of the East Fork Cow Creek watershed. Although localized, mercury values are sufficiently high enough to have warranted exploration, development and minor production between the 1930s and 1960s. Geochemical analysis of six soil samples collected along a 2,000-foot section of Pacific Connector's previously proposed route in this area that crossed partly through the historic Thomason mining claims near the East Fork Cow Creek determined the area to have very low concentrations of naturally occurring mercury mineralization. Pacific Connector subsequently rerouted its proposed route in this area approximately 2,500 feet from where the samples were taken.

Based on the analytical results, mapped bedrock at the proposed route, and the distribution/location of mercury mines, it is unlikely that the soils underlying the currently proposed crossing of the East Fork Cow Creek would have concentrations of naturally occurring mercury exceeding those measured in samples obtained from the previous crossing location and most likely would have lower levels. Additional details on the literature research, field observations and soil sampling and analysis completed for the prospects and mines located near MPs 108 to 110 are provided in GeoEngineers (2017a). Soil sampling and analysis results also support that mercury specific health and safety protocols would not be needed for the construction activities. It is expected that the planned erosion and sediment control measures described in the Pacific Connector's ECRP would protect the ecological health of upland and in-stream areas from the naturally occurring mercury concentrations.

The pipeline could potentially interfere with future mining and reclamation activities on lands adjacent to and within the right-of-way. Future expansions of surface mines near the right-of-way potentially could be limited or precluded in some cases because mineral resources could not be extracted from immediately up or downslope up of the pipeline right-of-way or from beneath the pipeline. Similarly, the presence of the pipeline could limit or preclude the stockpiling of mineral resources or development of a processing area immediately up or downslope of the pipeline. These considerations also could limit or preclude reclamation activities at mine sites near the pipeline because of the potential to disturb the slopes above and below the pipeline and right-of-way. Any impact would be site-specific and would depend on topography, drainage, and subsurface conditions in that area. If existing mining claims are identified within the Project's proposed right-of-way during the BLM's review, the BLM may require that the Project be microsited outside of these claims.

4.1.3.3 Rock Sources and Permanent Disposal Sites on Federal Lands

Rock source sites may contain useable mineral deposits that may be extracted and/or purchased for use during construction. Disposal sites were identified for final placement of unusable, non-merchantable materials. These sites are typically exhausted areas within active quarries or abandoned quarries and may include commercial sites. Other permanent storage sites, including some TEWAs, were identified for permanent storage of excavated material. The material disposed of in these areas would be properly graded, drained (if necessary), and revegetated. The sites identified are not proposed for expansion beyond their proposed permitted or authorized boundaries. Use of any site would be permitted as required by the appropriate jurisdiction or landowner, and Pacific Connector would comply with applicable permits/stipulations. The disposal of mineral material to Pacific Connector from rock sources proposed to be utilized on BLM lands would follow regulations in 43 CFR 3600.

Pacific Connector has identified 20 potential rock source and permanent disposal sites that total approximately 86 acres along the pipeline route. Of these 20 rock source/disposal sites, 12 are located within federal lands as shown in table 4.1.2.5-1. All of these sites have been previously used and disturbed by quarry operations and/or strip mining. Most of these sites continue to have ongoing quarry operations. Only the disposal sites (and not the TEWAs) listed in table 4.1.2.5-1 are being proposed for use as permanent disposal sites.

Pacific Connector does not intend to expand these sites beyond the existing or previously disturbed footprints. If Pacific Connector acquired rock from these sources or permanently disposed of excavated material, all available topsoil would be salvaged. The salvaged topsoil would be used to restore the site as required by landowner stipulations. Rock resource areas managed and developed by Pacific Connector would need quarry Operation and Reclamation Plans, to the extent required by DOGAMI's regulatory authority (OAR 632-030-0005 through 0070 and ORS 517.750 through 990). Appropriate BMPs would be implemented, such as those in Norman et al. (1998). No impacts are anticipated from the rock sources and permanent disposal sites.

4.1.3.4 Blasting During Trench Excavation on Federal Lands

Pacific Connector identified areas where blasting may be necessary by reviewing the NRCS soils maps and descriptions to identify soil units that typically contain bedrock within 5 feet of the ground surface. Soils data, geological maps, and topographic relief were used to rank the qualitative likelihood for blasting along the pipeline.

Table 4.1.2.6-1 provides a summary of the blasting potential along the pipeline including BLM and NFS areas that would be crossed. Although the blasting potential is classified as high for about 100 miles of the proposed route, this distance estimate includes local areas as much as 0.9 mile in length that contain valley fill, thick soils, and soft volcanic rocks (such as tuffs) that would not need to be blasted. In addition, some of the proposed route classified as having a high or moderate potential for blasting may contain weathered rock that could instead be ripped by conventional excavation equipment. The BLM-Coos Bay District portion of the pipeline alignment has a low potential for blasting during construction.

The pipeline route within the BLM-Roseburg District has low to moderate potential for blasting during construction. Portions of the pipeline route within the Umpqua National Forest, the BLM Medford District, the Rogue River-Siskiyou National Forest, the Fremont-Winema National Forest, and the BLM Lakeview District have a high potential for blasting during construction.

Blasting for grade or trench excavation would be utilized only after all other reasonable means of excavation have been used and are unsuccessful in achieving the required results. Pacific Connector may specify locations (foreign line crossings, near-by structures, etc.) where consolidated rock would be removed by approved mechanical equipment such as rock-trenching machines, rock saws, hydraulic rams, or jack hammers in lieu of blasting.

Pacific Connector would conduct all blasting in accordance with all federal, state, and local regulations and Pacific Connector Construction Specifications. Pacific Connector would include specifications in any blasting contract to control adverse impacts, including measures to minimize vibrations and flyrock, measures for safe blasting practices near active pipelines, and seasonal restrictions to protect wildlife, as needed. Pacific Connector would have blasting inspectors present to ensure that all specifications were met and to perform pre- and post-blast inspections of nearby structures and wells.

Drilling and blasting would be done with the Pacific Connector inspector present and with inspector's approval to proceed prior to each blast. Blasting operations would be conducted by or under the direct and constant supervision of experienced personnel legally licensed and certified to perform such activity in the jurisdiction where blasting occurs. Pacific Connector would require their contractor to provide a Blasting Plan at least five working days prior to any blasting-related activity, or two weeks prior to blasting on federal lands, and the contractor would be required to obtain Pacific Connector approval in writing prior to starting work.

4.1.3.5 Paleontological Resources on Federal Lands

Paleontological resources on federal lands are regulated, as outlined in 36 CFR Ch. 11 261.9 (i). Pacific Connector consulted with federal land management agencies for information on potential paleontological resources crossed by or within the pipeline right-of-way. Based on the consultation, the BLM required an assessment of the potential for paleontological resources on the portion of the right-of-way located on the lands it manages. The assessment indicates that there is a limited potential for encountering paleontological resources on BLM lands and only localized monitoring would need to occur during pipeline construction. The following sections summarize the findings from the paleontological resource assessment. The full assessment report is contained in *Final Paleontology Assessment, Pacific Connector Gas Pipeline Project, Coos Bay to Malin, Oregon* (GeoEngineers 2017c).[54]

Potential Paleontological Resources on NFS Lands

Pacific Connector states that consultation with staff of the Real Estate and Mineral Resources Section of the Umpqua National Forest reported that there were no known paleontological resources on the portions of the pipeline right-of-way located within the boundaries of the Umpqua, Rogue River, and Winema National Forests. According to Paleontology Associates, only the Umpqua and Rogue River National Forests bear potentially favorable lithologic units for fossil content along the pipeline corridor. These units occur in:

- Umpqua National Forest MPs 106 to 109—Fisher formation-volcanic ash and lacustrine siltstone;
- Umpqua National Forest MPs 109.5 to 115.5—Little Butte and Colestin formations-tuffaceous sediments;
- Rogue River National Forest MPs 120 to 121—Colestin formation-tuffaceous sediments; and
- Rogue River National Forest MPs 155 to 158—No formal formation designation-tuffaceous sediments, lahars, waterlaid tuffs.

Based on the information provided regarding the lack of identified paleontological resources within the pipeline right-of-way on NFS lands, no measures appear necessary for the avoidance and minimization of adverse effects on paleontological resources on NFS lands. Pacific Connector does not plan to monitor for lithologic units on NFS lands.

Potential Paleontological Resources on BLM Lands

The BLM required an assessment of the potential for paleontological resources on the portion of the right-of-way located on the lands it manages. Pacific Connector completed an assessment that indicates there is a limited potential for encountering paleontological resources on BLM lands and only localized monitoring would need to occur during pipeline construction. The following

[54] Appendix M to Appendix A-6 of Resource Report 2 in Pacific Connector's September 2017 filing with the FERC.

sections summarize the findings from the paleontological resource assessment. The full assessment report is contained in the *Final Paleontology Assessment, Pacific Connector Gas Pipeline Project, Coos Bay to Malin, Oregon* (GeoEngineers 2017c).

A formal analysis of existing paleontological data was completed for the portions of the pipeline right-of-way on BLM lands. The analysis, completed by Dr. William Orr, who is recognized by the BLM as a qualified paleontologist, was conducted in general accordance with BLM Manual H-8270-1 (BLM 1998).

Fossil-bearing rock formations along the portions of the right-of-way located on BLM lands range in age from the Jurassic period (almost 200 million years old) to the Pleistocene Epoch (about 12,000 years before present). Between MPs 17 and 54, the right-of-way on BLM lands almost entirely traverses Eocene units of the southern Coast Range. The units span the entire epoch, with a wide variety of clastics ranging from coarse conglomerates to very fine-grained deep water silts and shales. Paleocene Epoch intervals in the lower Roseburg Formation could potentially contain plants, invertebrates, reptiles (turtles) and odontocete cetacea (primitive toothed whales). In addition, Pleistocene intervals in localized swamp boggy areas of the Roseburg Formation could potentially yield bones of large Ice Age mammals.

The portion of the BLM lands in the Klamath Mountain interval between MPs 54 and 97 has some of the oldest and most complex rocks in Oregon. Because most of the Klamath rocks are mapped as tectonic accretionary terranes, even the most fragmentary fossils discovered would be an important find.

BLM lands would be crossed between MPs 110 and 123, MPs 128 and 137, and MPs 167 and 172 in the Cascade Range. Two formations in this region, the Colestin and Little Butte, have a potential for producing plant fossils. Both of these formations were deposited in nonmarine, continental settings with volcanogenic ash, tuff and silts mixed with extrusive volcanics of basalt, basaltic andesite and related igneous rocks. Despite the wide range of ages and environments, the floral lists at any given site for either formation are limited. As a result, any new taxa recorded or salvaged in the course of the construction activities would add to the knowledge of the Cascade geologic history.

Between MPs 216 and 217, the pipeline right-of-way crosses BLM lands in the Basin and Range province. Lake sediments of Cascade ash dating between 5 million to 11,000 years ago in this area bear a limited, but stratigraphically important fauna.

Paleontology Field Monitoring Protocols for BLM Lands

Pacific Connector conducted a field survey of the above-referenced portions of the pipeline right-of-way that occur on BLM lands. The locations observed during the survey were selected using the results of the formal analysis of the existing data and a mile-by-mile evaluation of the geologic formations along the right-of-way.

The field survey results were used to classify the potential for encountering paleontological resources on BLM lands during construction. The classifications used for the project were consistent with classes 1 through 5 in the BLM Potential Fossil Yield Classification procedure (revised H-8270-1).

All but 1 mile of the right-of-way on BLM lands has been classified as meeting Class 3a or 3b, based on the formal analysis and the field survey. An approximately 0.25-mile segment from MP

216.5 to 216.75 is classified as Class 4a. For approximately 25 miles of the Class 3a or 3b lands, the BLM would require limited spot monitoring during pipeline construction because the potential presence of fossils cannot be completely eliminated. The 1-mile-long area not classified as Class 3 is divided into two approximately 0.5-mile-long areas classified as Class 1 and Class 2. To satisfy BLM requirements, Pacific Connector would continuously monitor both of these segments for the potential presence of paleontological resources during pipeline construction. The spot or continuous monitoring during construction would be conducted by a field paleontologist working under the supervision of the lead paleontologist.

Procedures for Recovering Significant Discoveries of Vertebrate or Invertebrate Fossil Remains on BLM Lands

Although the likelihood of discovering paleontologically significant fossils on BLM lands is considered remote, such a discovery could potentially occur during the proposed surveys, brush clearing, or construction activities. The field inspector or field paleontologist identifying a fossil of potential interest would be responsible for notifying the lead paleontologist immediately of the discovery. The lead paleontologist would, in turn, evaluate the significance of the finding relative to the salvage parameters. If the fossil was considered salvageable material, it would be recovered under the direction of the lead paleontologist and Pacific Connector. Pacific Connector proposes to designate the University of Oregon Museum of Natural and Cultural History as the repository for any salvageable material recovered from the portion of the pipeline right-of-way located on BLM lands.

4.1.4 Conclusion

Much of the Project is located in the CSZ tectonic area (an area of potential earthquake and tsunami activity). Based on the documentation that mineral resources are not present along the Project; Jordan Cove and Pacific Connector's proposed construction and operations procedures, methods, and plans to appropriately design for geologic hazards; and their implementation of minimization and mitigation measures, we conclude that constructing and operating the Project would not significantly affect geology and would not be significantly affected by geologic hazards.

4.2 SOILS AND SEDIMENTS

4.2.1 Jordan Cove LNG Project

Soils at the proposed LNG terminal and the South Dunes site have been previously disturbed by the operations of the Menasha and Weyerhaeuser companies and from the placement of fill material derived from COE dredging of the Coos Bay Federal Navigation Channel in the 1970s. This fill material (composed predominantly of sand with a small percentage of silt) overlies much of the LNG terminal tract and is more than 10 feet deep in some areas. Recent testing and grading to support a 2014 geotechnical exploration program in a 2-acre area of the LNG terminal revealed the presence of ash-amended soils from 12 to 60 inches (SHN 2015).

Jordan Cove performed geotechnical investigations in the area of the proposed LNG storage tanks and process area in April through May 2013 (GRI 2013). The subsurface data revealed that surficial material in this area is generally fine-grained sand with traces of silt that is underlain by weathered sandstone. The sand layer extends from the surface to a depth of at least 124 feet. Another geotechnical investigation was performed in April 2012 (GRI 2012) in the South Dunes portion of the site. The upper 10 to 20 feet of the South Dunes site was found to be reworked dune sand fill that is underlain by weathered siltstone. Based on geotechnical borings, the sands in the access and utility corridor are composed of areas of fill and native material. Organics and peat were encountered only in the western end of the access and utility corridor at depths of approximately 11 feet below grade. At depths below 30 feet, the conditions for the access and utility corridor are similar to those described for the LNG terminal site. Geotechnical explorations at the proposed Kentuck project site found that surface fill is 1 to 2 feet deep, underlain by native sand and silt to a depth of about 35 feet, and silt to depths of about 70 to 100 feet.

4.2.1.1 General Impacts

Soil types and characteristics in the Jordan Cove LNG Project area were assessed using the NRCS Soil Survey geographic database (NRCS 2017). Construction of the Jordan Cove LNG Project would disturb several soil types, as shown in table 4.2.1.1-1.

The following discussion addresses the soil type characteristics that would be affected in order from highest total impact to lowest, as listed in table 4.2.1.1-1. Soil characteristics for soils that cover 1 percent or less of the total area are not discussed or described in detail.

Dune Land is mapped within approximately 18 percent (180 acres) of the Jordan Cove LNG Project area. It consists of fine and medium textured sands on hills and ridges, formed from aeolian deposits. Permeability is very rapid, and runoff is slow. This soil is severely susceptible to wind erosion and slightly susceptible to water erosion.

Waldport Fine Sand comprises approximately 15 percent (149 acres) of the Jordan Cove LNG Project area. The Waldport Fine Sand is a deep, excessively drained soil occurring on stabilized sand dunes. It is formed from aeolian deposits. Permeability of the Waldport soil is very rapid, but runoff is slow. This soil is severely susceptible to wind and water erosion.

TABLE 4.2.1.1-1

Acres of Impacts at the Jordan Cove LNG Project, by Soil Type a/

Soil Type / Map Unit	Acres b/	Percent (subtotal)
Permanent Operation Areas		
Beaches / 3	1.0	<1
Dune land / 16	23.3	14%
Heceta Fine Sand / 28	39.7	23%
Udorthents level / 57	0.4	<1%
Waldport Fine Sand / 59D	1.1	1%
Waldport Fine Sand / 59E	82.7	48%
Waldport-Dune land complex	0.1	<1%
Waldport-Heceta Fine Sand / 61D	23.5	14%
Subtotal	***171.8***	***100%***
Temporary Construction Areas		
Braillier mucky peat / 7	5.8	2%
Chetco silty clay loam	0.3	<1%
Dune Land / 16	116.8	36%
Heceta Fine Sand / 28	23.3	7%
Heceta Waldport Fine Sand / 29B	1.9	1%
Udorthents, level / 57	46.8	14%
Waldport Fine Sand / 59D	11.4	4%
Waldport Fine Sand / 59E	42.2	13%
Waldport Dune Land complex / 60D	0.1	<1%
Waldport-Heceta Fine Sand	76.9	24%
Subtotal	***325.5***	***100%***

a/ Values exclude aquatic areas that are encompassed by the Project but which do not contain "soils" as well as mitigation areas that are not considered jurisdiction areas.
b/ The totals shown in this table may not equal the sum of addends due to rounding. Acreages are rounded to nearest tenth acre, percentages are rounded to nearest whole value (values below 1 are shown as "<1%").

Bullards sandy loam comprises 12 percent (110 acres) of the Jordan Cove LNG Project area. This is a well-drained soil occurring on dissected marine terraces. It formed in mixed aeolian and marine deposits. Permeability of this soil is moderate, and runoff is medium. This soil is severely susceptible to wind erosion and moderately susceptible to water erosion.

Waldport-Heceta Fine Sands comprise approximately 10 percent (100 acres) of the Jordan Cove LNG Project area. This soil is composed of 50 percent Waldport Fine Sand and 50 percent Heceta Fine Sand (both described herein). This soil is severely susceptible to wind erosion and moderately susceptible to water erosion.

Heceta Fine Sand comprises 10 percent (93 acres) of the Jordan Cove LNG Project area. This is a deep, poorly drained soil found in deflation basins and depression areas between dunes. It is formed on aeolian materials. Permeability of this soil is rapid, and runoff is ponded. This soil is slightly susceptible to water erosion.

Coquille silt loam comprises 8 percent (77 acres) of the Jordan Cove LNG Project area. The Coquille silt loam is a deep, very poorly drained soil that is formed in alluvium on floodplains. Permeability of this Coquille soil is slow. This slow is slightly susceptible to wind and water erosion.

Udorthents soils comprise 5 percent (52 acres) of the Jordan Cove LNG Project area. They occur on floodplains, marshes, and tidal flats and in areas that have been filled and leveled for commercial and industrial uses. Areas on floodplains are made up of sandy, silty, or clayey material; and areas on marsh and tidal flats are made up of dredging spoil, dune sand, and wood chips.

Bandon sandy loam comprises 4 percent (40 acres) of the Jordan Cove LNG Project area. This is a deep, well-drained soil that occurs on dissected marine terraces and formed in sandy marine deposits. Permeability of this soil is generally moderate, and runoff is slow. This soil is slightly susceptible to water erosion and severely susceptible to wind erosion.

Nestucca silt loam comprises 3 percent (30 acres) of the Jordan Cove LNG Project area. This is a deep, somewhat poorly drained soil formed in alluvium on floodplains. Permeability is moderately slow, and runoff is very slow. This soil is slightly susceptible to wind and water erosion.

4.2.1.2 Project-Specific Soil Limitations

Prime Farmland

The NRCS defines prime farmland as land that has the best combination of physical and chemical characteristics for growing food, feed, forage, fiber, and oilseed crops. Prime farmland can include land that possesses these characteristics but is being used currently to produce livestock and timber. Urbanized land and open water are excluded from prime farmland. Prime farmland typically contains few or no rocks, is permeable to water and air, and is not excessively erodible or saturated with water for long periods. Unique farmland is land that is used for production of specific high-value food and fiber crops. In addition, soils may be considered of statewide or local importance if those soils are capable of producing a high yield of crops when managed according to accepted farming methods.

There are no soils at the Jordan Cove LNG Project site that are classified as prime or unique farmland soils. However, Coquille silt loam, Heceta Fine Sands, Bandon sandy loam, Bullards sandy loam, Chetco silty clay loam, Heceta-Waldport Fine Sand, Nestucca silt loam, and Wintley silt loam are classified as farmland of statewide importance. These areas comprise a total of approximately 338 acres (25 percent) of the Jordan Cove LNG Project area. This classification includes areas of soils that nearly meet the requirements for prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. The criteria for defining and delineating farmland of statewide importance are determined by the appropriate state agencies. Farmland of statewide importance may include tracts of land that have been designated for agriculture by state law (NRCS 2006). No areas within the Jordan Cove LNG Project area are currently being used for cropland, and much of the Project area has been previously modified by industrial activities and the placement of dredged material. Therefore, no farmland of statewide importance would be taken out of production by construction and operation of the Jordan Cove LNG Project.

Erosion Potential

Erosion is a continuing natural process that can be accelerated by human disturbances. Factors that influence soil erosion include soil texture, structure, length and percent of slope, vegetative cover, and rainfall or wind intensity. Soils most susceptible to erosion by wind or water are typified by bare or sparse vegetative cover, non-cohesive soil particles with low infiltration rates, and moderate to steep slopes. The soils at the LNG terminal site occur within an area of high wind intensity and are in wind erodibility groups 1 (extreme) and 2 (high), which are the most susceptible to wind erosion.

Soils with severe wind erosion potential include Bandon sandy loam, Bullards sandy loam, Chetco silty loam, Dune Land, and Waldport Fine Sand. Approximately 487 acres (36 percent) of the total area is characterized by the potential for severe wind erosion. Approximately 107 acres (52 percent) of the permanent operations area of the site includes soils with the potential for severe wind erosion. Soils with moderate to high potential for water erosion include Bandon sandy loam, Beaches, Bullards sandy loam, Chetco silty clay loam, Waldport fine sand, and Waldport-Dune complex. Approximately 291 acres (22 percent) of the total area is characterized with the potential for moderate to high water erosion. Approximately 85 acres (41 percent) of the permanent operations area of the site includes soils with the potential for moderate to high water erosion.

To minimize potential for soil loss due to erosion, temporary erosion controls would be installed and maintained in accordance with Jordan Cove's Plan. Permanent erosion control measures would be installed, as necessary, and in compliance with county and state BMPs. Permanent erosion control measures may include vegetation, vegetated swales, infiltration or settling basins, stormwater runoff diversion and control through ditches, check dams, or other velocity dissipaters. For portions of the storm surge/tsunami barrier and terminal areas above +25 feet in elevation, which are not expected to normally be subjected to severe wind or water conditions (but may be affected by storm surge or tsunami events), alternative erosion control would be used. Alternative erosion control for protection from potential tsunami runups in slope areas would include using concrete cellular mattresses, grout injected geotextile fabric mattresses, or other suitable means as determined during detailed design. The design of the slope protection against waves would be developed through consultation with DOGAMI. Erosion of the engineered slopes within the marine slip is not anticipated under normal wave, tide, and marine vessel traffic conditions. The proposed pile dike rock apron along the access channel side slope would be implemented in coordination with the COE to arrest slope migration and prevent effects on Pile Dike 7.3. The erosion control measures would be designed in accordance with the ODOT Erosion Control Manual. By implementing these erosion control measures, construction and operation of the Project would not result in significant soil erosion by water or wind.

Compaction Potential

Soil compaction is the process by which air spaces in the soil are reduced in size because of physical pressure exerted on the soil surface. Compaction results in soil conditions that reduce infiltration, permeability, and gaseous and nutrient exchange rates. Fine-textured soils with poor internal drainage are the most susceptible to compaction. Compaction can result from construction equipment traveling over wet soils, and could further disrupt soil structure, reduce pore space, increase runoff potential, and cause rutting.

Previous activities at the Roseburg tract and the LNG terminal site have already compacted soils. Jordan Cove would test subsoil for compaction at regular intervals in areas disturbed by construction activities; and would implement BMPs—especially in areas that have not been historically disturbed by industrial land use—as described in Jordan Cove's ECRP. Such BMPs would include limiting construction in wet weather conditions and application of soil amendments to facilitate plant establishment.

Potentially Contaminated Soils and Groundwater

The site of the LNG terminal was a livestock ranch until 1958. After it was acquired as part of the mill complex, the tract was occasionally used for log-sorting activities. In 1972/1973, the COE spread materials dredged during maintenance of the Coos Bay navigation channel on the site. From the late 1970s through the early 1980s, sand, boiler ash, and wood debris from milling operations were placed on the majority of what is defined as the LNG terminal site. Weyerhaeuser, which acquired the mill in 1981, spread decant solids from its wastewater treatment facility at the LNG terminal site between 1985 and 1994. The South Dunes site was originally developed as a sulfite pulp and paper mill by the Menasha Wood Ware Corporation in 1961. It was acquired by Weyerhaeuser in 1981 and converted to a recycle paper mill in 1995. The mill was closed in 2003. Between 1981 and 1992, Weyerhaeuser leased the southern portion of the property adjacent to the geographic Jordan Cove portion of Coos Bay to a fish hatchery operation. The buildings for both the mill and the fish hatchery have been removed.

Jordan Cove conducted multiple Phase I and Phase II Environmental Site Assessments at the terminal tract to assess for environmental contamination. Phase I protocols consist of record searches, inventories, site visits, and other non-intrusive information gathering. Phase II protocols consist of intrusive environmental media sampling. Phase II Environmental Site Assessments were conducted to address the findings of the Phase I Environmental Site Assessments (CH2M Hill 1996; Thiel Engineering 2004; GRI 2005; PES Environmental 2006; GRI 2007b; GSI Water Solutions 2012; GRI 2017b; SHN 2017; SHN 2018). The details of these investigations are all included in FERC filings for the Project and are only generally summarized in the following section.

A Phase I Environmental Site Assessment of the APCO site conducted by SHN in 2013 (SHN 2013a) identified dredge spoils that may have been affected by historical industrial activities upstream of the site as a recognized environmental condition.[55] The existing Boxcar Hill site is being used as a recreational facility with all-terrain vehicle (ATV) rentals, riding trails, and camping. A Phase I Environmental Site Assessment of the Boxcar Hill site did not identify any recognized environmental conditions in connection with the site (SHN 2017). A limited (specifically for the Port Laydown area and not entire property parcels) Phase I Environmental Site Assessment was conducted for the Port Laydown site in February 2018 (SHN 2018) which identified numerous concerns including a potential off-site source of contamination (D.B. Western facility cited for violations including illegal disposal of solid and hazardous waste), potentially contaminated dredge material, burn piles within the site, and the potential for lead in soil from target shooting activities. Contaminants identified as both soil and groundwater concerns include: tributyl tin, heavy metals (arsenic, barium, lead, cadmium, chromium, mercury, selenium and silver), copper, polychlorinated biphenyls (PCB), polycyclic aromatic hydrocarbons (PAH), semivolatile organic compounds (SVOC), volatile organic compounds (VOC), total petroleum hydrocarbons (TPH), dioxins and furans, and formaldehyde. A Phase II Environmental Site Assessment to assess for soil and groundwater contamination is planned for this site.

The following Phase II Environmental Site Assessment investigations were conducted at the proposed LNG terminal site to determine if contaminated soils and/or groundwater are present:

- In 1996, Weyerhaeuser conducted Phase II Environmental Site Assessment investigations which found that VOCs, SVOCs, metals, petroleum hydrocarbons, and PCBs (analytes tested) in the fill were below levels that would necessitate cleanup work (CH2M Hill 1996).

[55] The presence or likely presence of any hazardous substances or petroleum products in, on, or at a property: (1) due to release to the environment; (2) under conditions indicative of a release to the environment; or (3) under conditions that pose a material threat of a future release to the environment.

With the exception of arsenic and PCB, material present at the site is below the current (1996) Oregon residential soil cleanup standards. PCB in one ash discrete sample exceeded the residential standard, but was well below the industrial soil standard. Arsenic detected at the site is within typical background concentration levels for the western United States and, therefore, does not represent any substantial environmental issue.

- Phase II Environmental Site Assessment investigations were conducted by PES Environmental, Inc. (PES) in April 2006 (PES 2006). These investigations focused on the South Dunes site (inclusive of the portions of this site to be used for the LNG terminal) as well as the Ingram Yard site.
- Another Phase II Environmental Site Assessment investigation was completed at the LNG terminal site by GRI in October 2006 (GRI 2007b). The assessment was conducted at test pits in the area of the former Ingram Yard and along a wastewater pipeline
- GRI performed a Phase II Environmental Site Assessment investigation in 2005 of the Roseburg property (GRI 2005), which has been used for wood-processing activities since 1968.
- GRI conducted a Phase II Environmental Site Assessment in July 2017 (GRI 2017b) of the APCO site.

Grading for the north access road and the ground improvement geotechnical test site required excavation of between 12 inches and 60 inches of soil from a 2-acre area from April 7 through April 15, 2014. During the grading activities, ash-amended soils were encountered, with a total of 5,600 cy of ash/soil mixture excavated and stockpiled in the area of the north access road in berms as indicated in the 1200C permit. On May 8, 2014, the ODEQ determined that these actions, while not prohibited, required a solid waste letter of authorization before commencement of grading activities. The ODEQ required Jordan Cove to obtain a solid waste authorization letter; on July 16, 2014, a solid waste authorization letter was submitted to the ODEQ. Jordan Cove would be required by the ODEQ to provide prior notice to the ODEQ should any grading or ground disturbance activities be planned to occur on the LNG terminal site. Provisions for long-term disposal of disturbed LNG terminal site soils and any other specific mitigation measures would be specified in detail in the final engineering design.

The results of Phase II environmental sampling activities at the LNG terminal site identified contaminants in soil at levels below or slightly exceeding the applicable ODEQ risk-based concentrations (RBC) and EPA screening levels at several locations. Analytical results from samples collected from the LNG terminal site found low concentrations of PAHs, TPH, metals, VOCs, SVOCs, PCBs, dioxins, furans, and butyltin compounds in soil samples. It is noted that regulatory updates to toxicity values for some compounds have changed the screening levels used in preliminary risk assessments since the preparation of these environmental site assessment reports. Table 4.2.1.2-1 presents a subset of chemicals detected at the site and represents contaminants that either exceed or approach current ODEQ and EPA regulatory screening levels or were present in multiple sample locations at both the South Dunes site and LNG terminal site. Table 4.2.1.2-1 includes applicable ODEQ RBCs for the soil ingestion, dermal contact, and inhalation exposure pathway under the occupational and construction worker scenarios (ODEQ 2015) and the EPA regional screening levels for industrial soils (EPA 2018a). Table 4.2.1.2-1 also includes ODEQ-established natural background concentrations for naturally occurring metals in soil. The maximum detected concentrations for selected compounds generally encountered in on-site soils, as summarized by previous environmental investigations, are also included in table 4.2.1.2-1 (CH2M Hill 1996; GRI 2005; PES 2006; GRI 2007b). As a part of the investigations, a screening-level human and ecological risk assessment of residual contamination was conducted and concluded that residual contaminants did not exceed ODEQ's screening levels for the occupational and construction worker exposure scenarios (PES 2006). Based on the findings of previous environmental investigations, the ODEQ has recommended a "No Further Action" determination for the former Weyerhaeuser mill and the LNG terminal site. A copy of this determination letter is provided in Jordan Cove's September 2017 application to the FERC.[56] A "Condition" of the No Further Action determination states that "While surface soils at the LNG terminal site meet human health and ecological screening criteria, they contain low levels of potentially bio-accumulating chemicals and must not be placed in waters of the state." Implementation of erosion controls for runoff during and construction and operation, as well as revegetation plans would prevent the low-level contamination from entering surface waters. Jordan Cove's ECRP lists the specific measures to be used for erosion and sediment control practices, wind erosion and dust control, and clearing and grading. Peripheral erosion and sediment control would be provided along the site perimeter, and at all operational drain inlets and outlets at all times during construction. Sediment basins would be employed if necessary.

TABLE 4.2.1.2-1

Summary of Applicable ODEQ and EPA Screening Levels Concentrations (in parts per million [ppm])

			ODEQ			EPA
Compound	**Max. Detected Concentration**	**Data Source a/**	**Occupational**	**Construction Worker**	**Natural Background**	**Screening Value**
Petroleum Hydrocarbons						
Diesel	11,000	2	14000	4600	Not Applicable	Not Established
Gasoline	4,150	2	20000	9700	Not Applicable	Not Established
Metals						
Arsenic	28.5	3	1.9	15	19	3
Cadmium	0.799	3	9,000	220,000	0.54	98
Chromium (VI)	56	3	6.3	49	200	6.3
Lead	62	1	800	800	34	800
Mercury	0.34	3	350	110	0.24	4.6
PAHs						
Fluoranthene	62.3	3	30,000	10,000	Not Applicable	3,000
Fluorene	1.29	2	47,000	14,000	Not Applicable	3,000
Pyrene	52	3	23,000	7,500	Not Applicable	2,300
Naphthalene	70	3	23	580	Not Applicable	17
PCBs (Total PCBs)	0.64	1	0.74	8.4	Not Applicable	0.97
2,3,7,8-TCDD (dioxin) equivalents	0.000019	3	0.000016	0.00017	Not Applicable	0.000022

a/ Data Sources:
1. CH2M Hill 1996
2. PES 2006
3. GRI 2007b

[56] Included in Resource Report 7, Appendix G.7, as part of Jordan Cove's September 2017 application to the FERC.

Jordan Cove continues to work with the ODEQ toward the determination of appropriate regulatory requirements for the handling of contaminated soil and sediment. The ODEQ approved Jordan Cove's *Revised Work Plan for Joint Regulatory Closure Settling Basins, Petroleum-Contaminated Soil, Asbestos Waste, and Mill Waste Former Weyerhaeuser Mill Site and Ingram Yard Properties (LNG terminal site)* on July 22, 2013. The plan describes redevelopment of the South Dunes site that would involve increasing existing site grades a minimum of 3 feet with clean structural fill consisting of sand from the new slip to be excavated on the LNG terminal site (Ingram Yard property). Development over the existing mill wastewater system settling basins would require over-excavation of geotechnically unsuitable (highly organic) sludge in the basins and replacement with clean, compacted structural fill. A qualified contractor familiar with handling potentially contaminated materials would be mobilized, and a dredge would be used to remove the basin sludge to a dewatering system. Potentially contaminated material would be transported off-site to an approved ODEQ-regulated facility that would be identified prior to construction. In addition, landfill materials would be removed and handled according to the overall *Mill Site Closure Plan* that was approved by the ODEQ on July 22, 2013.

A disposal plan for contaminated soil would be developed by Jordan Cove once the Project engineering design is finalized. The disposal plan will be submitted to the ODEQ for pre-approval prior to the work. Additional details on the management and regulatory requirements of existing contaminants are provided in Jordan Cove's *Framework Contaminated Media Management Plan.*[57]

Jordan Cove completed a data gap investigation in 2018 to delineate existing petroleum and other contaminants at the former mill site in compliance with the terms and conditions of the No Further Action determination granted by ODEQ in 2006. Based on the analytical results from the data gap investigation, concentrations of PAHs, metals, and/or petroleum hydrocarbons exceeded RBCs for soil. Specific contaminants include naphthalene (46.8 and 92 mg/kg); oil (6,130, 6,190, 14,000, and 61,500 mg/kg); benzo(a)pyrene (2.27 mg/kg); diesel (27,660 mg/kg); and chromium (743 mg/kg). Jordan Cove is in the process of consulting with the ODEQ regarding potential required subsequent remedial mitigation efforts to reduce the concentration of contaminants in soil or eliminate exposure pathways in relation to the Project. Such remedial action(s) would comply with the requirements and recommendations of the No Further Action determination and ODEQ review and approval.

Soils and/or sediments containing residual contamination must be managed and/or disposed in accordance with ODEQ rules. Per guidance from the ODEQ, Jordan Cove would provide prior notice to the ODEQ when grading or ground disturbance activities are planned to occur on the LNG terminal site. In addition, a permanent disposal plan for the boiler ash material would be prepared by Jordan Cove and submitted to the ODEQ for approval prior to site development activities.

Jordan Cove has prepared a *Framework Contaminated Media Management Plan* that includes general measures to be implemented in the event that unanticipated soil contamination is discovered during construction of the Jordan Cove LNG Project but does not include specific monitoring and sampling protocols for handling potential or suspected contamination that might

[57] Included in Resource Report 7, Appendix O.7, as part of Jordan Cove's September 2017 application to the FERC.

be encountered. If Jordan Cove's Environmental, Health and Safety Division determines that additional action is necessary, Jordan Cove would implement the following measures:

- contact a qualified consultant and/or testing laboratory to assist with the determination of the extent and nature of the contamination;
- devise a plan for additional site-specific investigations as necessary;
- conduct site-specific testing and/or laboratory analysis to determine the extent and nature of contamination;
- notify all applicable environmental authorities as required by law, including the ODEQ;
- devise a site-specific plan depending on the nature and extent of the contamination encountered for continuation of construction, which may involve evaluation avoidance options as necessary to support the construction of the proposed facilities;
- devise a strategy or plan for handling wastes in an appropriate manner including waste characterization, hauling, manifesting, and disposal necessary to support continuing construction;
- devise a plan for site stabilization and backfilling; and
- complete all required and necessary agency follow-ups and reporting.

Spills or leaks of fuels, lubricants, or coolant from construction equipment could contaminate soils. The soil and sand on the Project site have high infiltration capacity, and comprise a shallow groundwater (10 feet or less) system with high aquifer transmissivity. A spill, if it occurred, would spread quickly; however, the effects of contamination would typically be minor because of the low frequency of spills and leaks. During construction, Jordan Cove would implement its water quality management plan that includes a SPCC Plan. This plan describes spill prevention practices, spill handling and emergency notification procedures, and training requirements that would be implemented during construction of the Project. The SPCC Plan addresses the unique soil and subsurface conditions of the Project site, including the high permeability, shallow groundwater, and rapid transmissivity. With the implementation of the SPCC Plan and ODEQ requirements, construction of the Project is not anticipated to spread existing contamination or cause additional soil contamination.

4.2.1.3 LNG-Specific Topics

Potentially Contaminated Bay Sediments

The Port developed a sampling and analysis program (SAP; SHN 2006a) that details the sediment collection and testing program conducted on the material that would be dredged during construction of the access channel. The sediment sampling and analysis program followed the Dredged Material Evaluation Framework (DMEF) Tier IIB approach for physical and chemical evaluation of the proposed dredged material and only included physical analysis of materials. As described below, chemical analyses were not required based on grain size.

The results of the grain size distribution based on COE-approved methods (COE et al. 1998) indicated the average percent of sand in sediment samples was over 99 percent. The results of the total volatile solids (TVS) analysis indicated that the average percent TVS in the sediments was approximately 0.7 percent. DMEF Tier IIA states, "If the results of grain size analysis are at least

80 percent sand and TVS is less than 5 percent, the proposed dredging material qualifies for unconfined, aquatic disposal based on exclusionary status." Therefore, the Port's report concluded that further characterization was not considered necessary.

In addition to the access channel, proposed dredging would take place at four locations along/adjacent to the Coos Bay Navigation Channel (i.e., dredge areas 1, 2, 3, and 4). For dredge areas 1 through 4, historical boring logs from the Federal Navigation Channel were evaluated to provide a dredged sediment characterization. Subsurface exploration within the Federal Navigation Channel was performed by GRI in 2005 and 2007 (GRI 2005 and 2007b). More recently, geotechnical site investigations were carried out by GRI in 2011 and 2017. Additional analyses for submittal to the Portland Sediment Evaluation Team (PSET) are underway. A detailed discussion of dredging and material disposal methods is provided in the *Dredged Material Management Plan.*[58]

Jordan Cove has conducted extensive investigations regarding soil contaminants in close coordination with the Portland Sediment Evaluation Team (PSET) at the west portion of the Kentuck mitigation site beginning in 2010. Jordan Cove has submitted four SAPs and three sediment characterization reports for the western portion of the site to the COE from September 2010 to November 2014. These studies document that chemical analysis of samples for VOCs, SVOCs, PAHs, PCBs, metals, dioxins, furans, and butyltin compounds did not detect any contaminants above applicable screening levels and that the material is suitable for its intended use in the Kentuck project site without restriction, with the exception of the golf course irrigation pond. According to the sampling results documented in the November 13, 2014 sediment characterization report, mercury is present at levels above clean fill screening criteria in sediments contained in the golf course irrigation pond. Although oil-range hydrocarbons are also present at this location, these were not detected above applicable screening levels. Affected soil in the Kentuck project site would be excavated and removed to a permitted disposal facility in accordance with an ODEQ work plan that would be approved prior to the removal action.

Jordan Cove prepared a sediment characterization report (GRI 2018) for the east portion of the Kentuck site to characterize material at the former Kentuck Golf Course that would be partially excavated and/or partially overlain by imported material to create a wetlands mitigation site. Sampling and analyses were performed for this portion of the Kentuck site in November 2017. Soil/sediment samples were collected from 10 locations within the intertidal channel and floodplain and analyzed for metals, VOCs, PAHs, SVOCs, PCBs (e.g., Aroclors), and pesticides. With the exception of the detection of the pesticide aldrin above the marine screening level in one area (sample S-27), the sampling and analyses completed show the proposed plan for Kentuck to be consistent with regulatory guidance and applicable screening levels. To address the S-27 area, Jordan Cove proposes to excavate 6 inches below the proposed final grade and replace to design grade with clean imported sand. This excavation would be completed laterally beyond S-27 to a point halfway to the nearest adjacent sample points. The excavated material from the S-27 area would be incorporated into an on-site constructed bermed area with a clean imported sand cap or transported offsite to an approved permitted disposal facility.

[58] Included in Resource Report 7, Appendix N.7, as part of Jordan Cove's September 2017 application to the FERC.

Shoreline along the Waterway for LNG Carrier Marine Traffic

Jordan Cove conducted two studies to evaluate shoreline impacts during the transit of LNG vessels in the waterway to and from the LNG terminal (Moffatt & Nichol 2017a, 2017b). The *Vessel Wakes Impacts Memo* (Moffat & Nichol 2017a) evaluates shoreline erosion within Coos Bay resulting from vessel transit. The study concluded that the proposed LNG terminal combined with the associated changes in the size and speed of vessels expected to utilize the proposed channels would not result in increased shoreline impacts (such as increased erosion) due to ship-generated waves. A rock apron has been proposed to arrest slope migration, or equilibration, before it can progress to a condition that could potentially negatively impact Pile Dike 7.3. Construction of the Pile Dike rock apron is expected to produce a localized, temporary increase in turbidity; however, the long-term effect of the rock apron would improve shoreline stability including accounting for the effects of marine traffic. The *Propeller Wash Analysis Memo* (Moffat & Nichol 2017b) evaluates potential impacts of propeller wash on scour in the slip, access channel, MOF, and at the pile dike areas. An area of potential scour due to propeller wash is located along the eastern side of the slip and access channel, where the maximum bottom propeller wash scour depth is estimated to be nearly 0.5 foot. Jordan Cove would provide slope protection (i.e., armor rip rap as described in section 2.4.1.5) for the west and north sides of the slip, and scour protection would be provided at the base/toe of the bulkhead walls. These measures would provide adequate slope and bulkhead protection to prevent associated scour.

4.2.2 Pacific Connector Pipeline Project

4.2.2.1 General Impacts

Soils along the proposed pipeline route were identified using NRCS surveys for Coos, Douglas, Jackson, and Klamath Counties (NRCS 2004; SCS 1985, 1989, 1993); and NRCS State Soil Geographic Database (STATSGO) and Soil Survey Geographic Database (SSURGO) soil classifications (NRCS 2017). The Forest Service soil resource inventories of the Umpqua, Rogue River, and Winema National Forests were used to assess soil resources in the National Forests (Forest Service 1976, 1977, and 1979). Information in the Forest Service surveys was supplemented by STATSGO and SSURGO data where available.

According to the NRCS Land Resource Regions and Major Land Resource Areas (MLRAs) (NRCS 2006), the pipeline route would cross four MLRAs:

- the Sitka Spruce Belt including the Pacific Coast and Coos Bay area in Coos County;
- the North Pacific Coast Range, Foothills, and Valleys including Coos County and portions of Douglas County;
- the Siskiyou-Trinity Area including portions of Douglas and Jackson Counties, the Umpqua National Forest, and portions of the Rogue River-Siskiyou National Forest; and
- the Klamath and Shasta Valleys and Basins in the southern part of Klamath County.

Soil associations crossed by the pipeline are shown in table G-1 in appendix G by MP, including the mileage percentage of the entire pipeline length. The Medco-McNull-McMullun and Vermisa-Vannoy-Josephine-Beekman soil associations are crossed by 15.7 and 12.9 percent of the pipeline length, respectively. The remaining soil associations are crossed by less than 10 percent of the pipeline length.

Detailed descriptions of all soil associations crossed by the Project and their characteristics are provided in appendix G of this EIS. The remainder of this discussion focuses on the sensitive soils characteristics present along the pipeline route as shown in table 4.2.2.1-1. It is noted that the soil characteristics studies for the Pacific Connector pipeline and the Jordan Cove LNG Project are different in approach. Pacific Connector primarily relies on soils data available from the NRCS databases; and Jordan Cove uses preliminary geotechnical study data as well as NRCS data.

To provide the highest level of detail in quantifying the soil properties and impacts, analysis was based on the characteristics of the individual soil mapping units crossed within each soil association. Major soil characteristics and limitations for the pipeline and aboveground facilities are discussed below. Table 4.2.2.1-1 provides a summary of soil limitations that could be encountered by the pipeline route.

TABLE 4.2.2.1-1

Acreages and Soil Characteristics Crossed by the Pacific Connector Pipeline

Milepost		Total Crossing Length (miles)	County	Sensitive Soil Groups and Estimated Crossing in Miles (acres) a/							
				Erosion From							
From	To			Water b/	Wind c/	Steep Slopes d/	Large Stones e/	Restrictive Layer f/	Soil Compaction g/	Reclamation Sensitivity h/	Prime Farmland i/
0.00 1.00 10.88R 11.18R 0.09 1.47	0.09 1.47 10.08R 11.72BR 1.00 3.03	1.3	Coos	0.07 (1.22)	0.09 (9.61)	0.07 (1.22)	0.0	0.07 (1.22)	0.84 (22.02)	0.09 (9.61)	0.67 (11.19)
11.08R 3.03	11.18R 10.88R	2.79	Coos	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11.72R 13.65BR 1r.10BR	13.54BR 13.91BR 15.70BR	7.82	Coos	3.35 (45.57)	0.17 (3.19)	3.35 (45.57)	0.0	6.25 (95.44)	7.65 (132.61)	2.76 (38.67)	3.13 (68.51)
20.09BR 24.59BR 28.93 30.31	22.40BR 27.79 29.47 32.50	12.01	Coos	7.55 (117.91)	0.0	5.27 (87.65)	0.65 (11.04)	1.42 (22.78)	10.56 (176)	7.55 (117.91)	0.13 (2.78)
22.40BR 29.47	24.59BR 30.31	2.67	Coos	0.27 (4.12)	0.0	0.27 (4.12)	0.02 (0.13)	0.02 (0.13)	2.67 (41.4)	0.27 (4.12)	1.75 (28.68)
13.54BR 13.91BR 15.70BR 27.79 32.50	13.63BR 15.10BR 20.09BR 28.93 47.26	22.06	Coos Douglas	13.78 (210.15)	0.48 (7.05)	11.15 (170.7)	6.17 (103.95)	15.88 (248.78)	21.45 (329.78)	15.18 (239.45)	0.98 (13.81)
47.26 52.50 57.57	48.06 55.18 58.07	4.28	Douglas	2.02 (28.87)	0.0	1.35 (20.03)	0.342(6.28)	3.53 (46.94)	4.28 (59.94)	3.83 (52.51)	2.74 (37.01)
48.06	52.50	4.47	Douglas	0.67 (8.7)	0.0	0.67 (8.69)	0.0	2.93 (44.93)	4.47 (65.99)	4.23 (62.82)	3.44 (50.64)
55.18 60.59	57.57 61.48	3.35	Douglas	1.45 (22.9)	0.0	1.45 (22.9)	0.07 (2.31)	1.72 (27.5)	3.35 (51.08)	2.59 (40.01)	1.8 (26.71)
58.07 61.48 71.72 91.90	60.59 70.91 89.39 95.23	29.55	Douglas	18.15 (259.16)	0.02 (<1)	18.15 (259.16)	2.3 (52.92)	20.69 (298.78)	29.23 (457.96)	26.22 (406.71)	10.3 (188.82)
70.89 146.38	71.72 146.86	0.9	Douglas	0.49 (10.37)	0.0	0.49 (10.37)	0.29 (7.02)	0.75 (21.83)	0.86 (23.53)	0.49 (10.37)	0.37 (13.16)
74.13	76.36	2.53	Douglas	2.37 (36.24)	0.0	2.37 (36.24)	2.38 (36.28)	2.53 (38.98)	1.3 (22.09)	2.53 (39.53)	<0.1 (1.5)
96.52	104.87	8.36	Douglas	8.24 (122.36)	4.4 (62.36)	8.24 (122.36)	2.88 (41.51)	8.01 (119.45)	4.31 (65.97)	8.36 (124.17)	0.13 (1.81)

TABLE 4.2.2.1-2 (continued)

Acreages and Soil Characteristics Crossed by the Pacific Connector Pipeline

Milepost		**Total Crossing Length (miles)**	**County**	**Sensitive Soil Groups and Estimated Crossing in Miles (acres) a/**							
				Erosion From		**Steep Slopes d/**	**Large Stones e/**	**Restrictive Layer f/**	**Soil Compaction g/**	**Reclamation Sensitivity h/**	**Prime Farmland i/**
73.19 89.39 95.23 104.87	74.13 91.9 96.52 110.10	6.25	Douglas Jackson	3.8 (56.95)	0.85 (11.26)	4.53 (66.7)	2.86 (39.6)	4.11 (61.69)	5.32 (86.28)	5.81 (93.17)	1.72 (32)
105.70 110.10	109.38 111.77	5.0	Douglas Jackson	3.2 (44.26)	3.2 (44.26)	5.0 (84.82)	4.8 (81.57)	4.8 (81.57)	0.37 (5.86)	4.8 (81.57)	0.0
111.77	117.75	5.98	Jackson	1.85 (26.22)	0.0	5.98 (87.09)	4.11 (59.05)	4.25 (62.45)	4.17 (60.15)	4.85 (70.93)	0.59 (8.49)
117.75 146.86 153.07	146.38 152.42 155.02	35.98	Jackson	16.0 (256.54)	0.0	28.87 (449.12)	26.69 (415.9)	32.8 (512.46)	33.68 (526.68)	35.61 (554.35)	5.16 (82.34)
146.38	146.86	0.47	Jackson	<0.1 (1.39)	0.0	<0.1 (1.39)	<0.1 (1.39)	0.47 (6.34)	0.47 (6.34)	0.47 (6.34)	0.39 (4.95)
152.42 155.02	153.07 168.00	13.69	Jackson/ Klamath	0.61 (7.49)	0.0 (0.03)	3.87 (82.93)	5.37 (98.55)	5.29 (82.43)	1.62 (26.5)	3.74 (97.92)	0.75 (12.38)
168.00	174.69	6.81	Klamath	0.0	0.0	0.18 (2.85)	3.13 (38.78)	0.0	2.86 (40.65)	0.18 (2.85)	0.0
174.69	180.20	5.5	Klamath	1.85 (27.19)	0.0	1.85 (27.19)	0.47 (6.41)	2.51 (31.8)	0.0	4.37 (58.99)	0.67 (8.24)
180.2	189.96	9.77	Klamath	1.03 (13.87)	0.0	3.07 (37.89)	1.32 (17.87)	3.36 (25.22)	1.03 (13.23)	3.97 (49.58)	3.45 (45.79)
189.96 197.86 221.06 221.68 224.85 226.22 227.63	190.83 198.59 221.22 224.09 225.52 227.31 228.81	7.2	Klamath	2.24 (27.74)	1.3 (20.91)	4.05 (50.79)	3.96 (49.61)	4.49 (59.32)	6.86 (97.75)	3.83 (48.94)	5.01 (74.57)
190.83 198.59	193.86 199.27	6.66	Klamath	0.33 (6.41)	0.0	0.0 (<1)	0.0 (<1)	4.4 (78.44)	6.66 (118.48)	0.95 (18.93)	6.66 (118.45)
199.27	202.09	2.8	Klamath	0.0	0.23 (4.93)	0.0	0.0	1.34 (23.56)	2.62 (47.16)	0.23 (6.96)	2.62 (47.16)
202.09 215.89 221.22 224.09 225.52 227.31	214.70 218.8 221.68 224.85 226.22 227.63	16.66	Klamath	1.49 (19.72)	3.62 (80.82)	1.81 (24.1)	1.81 (24.1)	8.91 (142.65)	16.65 (278.61)	1.85 (24.89)	15.21 (259.69)

TABLE 4.2.2.1-2 (continued)

Acreages and Soil Characteristics Crossed by the Pacific Connector Pipeline

Milepost		**Total Crossing Length (miles)**	**County**	**Sensitive Soil Groups and Estimated Crossing in Miles (acres) a/**							
				Erosion From		**Steep Slopes d/**	**Large Stones e/**	**Restrictive Layer f/**	**Soil Compaction g/**	**Reclamation Sensitivity h/**	**Prime Farmland i/**
214.7	215.89	4.42	Klamath	3.43	0.09	3.75	3.46	4.04	4.42	3.96	1.2
218.80	221.06			(50.04)	(1.14)	(54.12)	(50.26)	(58.35)	(64.87)	(57.23)	(17.94)
	Project Total	**229.28** [j/]	**All**	**94.3 (1,405.36)**	**14.45 (245.85)**	**115.87 (1,758.04)**	**73.24 (1,144.57)**	**144.57 (2,194.26)**	**178.7 (2,328.14)**	**148.71 (2,328.14)**	**68.90 (1,156.73)**
			Percent	**41.0%**	**6.3%**	**50.5%**	**31.9%**	**63.1%**	**78.1%**	**64.8%**	**30.0%**

Rows and columns may not add correctly due to rounding. Acres rounded to nearest whole acre, miles to nearest tenth of a mile (values below 1 or 0.1, respectively, are shown as "<1"/ "<0.1").

a/ Numerical values shown are miles crossed by construction, including construction right-of-way and TEWAs. Acres affected shown in parenthesis. Soil data from NRCS 2004; SCS (1985, 1989, 1993); Forest Service 1976, 1977, and 1979. NRCS State Soil Geographic Database (STATSGO and SSURGO) soil classifications (NRCS 2017).

b/ Soils with NRCS rating of high or severe.

c/ Soils with NRCS wind erodibility groups 1 and 2.

d/ Soils with slopes greater than 30 percent.

e/ Soils with greater than 25 percent cobbles and/or stones within pipeline trench depth.

f/ Soils with a restrictive soil layer (bedrock or cemented layer) within 60 inches of the soil surface.

g/ Soils with an NRCS rating of high or severe for the Haul Roads, Log Landings, and Soil Rutting category.

h/ Combined rating for soils with high or severe erosion potential, steep slopes, large stones, shallow soils, saline/sodic conditions, clayey soils (greater than 40 percent), and soil map units with dominant amounts of rock outcrop. The Reclamation/Sensitivity type does not include data related to the revegetation sensitivity studies on federally-managed lands (NSR 2015).

i/ Soils with dominant map unit included on either the state or county list of farmland of importance (includes prime farmland, unique farmland, and farmland of statewide or local importance).

j/ In an effort to maintain milepost continuity while adjusting the pipeline route, milepost equations have been incorporated into the alignment. This allows the mileposts, for the most part, to remain unchanged. However, the ending milepost no longer reflects the actual length of the proposed pipeline.

4.2.2.2 Project-Specific Soil Limitations

Prime Farmland

The pipeline alignment crosses approximately 69 miles (30 percent of the pipeline) of soils where the dominant map unit in the MLRA is classified on either the NRCS state or county list of prime farmland or "farmland of statewide importance."[59] These designations were previously described in section 4.2. Permanent impacts on prime farmland soils from the proposed pipeline would be associated with the aboveground facilities, as discussed in section 4.2.2.3 below. Pacific Connector would implement mitigation measures in areas where existing agricultural land uses would be affected (approximated 43 miles of the pipeline route) to minimize impacts on prime farmland and crop yields, such as topsoil salvaging, scarification, and subsequent testing to ensure that potential compaction is remediated. Topsoil salvage is achieved by mechanically segregating topsoil from subsoil to an approved depth and width along the pipeline right-of-way. Topsoil segregation would be performed over the trench line and spoil storage areas in croplands, hayfields, pastures, and areas specified by landowners. Areas where topsoil salvaging and segregation would occur are shown by MP in table 4.2.2.2-1 to minimize potential impact to soil and agricultural productivity.

TABLE 4.2.2.2-1

Areas Where Topsoil Would be Salvaged Along the Pacific Connector Pipeline

Area/Land Use	From (MP)	To (MP)	Mileage
Coos County			
Wetlands/Pasture	3.06	6.45R	3.39
Pasture	8.28R	8.45R	0.17
Pasture	10.96R	11.06R	0.1
Wetland/Pasture	10.96R	11.06R	0.1
Wetland/Pasture	11.19R	12.11BR	0.92
Pasture/Hayfield	22.59	23.04	0.45
Pasture/Hayfield	29.49	29.83	0.34
Pasture/Hayfield	29.87	30.14	0.27
Douglas County			
Croplands/Pasture	49.50	50.25	0.75
Croplands/Pasture	50.30	50.55	0.25
Pasture/Residential	50.72	50.82	0.1
Pasture	51.31	51.55	0.24
Pasture	51.58	51.78	0.2
Pasture/Wetlands/Residential	55.83	56.56	0.73
Pasture/Wetlands/Residential	56.77	57.10	0.33
Pasture/Wetlands/Residential	57.12	57.59	0.47
Wetlands/Pasture/Hayfield	57.61	57.20	-0.41
Wetlands/Pasture/Hayfield	58.21	58.53	0.32
Wetlands/Pasture/Hayfield	58.65	58.73	0.08
Wetlands/Pasture/Hayfield	58.79	59.60	0.81
Wetlands/Pasture/Hayfield	59.66	60.08	0.42
Pasture Pasture/Hayfield	60.15	60.24	0.09
Pasture Pasture/Hayfield	60.45	60.57	0.12
Pasture/Hayfield	60.58	60.66	0.08
Pasture/Hayfield	65.58	65.73	0.15
Pasture	66.88	66.94	0.06
Pasture	66.97	67.08	0.11
Pasture	69.22	69.49	0.27
Pasture	71.36	71.54	0.18
Pasture	76.41	76.47	0.06
Pasture	77.82	78.05	0.23

[59] It is noted that some area mapped as prime farmland or farmland of statewide importance have previously been affected by development activities that have precluded their use for agricultural activities.

TABLE 4.2.2.2-1 (continued)

Areas Where Topsoil Would be Salvaged Along the Pacific Connector Pipeline

Area/Land Use	From (MP)	To (MP)	Mileage
Pasture	79.00	79.03	0.03
Hayfield/Pasture	81.20	81.65	0.45
Pasture	88.29	88.50	0.21
Pasture	88.53	88.57	0.04
Pasture	88.61	88.70	0.09
Pasture/Wetlands	94.35	94.56	0.21
Pasture/Wetlands	94.87	95.07	0.2
Jackson County			
Pasture	118.84	118.91	0.07
Pasture	120.70	120.82	0.12
Pasture/Residential	120.84	120.90	0.06
Pasture/Hayfield	121.90	122.20	0.3
Pasture/Wetlands	128.47	128.69	0.22
Pasture	132.03	132.12	0.09
Pasture/Wetlands	132.03	132.18	0.15
Pasture/Wetlands	132.22	132.51	0.29
Pasture/Wetlands	132.53	132.57	0.04
Pasture/Wetlands	142.26	142.56	0.3
Pasture/Wetlands	142.58	142.66	0.08
Pasture	144.31	144.49	0.18
Pasture	144.58	144.69	0.11
Pasture/Wetlands	145.05	145.95	0.9
Pasture	146.12	146.87	0.75
Klamath County			
Pasture/Hayfield/Wetlands	190.63	197.61	6.98
Pasture/Hayfield/Wetlands	197.74	198.21	0.47
Pasture/Croplands/Wetlands	199.60	214.67	15.07
Pasture	217.30	217.54	0.24
Pasture/Croplands	217.55	217.92	0.37
Pasture/Croplands	221.31	221.85	0.54
Pasture/Croplands	221.95	222.25	0.3
Pasture/Croplands	223.25	223.36	0.11
Pasture/Croplands	224.23	225.65	1.42
Pasture/Croplands	226.03	226.86	0.83
Pasture/Croplands	227.78	227.94	0.16
Pasture	228.35	228.81	0.46
TOTAL			**43.22**

Note: For a description of topsoil segregation and effects on wetlands, see section 4.3. (Up to the top 12 inches of topsoil would be segregated from the area disturbed by trenching in wetlands, except in areas where standing water or saturated soils are present.) Topsoil would not be segregated on federal lands as discussed in section 4.2.3.

Erosion Potential

The pipeline route would cross about 94.3 miles (41 percent of pipeline length) of soils with a high or severe water erosion potential and 14.4 miles (6.3 percent of the pipeline length) of soils with a high wind erosion potential (NRCS wind erodibility groups 1 and 2).

Impacts on soils from erosion would be minimized by following the Pacific Connector's Plan and Procedures and their Project-specific ECRP. Pacific Connector would implement specific water erosion prevention measures such as covering temporary storage piles; covering, seeding and mulching of soil and vegetation piles; and installation of sediment barriers, interceptor ditches or berms, or other measures where necessary, to filter water and divert flow away from sensitive areas. With these measures, significant water erosion would not occur. Pacific Connector would implement reseeding efforts, apply mulch, and water for dust control to minimize potential erosion by wind on the disturbed soils during construction. In addition, as described in section 4.1 of this

EIS, an extensive geotechnical review was conducted to ensure that the route avoided known or potential areas of mass soil movement. This effort required minor reroutes in numerous areas along the alignment to ensure the safety and integrity of the pipeline.

Temporary erosion control measures would be installed immediately after clearing and prior to grading (i.e., the initial soil disturbance). Near waterbodies and wetlands, the EIs would determine in the field the extent of temporary erosion control measures (i.e., sediment barriers) that would need to be installed prior to clearing activities to minimize the potential for runoff to enter a wetland or waterbody. All erosion control devices would be routinely inspected and any damaged or temporarily removed structures would be replaced at the end of each working day. Temporary erosion control measures would be maintained until successful revegetation has been achieved.

Sediment barriers would be used to confine sediment to the construction right-of-way and would be constructed of either silt fence or straw bales. Sediment barriers would generally be placed as follows:

- at the base of slopes adjacent to road, wetland and waterbody crossings where sediment could flow from the construction right-of-way onto the road surface or into the wetland or waterbody;
- adjacent to wetland and waterbody crossings, as necessary, to prevent sediment flow in the wetland or waterbody consistent with the requirements of the FERC's *Procedures* (which Pacific Connector's *Procedures* were based upon); and
- on the downslope side of the right-of-way where it traverses steep side slopes (greater than or equal to 30 percent).

Pacific Connector would install temporary slope breakers to reduce runoff velocity, concentrate flow, and to divert water off the construction right-of-way to avoid excessive erosion. Temporary slope breakers may be constructed of materials such as soil, silt fence, staked straw bales, straw wattles, or sand bags. If it becomes necessary to delay final cleanup, including final grading and installation of permanent erosion control measures, beyond 20 days (10 days in residential areas) after the trench is backfilled in a specific area, Pacific Connector would apply mulch on all disturbed slopes before seeding.

Trench breakers would be installed in the trench and keyed into trench walls on slopes prior to backfilling to slow the flow of subsurface water along the trench to prevent erosion of trench backfill materials. A permanent slope breaker and a trench breaker would be installed at the base of slopes near the boundary between the wetland and adjacent upland areas.

Waterbody crossings would be stabilized and temporary sediment barriers installed within 24 hours of completion of backfilling in accordance with Pacific Connector's *Procedures*. Pacific Connector would install erosion control fabric (such as jute or excelsior) on streambanks and steep slopes at the time of recontouring. The erosion control fabric would be designed for the proposed use and would be approved by the EI, and authorized agency representative on federal lands.

Permanent slope breakers (waterbars) would be installed across the right-of-way on steep slopes (greater or equal to 30 percent). The purpose of these structures is to minimize erosion by reducing runoff velocities, by shortening slope lengths, preventing concentrated flow, and by diverting water off the construction right-of-way. Slope breakers are also intended to prevent sediment deposition into sensitive resources.

Compaction Potential

The proposed pipeline alignment would cross a total of 178.7 miles (78.1 percent of the total pipeline length) of soils that are highly susceptible to compaction. Soils in this sensitive group were determined based on the NRCS rating of high or severe for the Haul Roads, Log Landings, and Soil Rutting categories. Soils in this group are rated based on Unified soil texture classification, rock fragments on or below the surface depth to a restrictive layer, depth to a water table and slope. However, most soils are susceptible to compaction depending on the number of passes of heavy equipment and the moisture content of the soils at the time of construction. Unmitigated soil compaction can result in long-term reductions of soil productivity and increased erosion from increased surface runoff.

Pacific Connector would minimize soil compaction, rutting, and structural damage to wet soils and soils with poor drainage by employing BMPs such as the use of low-ground-weight construction equipment, or operating normal equipment on timber riprap, prefabricated equipment mats, or terra mats. In addition, Pacific Connector would not conduct construction activities during extremely wet weather conditions. During forest clearing activities, the potential for soil compaction would be minimized where cable and helicopter logging methods are used. Where log skidding occurs, several practices would be employed as described in Section 2.3 of Pacific Connector's ***Right-of-Way*** *Clearing Plan for Federal Lands*,[60] where feasible, to minimize the potential for soil compaction.

As described in Pacific Connector's ECRP, regrading, recontouring, scarifying, and final cleanup activities after pipeline construction would mitigate potential soil compaction in all areas of pipeline construction. However, these measures alone would not be sufficient to entirely address soil compaction, and additional measures including subsoil ripping and decompaction with hydraulic excavators would also be necessary to fully address soil compaction. Mitigating compaction promotes infiltration, reduces surface water runoff, minimizes erosion, and enhances revegetation efforts. Pacific Connector would test for soil compaction in agricultural areas (e.g., active croplands, hayfields, and pastures), residential areas, and on NFS and BLM lands. Soil compaction mitigation on federal lands is more specifically discussed in section 4.3.2.

Potentially Contaminated Soils and Groundwater

A review of the ODEQ's ECSI database (ODEQ 2017a, 2017b, 2017c, and 2017d) and EPA's (2017) EnviroMapper - Facility Detail Report revealed that there are 116 sites with either cleaned-up, potential, or confirmed soil and/or groundwater contamination within 0.25 mile of the pipeline route as listed in table G-2 in appendix G. Based on a review of these sites, the sites listed in appendix G have the potential to encounter contaminated soil or groundwater during construction. During the review of these sites, the following issues were considered: sites that are closed might have residual contamination and contaminated soils might be carried by the wind to adjacent areas.

The sites listed below are close to the proposed pipeline infrastructure and construction areas, and database listings were insufficient to reach a conclusion regarding the potential for encountering

[60] This plan was included in Pacific Connector's application to the FERC as Appendix U to the POD.

associated contaminated soil or groundwater during Project construction. As a result, **we recommend that**:

- **<u>Prior to the end of the draft EIS comment period</u>, Pacific Connector shall consult with the ODEQ regarding existing soil and groundwater contamination at the sites listed in appendix G, and file the results of this consultation, along with any proposed site-specific soil or groundwater handling, management, and disposal procedures.**

During construction, contamination from accidental spills or leaks of fuels, lubricants, and coolant from construction equipment could adversely impact soils. To minimize impacts, Pacific Connector would implement measures contained in its SPCC Plan, which specifies cleanup procedures in the event of inadvertent spills during Project construction. Pacific Connector has developed a *Contaminated Substances Discovery Plan*[61] that specifies the measures that would be implemented if unanticipated contaminated soil or groundwater are encountered during construction. Some of the measures outlined in that plan specify that all construction work in the immediate vicinity of areas where hazardous or unknown wastes are encountered would be halted; that all construction, oversight, and observing personnel would be evacuated to a road or other accessible up-wind location until the types and levels of potential contamination can be verified, and that if an immediate or imminent threat to human health or the environment exists, one of Pacific Connector's emergency response contractors identified in the SPCC Plan or the National Response Team would be notified and mobilized. Pacific Connector would update the *Contaminated Substances Discovery Plan* to be consistent with the latest information regarding contaminated sites in proximity to the pipeline alignment prior to construction.

4.2.2.3 Pipeline-Specific Topics

Soil Limitations

<u>Reclamation Sensitivity</u>

The pipeline alignment would cross a total of 148.7 miles (64.8 percent of the pipeline length) of soils that are rated as having reclamation sensitivity or poor revegetation potential (NSR 2014). These soils may have a combination of characteristics that could require additional measures or BMPs to reduce erosion and sedimentation potential. Restoration of these soils may require adaptive seed mixtures and implementation of revegetation practices (i.e., fertilization, mulching, monitoring) to enhance revegetation success. Section 10.0 of Pacific Connector's ECRP includes a detailed description of soil restoration procedures and requirements. Pacific Connector would implement revegetation procedures, such as topsoil segregation, recontouring, scarification, soil replacement, seedbed preparation, fertilization, seed mixtures, seeding timing, seeding methods, and supplemental plantings to ensure revegetation success. Information contained in the BLM/Forest Service *Technical Memorandum Soil Risk and Sensitivity Assessment on BLM and National Forest System Lands* (NSR 2015a) would be used to identify and treat areas on BLM and Forest Service lands where specific and focused soils remediation measures may be required to minimize potential erosion and accomplish vegetation objectives (see section 4.2.3).

Pacific Connector would work with individual landowners to address restoration of active agricultural and residential landscaping, if affected by pipeline construction. In active agricultural

[61] The *Contaminated Substances Discovery Plan* was included in Pacific Connector's application to the FERC as Appendix E to the POD.

areas, Pacific Connector would restore the lands in compliance with the *Plan* and *Procedures*, and would also compensate the landowner for any additional restoration measures (e.g., replanting crops) that the landowner preforms. In residential areas, Pacific Connector would use contractors familiar with local horticultural and lawn establishment procedures for reclamation work or would compensate the landowner if the landowner conducts that restoration work; Pacific Connector would still be responsible for ensuring the restoration efforts are successful.

Seedbed preparation would be conducted, where necessary, immediately prior to seeding to prepare a firm seedbed conducive to proper seed placement and moisture retention. Seedbed preparation would also be performed to break up surface crusts and to eliminate weeds which may have developed between initial reclamation and seeding. A seedbed would be prepared in disturbed areas, where necessary, to a depth of up to four inches using appropriate equipment to provide a seedbed that is firm, yet rough. A rough seedbed is conducive to capturing or lodging seed when broadcasted or hydroseeded, and it reduces runoff and erosion potential. The rough seedbed would retain soil moisture for seedling germination and establishment.

In most areas, final right-of-way cleanup procedures are sufficient because they leave a surface smooth enough to accommodate a drill seeder pulled by a farm tractor and rough enough to catch broadcasted seed and trap moisture and runoff. Where residential and cropland areas are disturbed, more intensive ground and seedbed preparations may be required including rock collection, grading, and soil preparation/amending. The EI would be responsible for determining where seedbed preparation measures are required prior to seeding.

Pacific Connector has consulted with the NRCS and land management agencies regarding recommended seed mixtures for the Project area. The seed mixtures developed for the Pacific Connector Pipeline Project are based on these agency recommendations and are provided in the ECRP. During right-of-way negotiations, private landowners may also request other seed mixtures than those proposed in the ECRP. These specific landowner requested/specified seed mixtures would be documented in landowner right-of-way agreements.

Disturbed areas would be seeded within six working days of final grading, weather and soil conditions permitting. If final grading occurs more than 20 days after pipe installation and backfilling, Pacific Connector would apply mulch on all disturbed areas prior to seeding. Seeding would proceed in accordance with the ECRP.

Restrictive Layer

Soils that are rated as having a restrictive layer are shallow soils that have a lithic, paralithic, or other restrictive soil layer within 60 inches of the soil surface. The pipeline alignment would cross a total of about 144.6 miles (63.1 percent of the pipeline length) of soils with a restrictive layer. These soils have thin profiles, restrictive root zones and hold less available water for plant growth. Shallow and hard bedrock can also restrict trenching, requiring special equipment (rock hammers/saws) or blasting in some areas to efficiently excavate the trench to required design depths. Excavation of bedrock or cemented layers may require additional measures to provide suitable pipe bedding materials. Soils in this group are also included in the soils that have reclamation sensitivity. Section 4.1 of this EIS discusses shallow soils, rock lithology, potential blasting locations, rock removal, and disposal.

Large Stones

Soils with more than 25 percent cobbles and stones in the soil profile can present problems with surface reclamation because they hold less available water for plant growth and generally require broadcast seeding methods. Further, the introduction of stones or rocks from subsoils to surface soil layers during trenching or blasting can adversely affect agricultural productivity and agricultural equipment operation.

The pipeline route would cross a total of 73.2 miles (31.9 percent of the pipeline length) of soils containing cobbles and stones. Pacific Connector has developed measures that would reduce impacts on restoration and revegetation caused by rocks, cobbles, and stones near the soil surface. In agricultural and residential areas, topsoil would be segregated except on federal lands as discussed in section 4.2.3. A rock picker would be used to remove large fragments.

Rocks excavated from the trench would be kept separate from topsoil during construction and during surface preparation as part of restoration. Pacific Connector has identified rock disposal sites. These sites are listed in table 4.1.2.4-1. Large rocks and boulders would also be used as OHV barriers along the right-of-way and at road crossings to control unauthorized OHV access to the right-of-way both during construction and operation. Additionally, large rocks and boulders would be piled in upland areas along the right-of-way to create habitat diversity features where approved by the EI or Pacific Connector's authorized representative and the landowner or land management agency.

Aboveground Facilities

Pacific Connector's aboveground facilities would be located within or immediately adjacent to the pipeline construction right-of-way. Each facility would be fenced and graveled immediately after construction. Permanent impacts on soils would occur at aboveground facilities that would be graded and graveled or where facilities would be constructed. Soil limiting characteristics at aboveground facilities are listed on table 4.2.2.3-1. Soils at specific aboveground facilities are described below. Section 10.0 of Pacific Connector's ECRP includes a detailed description of erosion control and soil reclamation procedures and requirements.

TABLE 4.2.2.3-1

Summary of Soils Limitations – Pacific Connector Pipeline Aboveground Facilities

Proposed Facility	Area (ac) a/	Soil Mapping Unit (STATSGO)	High Erosion Potential b/	Steep Slopes c/	Large Stones d/	Restrictive Layer e/	High Compaction Potential f/	Poor Revegetation Potential g/	Prime Farmland h/
Jordan Cove Receipt MS, BVA #1, Receiver Site	1.72	S6398 (61D)	N/A i/	N/A i/	N/A i/	N/A i/	N/A i/	N/A i/	N/A i/
MLV #2 (Boone Creek Road) /	<1	S6399 (54F)	No	No	No	Yes	No	No	Yes
MLV #3 (Myrtle Point Sitkum Rd)	<1	S6402 (47B)	No	No	No	No	Yes	No	No
MLV #4 (Deep Creek Rd)	<1	S6408 (262E)	No	No	No	Yes	Yes	Yes	No
MLV #5 (S. of Ollala Creek)	<1	S6360 (14C)	No	No	No	No	Yes	No	Yes
MLV #6 Launcher/ Receiver & CT	<1	S6385 (189F)	Water	Yes	Yes	Yes	No	Yes	No
MLV #7 (Pack Saddle Rd)	<1	S6360 (270F)	Water	Yes	No	No	Yes	Yes	No
MLV #8 (Hwy 227)	<1	S6360 (183B)	No	No	No	No	Yes	Yes	Yes
MLV #9 (BLM Rd 33-2-12) /	<1	S6381 (69E)	No	Yes	Yes	Yes	No	Yes	No
MLV #10 (Shady Cove)	<1	S6380 (122E)	Water	Yes	Yes	Yes	Yes	Yes	No
MLV #11 (Butte Falls & Launcher/Receiver Site) /	<1	S6380 (125C)	No	No	Yes	Yes	Yes	Yes	No
MLV #12 (Heppsie Mtn Quarry)	<1	S6380 (111G)	Wind	Yes	Yes	Yes	Yes	Yes	No
MLV #13 (Clover Creek Rd)	<1	S6387 (R6)	No	No	No	No	Yes	No	No
MLV #14 & Launcher/ Receiver Site	<1	S656 (129B)	No	No	Yes	Yes	No	Yes	No
MLV #15 Klamath River /	<1	S1150 (40)	No	No	No	No	Yes	No	Yes
MLV #16 (Hill Road)	<1	S6356 (58A)	No	No	No	Yes	Yes	No	Yes
Klamath Compressor Station, Klamath-Beaver and Klamath-Eagle Meter Stations, MLV #17, Launcher/Receiver & CT	21.40	S542 (19C)	Wind	No	No	No	Yes	No	Yes

TABLE 4.2.2.3-1 (continued)

Summary of Soils Limitations – Pacific Connector Pipeline Aboveground Facilities

Proposed Facility	Area (ac) a/	Soil Mapping Unit (STATSGO)	High Erosion Potential b/	Steep Slopes c/	Large Stones d/	Restrictive Layer e/	High Compaction Potential g/	Poor Revegetation Potential h/	Prime Farmland k/
Blue Ridge Communication Site	<1	S6396 (4D)	Water	No	No	No	Yes	Yes	No
Signal Tree Communication Site	<1	S6395 (50D)	No	No	Yes	Yes	Yes	Yes	No
Sheep Hill Communication Site	<1	S6395 (50D)	No	No	Yes	Yes	Yes	Yes	No
Harness Mountain Communication Site (Existing)	0.0	S6396 (122E)	No	No	Yes	No	No	No	No
Starveout Communication Site	<1	S6361 (89E)	Water	No	Yes	Yes	No	Yes	No
Flounce Rock Communication Site	<1	S6380 (113G)	Water	Yes	No	Yes	Yes	Yes	No
Robinson Butte	<1	S6388 (0038)	No	Yes	Yes	No	No	No	No
Stukel Mountain Communication Site	<1	S6388 (16E)	No	Yes	Yes	No	No	Yes	No

MS = meter station, MLV = mainline block valve, CT = communication tower. Soil data from NRCS (2004); SCS (1985, 1989, 1993); Forest Service (1976, 1977, and 1979). NRCS State Soil Geographic Database (STATSGO and SSURGO) soil classifications (NRCS 2017).

a/ Area of pipeline construction and operation right-of-way disturbance. Acreages rounded to nearest whole acre; values less than 1 are reported as <1.

b/ Soils with NRCS water erosion rating of high or severe; and/or soils with NRCS wind erodibility groups 1 and 2.

c/ Soils with slopes greater than 30 percent.

d/ Soils with greater than 25 percent cobbles and/or stones within pipeline trench depth.

e/ Soils with a restrictive soil layer (bedrock or cemented layer) within 60 inches of the soil surface.

f/ Soils with an NRCS rating of high or severe for the Haul Roads, Log Landings, and Soil Rutting category.

g/ Combined rating for soils with high or severe erosion potential, steep slopes, large stones, shallow soils, saline/sodic conditions, clayey soils (greater than 40 percent), and soil map units with dominant amounts of rock outcrop. The Reclamation/Sensitivity type does not include data related to the revegetation sensitivity studies on federally managed lands (NSR 2015).

h/ Soils with dominant map unit included on either the state or county list of farmland of importance (includes prime farmland, unique farmland, and farmland of statewide or local importance).

i/ These aboveground facilities would be located entirely within the proposed Jordan Cove LNG terminal. This soil association has been previously disturbed and would be graded and built up during construction of the Jordan Cove LNG terminal prior to construction of the Pacific Connector pipeline.

Jordan Cove Meter Station

The Jordan Cove Meter Station (at MP 0.0) would be within the South Dunes site, on the North Spit, in Coos County. This area was formerly the location of the Menasha-Weyerhaeuser mill (operated between 1961 and 2003), which is now dismantled. Petroleum hydrocarbons (e.g., fuel, fuel oil, lubricants, solvents, and hydraulic oil constituents) are present in subsurface soils and groundwater from past mill operations/practices in the area of the South Dunes site. In addition, transite/asbestos siding and other debris from the Weyerhaeuser Company mill demolition are present in surficial soils. The meter station would occupy approximately 1 acre on the Bullards-Nehalem-Dune Land soil association. There are no known soil limitations that would affect the construction and use of this parcel for a meter station. The meter station site would be graded and its elevation built up by Jordan Cove from soils excavated and dredged from the LNG terminal access channel and marine slip. The Jordan Cove Meter Station would also contain MLV#1, a receiver, and a communication tower.

The Jordan Cove Meter Station location and pipeline alignment are in the general area of potential debris/fill; however, the TEWA usage has been reduced in size, and the debris/fill material would not be disturbed as the TEWA would be used only for staging equipment or materials. To protect human health and ensure worker safety, Pacific Connector or qualified contractor personnel would collect representative samples of the debris/fill in the excavation zone prior to construction for the meter station and pipeline alignment and surrounding materials for laboratory analysis for contaminants of concern listed above. Based on the results of laboratory analysis, any contaminated material would be removed and properly disposed of in accordance with appropriate federal and state regulations. Where the removed fill must be stockpiled pending characterization and ODEQ approval, Pacific Connector would take precautions to avoid mitigation of existing contamination (e.g., appropriate liner for storage area, berms). Clean backfill would be utilized to backfill excavations. This approach is consistent with ODEQ recommendations for this general area (ODEQ - No Further Action Determination Letter, Former Weyerhaeuser Containerboard Mill North Bend, Coos County, Oregon Tax Lots #25S-13W-4-100, 25S-13W-3-200, and the LNG terminal [Ingram Yard portion of 25S-13W-0-200 ECSI Site ID No. 1083]).[62] Lastly, Pacific Connector would mandate pipeline contractor training that would include this site's status and history, and instruct that site excavation and disturbance is to be limited. Documentation of all analytical results and disposal records would be filed with the FERC following construction of the meter station.

Klamath Compressor Station

The Klamath Compressor Station would be located at MP 228.8 in Klamath County. The site would also include the Klamath-Beaver and Klamath-Eagle meter stations, MLV #17, a launcher/receiver, and a communication tower. The compressor station would occupy a 21.4-acre site within the Fordney-Calimus Poman soil association. The two dominant mapped soil units (i.e., Fordney loamy fine sand and Calimus loam) are considered prime farmland if irrigated; however, the site is not irrigated or otherwise in agricultural use. Fordney loamy fine sand has a high wind erosion hazard; therefore, periodic watering may be necessary to minimize fugitive dust during construction clearing and grading activities until the site has been stabilized with gravel.

[62] Included in Jordan Cove's Resource Report 7, Appendix G.7, in their September 2017 application to the FERC.

Gas Control Communication Towers

Pacific Connector would install a series of communication towers for gas control and system monitoring at 8 locations. As discussed above, one new communication tower would be erected within the Klamath Compressor Station and the Jordan Cove Meter Station. No soils would be disturbed where an existing tower would be utilized. Pacific Connector expects to erect new communication towers adjacent to existing facilities at three locations: Flounce Rock, Robinson Butte, and Stukel Mountain. Construction of the new towers would disturb about 0.2 acre at each location. Information on the soil characteristics for the new tower locations is provided in table 4.2.2.3-1. Pacific Connector would minimize erosion by following its ECRP. Because the communication towers are industrial facilities, the presence of stones, restrictive layers, and poor revegetation potential would not be environmentally adverse factors in the construction and operation of the towers.

Launchers/Receivers and Mainline Block Valves

Seventeen MLVs would be installed along the pipeline according to USDOT spacing requirements (49 CFR Part 192 Section 192.179). Potential impacts from the MLVs are accounted for within the proposed pipeline because these facilities would be located entirely within the construction right-of-way. However, because these small (less than a tenth of an acre) sites would contain aboveground facilities, they would permanently affect soils. Six of the MLV locations would be on soils designated as prime farmland, with five of these locations (MLVs 5, 8, 15, 16, and 17) within existing cropland/pastures rangeland. Construction and operation of the launchers/receivers and MLVs would take a total of about one-third of an acre out of agricultural production, excluding acres that were already discussed under the meter stations. Loss of agricultural production would be a factor considered in compensation to landowners negotiated by Pacific Connector while obtaining easement agreements.

Temporary Storage Yards

Pacific Connector has identified 36 potential, privately-owned contractor and pipe storage yards in the general area of the proposed route. These yards would be used for pipe offloading, office trailers, fabrication, equipment storage, material staging and employee parking. Although it is unlikely that all 36 yards would be utilized, numerous sites are identified and evaluated given that some sites could become unavailable at the time of construction. Most (28) of the yards are located in existing industrial areas or sites that have been previously disturbed by filling, grading, and gravelling activities, and therefore the soils resources at these locations have been substantially altered from natural conditions. Of the remaining storage yards, two have been partially disturbed (i.e., Coquille Park and Rogue Aggregates). Only six storage yards have not been disturbed previously. These include four storage yards that are currently used for agriculture (i.e., Roth, Riddle Pasture, Klamath Falls North of Cross Road East, and Klamath Falls North of Cross Road West). The remaining undisturbed storage yards (i.e., Klamath Amuchastegui Building, and Klamath Falls Industrial Oil) are undeveloped land in industrial parks.

Soil associations, mapping units, and sensitive soil characteristics are listed for each of the storage yards in table 4.2.2.3-2.

TABLE 4.2.2.3-2

Contractor and Pipe Storage Yards with Sensitive Soil Characteristics (Pastures, Fields and Vacant Lots)

Name	County	Section, Township, Range	Acres a/	Description	Soil Association – Soil Mapping Units and Sensitive Soil Characteristics b/
Coquille Park	Coos	Section 35, T. 27 S., R. 13 W.	3.3	Sturdivant Park, adjacent to rail siding	Soil Association: Waldport (OR0797) Soil Mapping Units: (Coos County): 40 & 41 Sensitive Soil Characteristics: 8, 10, 11, 12
Roth	Douglas	Section 29, T. 28 S., R 5 W.	3.8	Pasture, adjacent to rail siding, connect to Pipeline right-of-way	Soil Association: Ruch-Medford-Takilma (OR059) Soil Mapping Units: (Douglas County): 81A & 189F Sensitive Soil Characteristics: Philomath-Dixonville complex soil: 1, 4, 5, 8, 9 Foehlin soil: 8, 12
Riddle Pasture	Douglas	Section 45, T. 30 S., R. 6 W.	7.3	Vacant field adjacent to industrial sites and rail siding	Soil Association: Ruch-Medford-Takilma (OR058) Soil Mapping Units (Douglas County): 14A &14C Sensitive Soil Characteristics: 1, 3
Rogue Aggregates	Jackson	Section 20, T. 36 S., R. 2 W.	38.9	Pasture/undeveloped land within active aggregate quarry and processing facility and undeveloped land includes rail siding	Soil Association: Ruch-Medford-Takilma (OR059) Soil Mapping Units (Jackson County): 10B, 31A, 55A, 133A Sensitive Soil Characteristics: 1
Klamath Amuchastegui Building	Klamath	Section 10, T. 39 S., R. 9 E.	25.5	Existing commercial site and undeveloped industrial lots adjacent to rail siding	Soil Association: Fordney-Calimus-Poman (OR059) Soil Mapping Units (Klamath): 19A, 90 Sensitive Soil Characteristics:1, 5
Klamath Falls Industrial Oil	Klamath	Sections 8, 9 & 10, T.39 S., R. 9 E.	39.5	Undeveloped Industrial Lots adjacent to highway, rail and rail sidings	Soil Association: Malin-Laki-Henley (OR008) Soil Mapping Units (Klamath): 7C, 18A, 74D Sensitive Soil Characteristics: 1, 4
Klamath Falls North of Cross Road East	Klamath	Section 1, T. 40 S., R.9 E.	7.0	Farmland, adjacent to rail siding	Soil Association: Fordney-Calimus-Poman (OR059) Soil Mapping Units (Klamath): 58A Sensitive Soil Characteristics: 1, 4
Klamath Falls North of Cross Road West	Klamath	Section 1, T. 40 S., R.9 E.	37.0	Agricultural Field	Soil Association: Fordney-Calimus-Poman (OR059) Soil Mapping Units (Klamath): 58A Sensitive Soil Characteristics: 1, 4

a Acreages are rounded to nearest tenth acre.
b/ Sensitive Soil Characteristics:
1 – All soils within this mapping unit (based on SSURGO geographic databases) are considered prime farmland soil or farmland of statewide importance.
2 – These soils are positioned on floodplains and stream terraces and have soil components within the mapping unit that may be poorly drained and have either seasonal high water tables at or near the surface and have surface soils that are susceptible to compaction impacts and some that are susceptible to occasional or rare flooding.
3 – These soils have low strength and are susceptible to compaction especially if wet.
4 – Shallow to bedrock or duripan
5 – Seasonal high water table

Pacific Connector would use appropriate erosion control measures to minimize potential impacts at the yards. After the pipeline is constructed, the temporary yards would be restored to their previous condition and use.

The Coquille Yard is identified as a TEWA intended for use as a contractor yard for staging pipe, equipment, or other construction supplies and materials. Based on historical information, contaminated soil at the site was removed and treated in a soil treatment area and the site was encapsulated with fill dirt from ODOT in 1995. In 1998, the ODEQ recommended no further action for the site. Pacific Connector has identified this yard for staging of pipe, equipment or other construction supplies and materials and the use would be surface use only. Minor surface grading would be limited to pushing berms as needed to support pipe joints. This limited use of the site is not expected to result in effects on the encapsulated area or in potential effects on human health, worker safety, or the environment. However, Pacific Connector would consult with the ODEQ prior to use of the site to confirm that the intended use is consistent with the protections required for this property. In addition, Pacific Connector would include pipeline contractor training regarding this site's status and history and would require that site excavation and disturbance be limited.

Access Roads

Most access roads for the pipeline would be existing federal (BLM and Forest Service), state, county, and private roads that intersect the proposed pipeline alignment. Where needed, Pacific Connector proposes to modify existing roads and construct new roads to ensure construction and operation access. Approximately 3.8 acres of soils would be disturbed to construct 10 TARs, and approximately 2.16 acres of soils would be permanently affected to construct or reconstruct 15 PARs. The TARs would be constructed using appropriate BMPs to minimize potential impacts and would be designed and constructed for their intended use. All TARs would be reclaimed (i.e., regraded, scarified, and replanted) upon completion of construction according to the landowner or agency requirements. Soils along PARs would be permanently compacted and unvegetated.

4.2.3 Environmental Consequences on Federal Lands

The causes and extent of environmental effects on soil resources from the proposed Project are described above. The Forest Service has determined that these effects will, in some areas and for some activities will exceed allowable thresholds for detrimental soil conditions established by the applicable forest plans. Therefore, the Forest Service has proposed plan amendments and compensatory mitigation actions to make provision for the proposed project.

The BLM has not established detrimental soil condition thresholds within the applicable Resource Management Plans and therefore has not proposed similar plan amendments.

4.2.3.1 Environmental Consequences on National Forest Lands

The Project may cause soil mixing, displacement, and compaction on the backfilled trench and the spoils side of the corridor, steep slopes in some locations, and rocky soils where subsoil ripping would not effectively be restored to a condition with less than 15 percent increase in bulk density. As a result, an estimated 30 to 70 percent of the project area would likely have detrimental soil conditions from mixing, displacement, or compaction. Complete rehabilitation would also require recovery of the soil biology, which requires restoration of the soil organic matter and time. Some surface erosion is likely to occur; however, 85 to 95 percent of surface erosion can be prevented or trapped on-site by application of measures in the ECRP. Any surface erosion that does occur is expected to be minor, and within the range of natural variability for watersheds in southwest Oregon (see appendix F.4).

The Project may cause sediment transport from construction clearing and use of roads by the project. As part of the Project mitigation, road sediment reduction projects are aimed at reducing the chronic contributions of fine-grained sediment from road surfaces and fill failures to stream systems. As described in chapter 2, table 2.1.5-1, mitigation activities include decommissioning of 93.9 miles of Forest Service roads. Proposed road decommissioning would increase infiltration of precipitation, reduce surface runoff, and reduce sediment production from road-related surface erosion in the watershed where the impacts from the Project occur. Sediment reduction would also include closure of about 1.2 miles of Forest Service roads, reducing fine-grained sediments by eliminating traffic impacts.

LRMPs for the Umpqua, Rogue River, and Winema National Forests have standards and guidelines that establish thresholds for detrimental soils conditions as shown in table 4.2.3.1-1.

TABLE 4.2.3.1-1

Thresholds for Detrimental Soil Conditions on NFS Lands

Watershed	Total Project Acres a/	Cleared Acres b/	Threshold Acres Allowed c/	Minimum Projected Acres in Detrimental Condition d/	Maximum Projected Acres in Detrimental Condition	Minimum Acres Over Threshold	Maximum Acres Over Threshold
Umpqua National Forest							
Days Creek- South Umpqua	53	21	11	6	15	-5	4
Elk Creek-South Umpqua	30	29	6	9	20		14
Upper Cow Creek	74	74	16	22	52	6	36
Trail Creek	50	41	12	12	29	0	17
Total Umpqua NF	***207***	***165***	***45***	***49***	***116***	***8***	***71***
Rogue River National Forest							
Little Butte Creek	277	207	28	62	145	34	117
Winema National Forest							
Spencer Creek, All Land Allocations other than Management Area 8	85	73	17	22	51	5	34
Spencer Creek Riparian Areas (Management Area 8)	7	7	1	2	5	<1	4
Total Winema NF	***92***	***80***	***18***	***24***	***56***	***5***	***38***
Total Cumulative Direct Effect, All NFS Lands	**576**	**452**	**91**	**135**	**317**	**47**	**226**

Rows and columns may not add correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as “<1”).

a/ Total Project Acres is all acres within the right-of-way. This includes cleared and uncleared areas.

b/ Cleared Acres are the construction corridor and TEWAs.

c/ Threshold Acres Allowed is the threshold from the standards and guidelines times the Total Project Acres.

d/ Projected Acres in Detrimental Conditions is estimated at 30 percent (minimum) to 70 percent (maximum) of the Cleared Acres.

Detrimental soil conditions are measured upon completion of a project after restoration and rehabilitation work is completed. Detrimental soil conditions are defined in each national forest LRMP, but generally include:

- compaction, which is defined as an increase in bulk density of 15 percent when compared to adjacent undisturbed soils for all soils except volcanic ash or pumice. For volcanic ash soils, compaction is defined as a 20 percent increase in bulk density when compared to adjacent undisturbed soils;
- displacement or mixing, which is the horizontal removal by mechanical means of 50 percent or more of the topsoil or “A” horizons, or mixing of these layers with less fertile subsurface mineral layers such that the continuity of the horizons is lost; and
- detrimental puddling, which is the physical change to soil structure that results when traffic ruts and molds a soil to a depth of 6 inches or more.

Precise estimates of detrimental soil conditions likely to exist at completion of a project are impossible to make. For the purposes of this assessment, 30-70 percent of the pipeline project area may be in a detrimental soil condition upon completion of all soil restoration and rehabilitation efforts. Table 4.3.2.2-1 provides an estimate of predicted detrimental soil conditions. Where projected acres exceed the threshold, an amendment of the affected LRMP is necessary to make provision for the Pacific Connector Pipeline Project.

The impacts of detrimental soil conditions include:

- a possible reduction in soil productivity from mixing or displacement of nutrient-bearing soil layers; and
- a potential increase in runoff and erosion from decreased infiltration of compacted soils.

See section 4.3.4 for measures that would be applied on federal lands to address these issues.

Amendments of Forest Plans Related to Thresholds for Detrimental Soil Conditions

Where detrimental soil conditions exceed the threshold established in an LRMP, an amendment of the LRMP is necessary for the Project to proceed. The following amendments of National Forest LRMPs are proposed to waive limitations on detrimental soil condition thresholds to make provision for the Project. Additional discussion of forest-specific management direction related to soil conditions is provided in section 4.7.3.

UNF-3. Project-Specific Amendment to Waive Limitations on Detrimental Soil Conditions Within the Pacific Connector Right-of-Way in All Management Areas[63]

For planning purposes, soil impacts are considered long term. Soil compaction and displacement would be confined to the project area, but predicting how much would be affected is an estimate based on professional judgment and the nature of corridor construction. See section 4.3.2.3 for a discussion of environmental consequences.

The Project would likely result in a detrimental soil condition on 30 to 70 percent of the project area on the Umpqua National Forest (165 acres) due to displacement and compaction. Approximately 11 of those acres would likely be in Riparian Reserves. Compaction can largely be addressed by subsoil ripping, but displacement would be unavoidable because of the nature of the Project. Existing LRMP standards and guidelines allow up to 20 percent of the project corridor (about 33 acres of the corridor on the Umpqua National Forest) to be in a degraded soil condition upon completion of a project. The Pacific Connector Pipeline Project would exceed these thresholds by about 8 to 71 acres on the Umpqua National Forest. These impacts would be spread over four separate fifth-field watersheds. See section 4.7.3 and appendix F.4, Aquatic Conservation Strategy Assessment, for a watershed-specific evaluation. Amendment of the Umpqua National Forest LRMP to waive limitations on detrimental soil conditions is not expected to prevent attainment of Aquatic Conservation Strategy objectives (section 4.7.3 and appendix F.4). See section 4.7.3 for a discussion of this amendment in the context of the Umpqua National Forest LRMP.

[63] Forest-Wide Soils Standard and Guideline #1 (Umpqua LRMP IV-67)

RRNF–6. Project-Specific Amendment to Waive Limitations on Detrimental Soil Conditions Within the Pacific Connector Right-of-Way in All Management Areas[64]

The Pacific Connector Pipeline Project would likely result in a degraded soil condition on an estimated 30 to 70 percent of the pipeline right-of-way on NFS lands in the Rogue River National Forest (all in the Little Butte Creek Watershed) due to displacement and compaction (Orton 2009). Compaction can largely be addressed by subsoil ripping, but displacement would be unavoidable because of the nature of the project. Existing LRMP standards and guidelines allow up to 10 percent or 28 acres of the pipeline corridor to be in a degraded soil condition on completion of a project. Thus, the pipeline project would likely exceed this threshold by about 34 to 117 additional acres or 0.07 to 0.2 percent of the 57,234 acres (NFS lands only) within the Little Butte Creek Watershed upon completion. About 2 to 6 acres of degraded soil conditions above LRMP thresholds may be in Riparian Reserves. See section 4.7.3 and appendix F.4, Aquatic Conservation Strategy, for a watershed-specific evaluation of consequences. Amendment of the Rogue River National Forest LRMP to waive limitations on detrimental soil conditions is not expected to prevent attainment of Aquatic Conservation Strategy objectives (section 4.7.3 and appendix F.4). See section 4.7.3 for a discussion of this amendment in the context of the Rogue River National Forest LRMP.

WNF-4 and WNF-5: Project-Specific Amendment to Waive Limitations on Detrimental Soil Conditions within the Pacific Connector Right-of-Way in All Management Areas[65]

These standards and guidelines of the Winema National Forest LRMP restrict the amount of an area that may be in a degraded soil condition as a result of a management activity. They are considered together here because the assessment is the same for both standards.

The Pacific Connector Pipeline Project would likely result in a degraded soil condition on an estimated 30 to 70 percent project right-of-way on NFS lands in the Winema National Forest (all in the Spencer Creek Watershed) due to displacement and compaction (Orton 2009). Compaction can largely be addressed by subsoil ripping, but displacement would be unavoidable because of the nature of the project. Existing LRMP standards and guidelines allow up to 10 percent (1.5 acres) of the project corridor in Management Area 8 Riparian Areas or 20 percent (17 acres) in the pipeline corridor outside of Management Area 8 to be in a degraded soil condition on completion of a project. Thus, the pipeline project would likely exceed this threshold by an estimated 5 to 38 additional acres or 0.03 to 0.16 percent within the Spencer Creek watershed upon completion. See section 4.7.3 and appendix F.4, for a watershed-specific evaluation of consequences. Amendment of the Winema National Forest LRMP to waive limitations on detrimental soil conditions is not expected to prevent attainment of Aquatic Conservation Strategy objectives (section 4.7.3 and appendix F.4). See section 4.7.3 for a discussion of this amendment in the context of the Winema National Forest LRMP.

Cumulative Impacts, All Units

Cumulatively, on the Umpqua, Rogue River, and Winema National Forests, detrimental soil conditions within the pipeline project area are expected to range between about 135 and 317 acres

[64] Standards and guidelines in the Rogue River National Forest LRMP (pp. 4-41, 4-83, 4-97, 4-123, 4-177, 4-307)
[65] Winema National Forest LRMP Management Direction for Riparian Areas page 4-73 (WNF-4) and 4-137 (WNF-5).

(table 4.3.3.3-1), or about 47 to 226 acres over the combined LRMP threshold for the pipeline project of 91 acres. Assuming an even distribution over the 30.6-mile NFS part of the pipeline project area, this equals about 2 to 8 acres of detrimental soil conditions above the LRMP thresholds for each mile of pipeline, spread over six separate fifth-

Mitigation also includes storm-proofing of 11.4 miles of Forest Service roads would reduce sediment from roads by increasing the resistance of a road to failure during high-intensity rainfall events. Storm-proofing strategies include improving drainage, reducing diversion potential at culverts, outsloping road surfaces and replacing culverts with hardened low water fords. Road sediment reduction activities would result in approximately 207 total acres (assuming a typical 16-foot wide roadway) of long-term sediment mitigation on federal lands.

Road stabilization and culvert replacement of 11 sites on NFS lands would reduce road-related sediment by stabilizing or removing failing cut and fill slopes. Culvert replacement reduces sediment by replacing undersized or failing culverts with culverts that are appropriate to pass debris at higher flows. This reduces the probability of fill failure associated with plugged culverts.

The locations of the road sediment reduction activities are listed in table 4.2.3.1-2.

TABLE 4.2.3.1-2

Mitigation Projects to Address LMP Amendments on NFS Lands

Unit	Watershed	Mitigation Group	Project Type	Project Name	Quantity	Unit
Umpqua National Forest	Elk Creek - South Umpqua	Road sediment reduction	Road Storm-proofing	Elk Creek Road Storm-proofing	9.2	miles
	Elk Creek - South Umpqua	Aquatic and Riparian Habitat	Fish Passage	Elk Creek Fish Passage Culverts	5	sites
	Elk Creek - South Umpqua	Road sediment reduction	Road Decommissioning	Elk Creek Road Decommissioning	5.9	miles
	Trail Creek	Road sediment reduction	Road Decommissioning	Trail Creek Road Decommissioning	0.3	miles
	Trail Creek	Road sediment reduction	Road Storm-proofing	Trail Creek Storm-proofing	2.2	miles
	Upper Cow Creek	Road sediment reduction	Road Closure	Upper Cow Creek Road Closure	1.2	miles
	Upper Cow Creek	Road sediment reduction	Road Decommissioning	Upper Cow Creek Road Decommissioning	1.0	miles
	Upper Cow Creek	Aquatic and Riparian Habitat	Fish Passage	Upper Cow Creek Fish Passage Culverts	6	sites
Rogue River National Forest	Little Butte Creek	Road sediment reduction	Road Decommissioning	Little Butte Creek Road Decommissioning	57.5	miles
Winema National Forest	Spencer Creek	Road sediment reduction	Road Decommissioning	Spencer Creek Road Decommissioning	29.2	miles

a/ Mileages are rounded to nearest tenth of a mile.

4.2.3.2 Soil Risk and Sensitivity Assessment

At the request of the BLM and Forest Service, Pacific Connector identified areas on BLM and NFS lands along the proposed Project where there is a low vegetation recovery potential. These soils included combined characteristics including high or severe erosion potential, steep slopes, large stones, shallow soils, saline/sodic conditions, clayey soils (greater than 40 percent), and soil map units with dominant amounts of rock outcrop. Certain types of disturbed soils where residual soil compaction exists in subsurface soil layers, topsoil has eroded, soil horizons have been mixed, and/or topsoil has been removed, can lead to conditions where revegetation can be very difficult, no matter what mitigation methods are employed.

In order to specifically identify areas of revegetation concern where more rigorous mitigation might be required, a Soil Risk and Sensitivity Assessment was performed for the BLM and Forest Service in 2015. The intent of the assessment was to identify the areas where additional soil decompaction, erosion control, or other types of site-specific and focused remediation measures may be required on BLM and NFS lands to minimize erosion potential and/or accomplish agency revegetation objectives. Soil risk and sensitivity factors were identified by a BLM/Forest Service team including four criteria in the assessment of the risk element; plant mortality, soil erosion, slope rating and aspect; and three levels of sensitivity, primarily based on qualitative values related to management objectives.

As depicted in table 4.2.3.2-1, approximately 83 percent of the Project area, or about 1,143 acres, is rated as Level 1 – very low or Level 2 – low for combined risk and sensitivity. These are locations where revegetation measures are expected to be successful with decompaction and other standard methods described in the ECRP. Approximately 18 percent of the Project area, or about 237 acres, is rated as Level 3 – moderate or Level 4 – high for combined risk and sensitivity where more aggressive erosion controls and/or soil remediation are likely to be needed.

TABLE 4.2.3.2-1

Risk/Sensitivity Ratings by Administrative Unit by Watershed (Acres)

Unit	Watershed	Risk Sensitivity Rank: 1 (very low)	2 (low)	3 (moderate)	4 (high)	5 (very high)
Coos Bay BLM	East Fork Coquille River	13	26	4	32	0
	Coquille River	0	<1	<1	<1	0
	North Fork Coquille River	5	22	8	8	0
	Middle Fork Coquille River	9	58	6	9	<1
	Coos Bay-Frontal Pacific Ocean	<1	2	<1	<1	0
	Subtotal	**27**	**108**	**20**	**19**	**<1**
Roseburg BLM	Clark Branch South Umpqua	2	7	1	0	0
	Olalla-Looking Glass	10	10	5	0	0
	Days Creek -South Umpqua	13	146	16	3	0
	Middle Fork Coquille River	6	17	3	<1	0
	Myrtle Creek	2	65	24	<1	0
	Elk Creek	<1	2	<1	<1	0
	Subtotal	**33**	**247**	**50**	**4**	**0**
Medford BLM	Big Butte Creek	3	<1	1	7	0
	Little Butte Creek	35	63	12	3	0
	Shady Cove RR	10	49	13	3	0
	Trail Creek	28	41	5	0	0
	Subtotal	**76**	**153**	**32**	**13**	**0**
Lakeview BLM	Spencer Creek	**2**	**<1**	**12**	**<1**	**0**
Umpqua National Forest	Days Creek - South Umpqua	0	40	15	0	0
	Elk Creek - South Umpqua	<1	31	<1	0	0
	Trail Creek	15	24	0	0	0
	Upper Cow Creek	7	39	15	9	<1
	Subtotal	**22**	**134**	**30**	**9**	**<1**
Rogue River National Forest	Little Butte Creek	**158**	**119**	**14**	**3**	**0**
Winema National Forest	Spencer Creek	**12**	**52**	**25**	**3**	**0**
	Total	**328**	**814**	**183**	**54**	**<1**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as “<1”).

Areas rated as Level 3 – moderate (about 183 acres or 13 percent of the Project) had either high risk or high sensitivity but not both, or were ranked as moderate for both criteria. Areas that ranked as Level 4 – high (about 54 acres or 4 percent of the Project) had both high sensitivity and high risk and would be considered high priority areas for aggressive soil remediation. Less than one acre was ranked Level 5 – very high and considered to have a very high priority for aggressive restoration measures.

Areas ranked a Level 3 – moderate to 5 – very high (237 acres total) would be recommended for more site-specific validation of the risk criteria used in this assessment to confirm that specific locations merit consideration of the more aggressive soil remediation measures listed below:

- a 2- to 3-inch organic mulch surface application (80 percent coverage) of woodchips, logging slash, and/or straw;
- adaptive seed mixes and vegetation to better fit site conditions;
- deep subsoil decompaction with hydraulic excavators that leave constructed corridor mounded and rough with maximum water infiltration so that water cannot flow downhill for any appreciable distance;
- more aggressive use of constructed surface water runoff dispersion structures such as closely placed and more pronounced slope dips and water bars, etc.;
- more aggressive use of constructed surface runoff entrapments such as silt fencing, sediment settling basins, or straw bale structures, etc.;
- more aggressive placement (100 percent coverage) and depth (3 to 4 inches) of ground cover using woodchips, logging slash, straw bales, wattles, etc.; and
- priority monitoring of results as needed to measure success or make future recommendations.

4.2.4 Conclusion

Constructing the Project would result in both short-term and long-term permanent impacts on soils, including soils characterized for reclamation sensitivity. However, based on the applicants' proposed construction and operations procedures, methods, and plans to address known and unanticipated soil contamination, and the implementation of impact minimization and mitigation measures, we conclude that constructing and operating the Project would not significantly affect soils.

4.3 WATER RESOURCES AND WETLANDS

4.3.1 Groundwater

4.3.1.1 Jordan Cove LNG Project

The Jordan Cove LNG Project area is underlain by the unconfined Dune-Sand Aquifer. This aquifer is located within unconsolidated deposits of sand and gravel, which may also contain variable quantities of silt and clay (USGS 2009b). The Dune-Sand Aquifer is generally 100 feet thick (USGS 1992). The aquifer extends to a depth of -160 feet below sea level. Groundwater has been found within about 8 to 10 feet depth at the terminal and fluctuates with the tides and seasonal precipitation. Because the terminal site is bordered on three sides by saltwater bodies, saltwater intrudes into the aquifer and influences groundwater quality (GSI 2017). Iron concentration is also an existing groundwater concern in the area.

High concentrations of iron in shallow groundwater arise from leaching that occurs as rainfall percolates through vegetative litter (such as leaves and pine needles) and into the underlying dunal sands (GSI 2017). Once the percolating water reaches the water table, the iron remains dissolved in the shallow groundwater and can migrate deeper into the aquifer at and near the CBNBWB production wells, which are all screened at depths of 50 feet and greater. Historically, the CBNBWB has observed higher iron concentrations in water from some of its production wells at the northern end of the west wellfield. As part of its wellfield management plan, pumping from these wells was terminated indefinitely to reduce the downward migration of high-iron groundwater from the shallow portion of the aquifer in that area. CBNBWB would not use those wells to meet the Jordan Cove LNG Project's water supply needs.

Information maintained by the OWRD indicates that there are four groundwater wells permitted for industrial use and fire protection by the Roseburg Forest Products located within or near the disturbance area. Additionally, the CBNBWB maintains 18 non-potable, groundwater withdrawal wells north of the terminal site. The closest CBNBWB well is about 3,500 feet north of the terminal site.

A review of EPA's sole source aquifer (SSA) mapping revealed that the closest SSA is approximately 40 miles north-northeast of the Jordan Cove LNG Project.[66] Additionally, a review of ODEQ data showed that the site would not overlie any Groundwater Management Areas where groundwater contamination from non-point source activities warrants state intervention.

Impacts and Mitigation

Jordan Cove would obtain water from the CBNBWB to construct and operate the Jordan Cove LNG Project. As shown in table 4.3.1.1-1, Jordan Cove estimates that it would need a total of about 667 million gallons of water for construction and operation of the Jordan Cove LNG Project.

[66] EPA defines an SSA area as one that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. EPA guidelines also stipulate that these areas can have no alternative drinking water source(s) that could physically, legally, and economically supply all those who depend upon the aquifer from drinking water (EPA 2013).

TABLE 4.3.1.1-1

Projected Water Usage for the Proposed Jordan Cove LNG Project

Construction			
Activity	**Total (million gallons)**	**Peak Use (thousand gallons per month)**	**Potable (Y/N)**
General Construction Activities	11.3	382.0	N
Grading Activities	488.4	21,861.0	N
LNG Tank Hydro	60.0	30,000.0	N
Drinking Water	1.7	57.0	Y
Concrete Batch Plant	7.2	275.0	Y
Workforce Housing	26.9	1,102.0	Y
TOTAL	**595.5**		
Operation			
Source of Operation- Phase Water Demand	**Annual Water Demand (million gallons)**	**Average Instantaneous Flowrate (gallons per minute)**	**Potable (Y/N)**
Process Water Makeup	36.3	69	Y
Quench Water	15.8	30	Y
Plant Water	15.8	30	Y
Buildings	3.7	7	Y
TOTAL	**71.5**		

Constructing and operating the Jordan Cove LNG Project could affect groundwater, because of the shallow depth to groundwater and the permeability of the overlying sands and gravels across the site. Site stabilization, excavation, pile driving, and the installation of permanent aboveground facilities could all affect groundwater. In addition to the permanent modification of site topography which could affect underlying groundwater characteristics (quantity, flow, and quality); an inadvertent release of equipment-related fluids, such as lubricating oil, gasoline, and diesel fuel, could affect groundwater. Installing piles to support the Jordan Cove LNG Project could create vertical conduits further affecting underlying groundwater characteristics. Additionally, these conduits could also transmit contaminants.

Three of four Roseburg Forest Products wells would be buried to create a construction staging area and would be permanently abandoned in accordance with state regulations. Jordan Cove would drill new wells to the east to replace the buried wells. The fourth well would remain in place. We conclude that neither construction nor operation of the Project would impact the CBNBWB wells to the north due to the distance of the wells from the Project (the closest CBNBWB well is about 3,500 feet north of the terminal).

The excavation and grading required to create the marine slip could cause local groundwater elevations to shift as a result of the change in topography; however, this change would be minor and localized. Creating the marine slip would also shift the seawater interface inland, but it would not affect the water supply wells.

Based on the depth to groundwater, dewatering would be required during construction of the marine slip. The anticipated method for dewatering is the use of well-points, which consist of a closely spaced series of small-diameter shallow wells connected to a dewatering pump via a common headermain (i.e., a pipe that context to the dewatering pump). The contractor would determine the most appropriate method for dewatering excavations and obtain appropriate permits prior to construction. All water associated with dewatering would be allowed to infiltrate elsewhere onsite and return to the groundwater table. Water associated with construction dewatering would not be directly discharged to waterbodies until either filtered or directed to a settling pond before discharge in accordance with Jordan Cove's ESCP and their *Plan* and *Procedures*. A monitoring program would be conducted prior to, during, and after construction to monitor potential impacts on ground and surface waters. Dewatering would have temporary, localized effects on groundwater movement, but flow patterns would return to normal soon after construction.

An inadvertent equipment-related fluid spill could adversely affect groundwater quality. The significance of the effect would vary depending on fluid, quantity spilled, and location of the spill. To prevent and reduce the potential of a spill and the resulting impact on groundwater, Jordan Cove would implement measures as described in its SPCC Plan.[67] These measures include refueling procedures; spill response procedures, spill response materials, and training; countermeasures/contingency plan; and hazardous liquids storage, and disposal. Spill-related impacts during operation of the Jordan Cove LNG Project would mainly be associated with fuel storage, facilities use, equipment refueling, and equipment maintenance, which would be prevented or minimized with the implementation of Jordan Cove's SPCC Plan.

The terminal site would have a system of curbs, drains, and basins to collect and contain any spills of LNG during operation. In the unlikely event that LNG is spilled, the cryogenic liquid would vaporize rapidly upon contact with the warm air and water. Because LNG is not soluble in water and would completely vaporize shortly after being spilled, the LNG could not mix with or contaminate groundwater.

During operation, the LNG terminal would cover about 100 acres with impervious surface materials, such as asphalt, concrete, and compacted gravel. The conversion of pervious surface to impervious surface can typically cause a decrease in the local recharge of shallow groundwater (by converting infiltration to runoff); however, Jordan Cove would capture most runoff for infiltration into the ground on-site with only high flows expected to run off directly to the bay. Additionally, in comparison to the total 12,480-acre area of the Dune-Sand Aquifer, this 0.8 percent area reduction would not likely result in an adverse effect on the level of groundwater in the area. Through use of the measures discussed above, we conclude that impacts on groundwater resources at the Jordan Cove LNG Project would be minimized to the extent practicable and would not be significant.

Five domestic supply wells in the vicinity of the Kentuck project were evaluated for their vulnerability to saltwater intrusion caused by inundation of the former golf course area as part of the Project wetland mitigation. Of the five wells, two were determined to be moderately to highly vulnerable to Project impacts, and a third was found to have low to moderate vulnerability. Jordan Cove has initiated discussions with the landowners regarding mitigation strategies to offset potential effects on these wells, including well replacement, and other means of settlement.

[67] The preliminary SPCC Plan was included in Jordan Cove's September 2017 application to the FERC as Appendix F.2 to Resource Report 2. The preliminary Spill Plan provides general content but would be updated prior to the start of construction to final detail.

4.3.1.2 Pacific Connector Pipeline Project

The Pacific Connector pipeline (and associated facilities) would be located above four general aquifer types: unconsolidated-deposit; pre-Miocene rock; volcanic and sedimentary rock; and Pliocene and younger basaltic rock.

Unconsolidated-deposit Aquifers – The pipeline would overlie unconsolidated-deposit aquifers for approximately 7.6 miles in and around Coos Bay (between MPs 3.0 and 23.4), 3.1 miles in Douglas County between MPs 55.3 and 69.7, and 23.0 miles in the Klamath Basin between MPs 191.9 and 214.9. These aquifers consist primarily of sand and gravel and are the most productive and widespread aquifers in Oregon. These unconsolidated-deposit aquifers typically provide freshwater for most public-supply, domestic, commercial, and industrial purposes (USGS 1994).

Pre-Miocene Rock Aquifers – The majority of the pipeline route between MPs 23.5 and 155.8 would overlie aquifers in pre-Miocene rocks. These aquifers consist of undifferentiated volcanic rocks, undifferentiated consolidated sedimentary rocks, and undifferentiated igneous and metamorphic rocks principally in the mountainous areas crossed by the pipeline. Within and west of the Cascade Range, the consolidated sedimentary rocks are of marine origin and commonly yield salt water. At depth, the salt water can contaminate overlying freshwater aquifers. Permeability of the aquifers varies greatly. Water from wells completed in these aquifers is used mostly for domestic and agricultural (livestock watering) supplies (USGS 1994).

Volcanic and Sedimentary Rock Aquifers – Northeast of Medford, the pipeline route enters a groundwater area of volcanic and sedimentary rock aquifers for about 8.2 miles between MPs 134.2 and 156.9. These aquifers consist of a variety of volcanic and sedimentary rocks that generally yield fresh water but locally can yield salt water. About 30 percent of the fresh groundwater withdrawals are used for public supply, about 20 percent are used for domestic and commercial, and about 50 percent are used for agricultural (primarily irrigation) purposes (USGS 1994).

Pliocene and Younger Basaltic-rock Aquifers – In the Klamath Basin, between MPs 191.9 and 228.8, the pipeline route passes through an area of Pliocene and younger basaltic-rock aquifers for about 51 miles while also passing in and out of unconsolidated deposit aquifers. Pliocene and younger basaltic-rock aquifers yield fresh water that is used mostly for agricultural (primarily irrigation) purposes (USGS 1994).

Depth to groundwater varies throughout the Project area. Approximately 26 miles (or 13 percent) of the pipeline route would cross areas of shallow groundwater where the water table ranges from zero to 6 feet bgs. Approximately 16 of those 26 pipeline miles would be in areas that have seasonally high groundwater (fall through spring) and the remaining 10 pipeline miles, primarily in the Klamath Basin, would be located in areas with shallow groundwater year-round.

Groundwater-fed springs and seeps were identified along the pipeline route during wetland surveys and by review of aerial photos. Additional springs and seeps may be identified by landowners during easement negotiations and through contact with adjacent property owners. The owners would be asked to identify springs and seeps and their uses. For springs and seeps located within

200 feet of the construction disturbance, Pacific Connector would implement its *Groundwater Supply Monitoring and Mitigation Plan*.[68]

No EPA-designated SSAs would be crossed by the Pacific Connector pipeline. The nearest EPA-designated SSA is located approximately 40 miles to the north.

The 1996 federal Safe Drinking Water Act (SDWA) requires Source Water Assessments for all public water systems that have at least 15 hookups, or serve more than 25 people year-round. About 80 percent of Oregonians get their drinking water from public water systems. The Oregon Health Authority and the ODEQ Drinking Water Protection Program jointly manage the SDWA assessment requirements. ODEQ maintains the Drinking Water Protection database[69], which includes public drinking water source areas for groundwater and surface water, as well as the locations of public water system intakes and public groundwater wells. ODEQ has identified and established wellhead protection areas (WHPAs) to protect public drinking water sources. The SDWA defines a WHPA within the recharge area of a well as the surface and subsurface area surrounding a water well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such a water well or well field. The pipeline would cross six WHPAs as shown in table 4.3.1.2-1 (ODEQ 2017e). One pipe yard is located within the Klamath Auction Cafeteria WHPA, and one rock source and disposal site (Rum Rye/MP 160.41) is located within the Medford Water Commission WHPA.

TABLE 4.3.1.2-1

Wellhead Protection Areas Crossed by the Pacific Connector Pipeline Project

Starting Milepost	Ending Milepost	County	Public Groundwater Source Area	Public Drinking Water System ID
6.38R	6.74R	Coos	Kentuck Golf Course	4190858
195.09	196.29	Klamath	Production Metal Forming, Inc	4195058
197.43	197.77	Klamath	Green Diamond Resources Services LLC	4193994
198.45	199.62	Klamath	Collins Products LLC	4193995
199.26	199.66	Klamath	Columbia Plywood Corp	4194403
200.54	201.12	Klamath	Crossroads Mobile Home Park	4100446

There are also numerous private wells located along the pipeline route that are exempt from water rights permitting and the locations are not known. To identify these unmapped wells, Pacific Connector would ask the property owners to identify their wells and the water use. For wells located within 200 feet of the construction disturbance, Pacific Connector would implement its *Groundwater Supply Monitoring and Mitigation Plan*. Table 4.3.1.2-2 lists the seven private wells within 200 feet of the construction work area for which location information was available (OWRD 2017).

[68] Included in Pacific Connector's application to the FERC as Appendix F.2 of Resource Report 2.
[69] According to the ODEQ water quality mapping and GIS data page, for security reasons, the agency restricts access to the GIS layers with latitude/longitude readings of wells, springs and intakes (ODEQ 2017e).

TABLE 4.3.1.2-2

Private Wells Within 200 Feet of Construction Work Space for the Pacific Connector Pipeline Project

Milepost	Permit Number	Use	Distance to Construction Area (feet)
190.8	10354	Irrigation	85
201.1	15997	Supplemental Irrigation	116 a/
202.5	15120	Irrigation	175
203.8	15818	Irrigation	31
205.7	15134	Irrigation	118
217.3	3957	Irrigation	62
NA	15245	Industrial	55 b/

a/ Well located 50 feet of a temporary extra work space
b/ Well located 55 feet from Millington 1 Yard

Impacts and Mitigation

Construction activities such as; grading, trenching, dewatering, and backfilling could cause minor fluctuations in shallow groundwater levels, increase turbidity within shallow groundwater and alter the flow path of springs and seeps.

As described previously, approximately 26 miles of the pipeline route would cross areas where groundwater can be found at or very near the surface. In areas with a high groundwater table where standard dewatering may be insufficient, Pacific Connector may use "push-pull" or "float" techniques to install the pipeline. While the installation of trench breakers and trench dewatering by pumps to an upland area may be feasible for small areas of seasonally high groundwater, we note that some of these shallow groundwater areas could extend over 1.6 miles (see table H-4 in appendix H). For longer stretches of the pipeline route, trench dewatering through a well point pumping system with a groundwater treatment plan (such as controlled discharging to a straw bale structure or filter bag) may be required. Dewatering may locally lower the groundwater table and alter flow paths; however, these impacts would be temporary, and the dewatering typically occurs over a few days. If there are wells, seeps, or springs near the dewatering activities, they would be monitored for effects.

Near-surface soil compaction caused by heavy construction vehicles could reduce a soil's ability to absorb water, which would affect infiltration/groundwater recharge rates and could affect underlying groundwater flow and quality. To minimize these impacts excavated topsoil and subsoils would be segregated within wetlands, agricultural areas, and at the request of landowners, and returned as closely as practical to their original soil horizon and slope position. Following construction, restoration of compacted soils would include regrading, recontouring, scarifying (or ripping), and final cleanup activities. Decompacting soils would restore water infiltration, reduce surface water runoff, minimize erosion, and support revegetation efforts.

There are 116 sites with cleaned-up, potential, or confirmed soil and/or groundwater contamination within 0.25 mile of the pipeline route where there is the potential to encounter contaminated soil or groundwater during construction. The potential to encounter previously contaminated soils and groundwater is evaluated and discussed in the Contaminated Soils and Groundwater section under section 4.2.2.3.

A spill or inadvertent release of equipment-related fluids could adversely affect underlying groundwater quality and use. To minimize the potential for a spill or inadvertent release, Pacific Connector would implement numerous measures as described in its SPCC Plan.[70] These measures include, but are not limited to:

- regular inspection of containers and tanks;
- use of secondary containment of fuel storage tanks and hazardous materials containers 55-gallons or greater;
- implementation of emergency response procedures, including spill reporting procedures; and
- use of standard procedures for excavation and off-site disposal of any soils contaminated by spillage.

Prior to construction, Pacific Connector would include in the SPCC Plan the types and quantities of hazardous materials that would be stored or used during construction. Project personnel would be trained and prepared to demonstrate their ability to implement the SPCC Plan to federal, state, or local inspectors.

In addition to the SPCC Plan, Pacific Connector would implement the measures described in its *Contaminated Substances Discovery Plan*[71] to address an unanticipated discovery of contaminants during construction. As described previously, this plan outlines practices to protect human health and worker safety and measures that would be taken to prevent further contamination.

As described in section 4.1, Pacific Connector has identified numerous locations where blasting may be required for pipeline installation. Blasting could temporarily increase turbidity in groundwater. Pacific Connector has developed a *Blasting Plan*[72] to minimize potential adverse impacts on the environment, nearby water sources, structures, or utilities. As stated in the *Blasting Plan*, licensed blasting contractors would conduct the blasting activities in accordance with all applicable federal, state, and local regulations. Pacific Connector would obtain all necessary permits if blasting is required.

Constructing the Project could affect springs, seeps, and wells. Depending on the location of a well, spring or seep relative to the pipeline, the flow of the feature could be temporarily or permanently affected. These resources could be redirected and experience changes in quantity and quality. To minimize potential impacts, prior to construction, Pacific Connector would implement the measures described in its *Groundwater Supply Monitoring and Mitigation Plan.* Landowners would be supplied with documentation that explains the proposed pipeline construction methods, and outlines the pre-construction field investigation for the identification and monitoring of groundwater supplies. Pre-construction surveys would be conducted to confirm the presence and locations of all groundwater supplies for landowners within and adjacent to construction workspace. Pacific Connector would conduct post-construction sampling if requested by the landowner or in disputed situations to determine the effects of construction, if any, on the

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[70] The SPCC Plan was included in Pacific Connector's September 2017 application to the FERC as Appendix B.2 to Resource Report 2.
[71] Included in Pacific Connector's September 2017 application to the FERC as Appendix E of the POD.
[72] The *Blasting Plan* was included in Pacific Connector's September 2017 application to the FERC as Appendix C of the POD.

groundwater supply. The landowner would be provided with a point of contact with Pacific Connector to report potential problems with wells, springs, and seeps believed to be the result of construction. If a groundwater supply is affected by the Project, Pacific Connector would work with the landowner to provide a temporary supply of water; if determined necessary, Pacific Connector would provide a permanent water supply to replace affected groundwater supplies. Mitigation measures would be coordinated with the individual landowner to meet the landowner's specific needs and be specific to each property.

Operation of the aboveground pipeline facilities would include connections to fixed belowground pipes. Pacific Connector would conduct monitoring in accordance with the DOT requirements during operations to minimize the potential of corrosion and leaks that could affect groundwater. Additionally, Pacific Connector would implement BMPs as detailed in the ECRP and SPCC Plan to avoid, minimize, and mitigate the spill of any hazardous substances that could affect shallow groundwater and/or unconsolidated aquifers.

4.3.1.3 Conclusion

The construction of the Project would temporarily affect groundwater. However, based on the characteristics of underlying groundwater, the applicant's proposed construction and operations procedures and methods, and their implementation of impact minimization and mitigation measures, we conclude that constructing and operating the Project would not significantly affect groundwater resources.

4.3.2 Surface Water

The surface waters in the Project area include marine waters along the shipping route within 3 nautical miles of the coast, Coos Bay, and adjoining surface waters, and streams crossed by or near Project facilities extending from Coos Bay about 229 miles to the connecting point of the proposed pipeline in Klamath County in eastern Oregon. State and federal laws and regulations that will affect Project actions related to surface waters are discussed in chapter 1. Waters having special status relative to some of these laws and regulations are discussed below. The discussion is separated into two sections, the first dealing with effects on waters from actions relating to the development and operation of the Jordan Cove LNG Project and the second addressing actions related to the development and operation of the Pacific Connector pipeline.

4.3.2.1 Jordan Cove LNG Project

The Jordan Cove LNG Project would be located in Coos Bay, Oregon. Coos Bay is a major coastal estuary with a surface area of about 12,380 acres at mean high water. Coos Bay is fed by about 30 tributaries, including the Coos River, Millicoma River, Catching Slough, Isthmus Slough, Pony Slough, South Slough, North Slough, Kentuck Slough, and Haynes Inlet. The estimated average annual discharge at the mouth of Coos Bay is 2.2 million acre-feet of fresh water (Roye 1979). The Coos Bay watershed covers an area of approximately 739 square miles of Oregon's southern coastal range and is included in the larger South Coast Watershed Basin (ODEQ 2012b).

The existing Federal Navigational Channel is used by recreational, fishing, and major transport vessels to access multiple locations within Coos Bay from the open ocean and coastal marine waters. Four areas adjacent to the Federal Navigation Channel would be modified (see chapter 2 of this EIS) and used by LNG carriers transiting to the Jordan Cove LNG Project. Between the existing navigation channel and the terminal marine slip, Jordan Cove would create a new access channel. The Oregon Institute of Marine Biology (OIMB) sampled physical oceanographic data in Coos Bay, near the proposed location of the terminal access channel, from August 2009 through December 2010 (Shanks et al. 2010, 2011). The OIMB data set included salinity, temperature, and Chlorophyll a. The OIMB data show there is little variation exhibited in salinity during the tidal cycle, but slightly lower salinity levels occur during low tides and slightly higher salinity levels during high tides. In contrast, temperatures are markedly higher during low tides than high tides. In effect, the results of the OIMB sampling program indicate that there is a great amount of seasonal, but only moderate daily, variability in the physical oceanographic data of the waters of Coos Bay near the Jordan Cove LNG Project.

Impact and Mitigation

The potential impacts and mitigation associated with the construction of the Jordan Cove LNG Project and LNG carrier traffic are related primarily to Project-related dredging, stormwater management, carrier travel, and carrier water use. The effects are related to increases in turbidity, suspended and deposited sediment, bottom and shoreline erosion, toxic substance releases, and water temperature changes.

Jordan Cove would not use surface water sources during construction[73] or operation of the terminal, and all waters discharged from the site would be treated prior to release, including decant water[74] returning from on-land dredge deposits. Permits would be obtained for all wastewater discharges as required by ODEQ. A more detailed presentation of water supply needs for both construction and operation is provided in section 4.3.1.1 and table 4.3.1.1-1.

There are no process water discharges anticipated from the liquefaction process. There would be some wastewater discharges from the oil-water separators that would be directed to the industrial wastewater pipeline. There are no anticipated changes to water quality in Coos Bay from the release of wastewater from the Jordan Cove LNG Project.

The ODEQ's Integrated Report includes Coos Bay on the Section 303(d) list of waterbodies not meeting the criteria for shellfish growing since 2004, due to elevated fecal coliform measurements. Coos Bay is listed as Category 5, water quality limited, and a Total Maximum Daily Load (TMDL) is needed (ODEQ 2012c). Wastewater generated during construction and operation of the Jordan Cove LNG Project would be treated by the City of North Bend's wastewater treatment system via a new sewer line, and therefore the Project is not likely to add fecal coliform to Coos Bay.

<u>Turbidity and Sedimentation</u>

Dredging and construction activities at the Jordan Cove LNG Project would result in temporary increases in turbidity and sedimentation in Coos Bay. Details on marine facility construction, including dredging activities, are provided in chapter 2 of this EIS. Dredging activity, primarily associated with slip, access channel, temporary material barge berth, MOF, and marine waterway modifications would be the major sources of turbidity and suspended sediment in Coos Bay. The

[73] Water from Coos Bay would be included with estuarine dredged bottom sediment transported to land storage areas; no reduction in Coos Bay water volume would occur from this water use.
[74] Water that is included with dredge bottom material from the bay that goes to on-land deposition areas will be held until sediment settles before it is returned to the access slip or adjacent bay areas. ESCP procedures will be implemented to meet turbidity discharge standards.

construction of the marine slip would have most of the slip dredging separated from the bay by an earthen berm and would not affect bay turbidity. Other sources of turbidity would include a dike rock pile apron, Trans-Pacific Parkway/U.S. 101 intersection widening, and various construction-related tailing lines placements.

All work in the bay would be done during the ODFW recommended in-water window between October 1 to February 15. Within the access channel, dredging would be conducted using a hydraulic (e.g., suction) dredge with a cutterhead or mechanical (e.g., clamshell) dredge. The applicant has indicated that the hydraulic cutter suction dredge is their preferred dredging method (due to the lower turbidity that would be generation) and would be used as the primary method; however, the mechanical dredge would need to be used in certain locations due to the presence of buried woody debris or other materials in the substrates that could not be removed using hydraulic methods (e.g., the mechanical dredging methods would be used in parts of the access channel near the shoreline and along the proposed modifications to the marine waterway).

Jordan Cove commissioned modeling efforts to estimate the range of turbidity and suspended sediment that would result from Project-related dredging (Moffatt and Nichol 2006a, 2017c). The models were developed based on a sediment analysis conducted at the site of the dredging and took into consideration wind, tidal currents, and seasonal flows. Moffatt & Nichol (2006a) indicated that constructing the access channel via mechanical dredging would result in a maximum concentration of turbidity of 600 to 6,000 mg/l depending on tidal velocity, decreasing substantially farther away from the site. The latest model (i.e., Moffat & Nichol 2017c) addresses suspended sediment concentrations from the proposed dredging operations. Constructing the slip and access channel would result in suspended sediment that would exceed about 20 mg/l over background levels within about 0.2 to 0.3 mile of the dredging site and exceed about 500 mg/l within about 0.1 mile with either dredging method (clamshell or cutter suction dredge) (Moffat & Nichol 2017c). Moffat & Nichol (2006a) noted maximum concentrations outside of the specific dredge location would only occur for about 2 hours or less over the daily tidal cycle with the plume moving upstream or downstream of the dredge site on flood or ebb tide, respectively. Moffatt & Nichol (2006a) indicated that due to this limited period of elevated suspended sediment in any site-specific area of the plume, other than the actual dredge area, average daily turbidity levels would remain near background values for the mechanical dredge at the slip during active dredging.

Turbidity models for both construction and maintenance of the four Marine Waterway Modifications areas were developed using the three possible dredging methods. Generally, suspended sediment levels would be similar to those modeled for the access channel, but distribution of sediment plumes would be more extensive. The cutter suction dredge would generally have lower concentrations of sediment than other options, but the overall maximum distribution of areas over background suspended sediment (about 20 mg/l) would be similar, averaging about 1.2 miles[75] from the specific active dredging site of the four channel expansion areas with any dredging methods. Turbidity levels and distribution would be similar for both construction or maintenance dredging. Overall levels of peak concentration dependent on method used, with cutter suction the lowest and hopper dredge the highest. Areas of high concentrations, over about 500 mg/l, would generally extend about 0.1 mile from dredge site for cutter suction and clamshell dredges and 1.0 mile for hopper dredge. Based on the Moffat & Nichol (2006a) model

[75] Plume distance noted includes total spread both upstream and downstream of dredge site.

of the access channel dredging, it would be expected that these peak levels would be short lived at any specific location. Given that, as noted above, tides would move the location of the sediment plume, higher concentrations in any location, other than near actual dredge location, would only last about 2 hours.

The model of the Eelgrass Mitigation site (Moffat & Nichol 2017c) assumed an excavator would be used, which would result in a confined area of elevated suspended sediment extending less than 0.1 mile from point of dredging. The more limited effect of tidal flow over the area would help confine the distribution of the elevated sediment plume. These elevated levels would be short term and highly localized to the nearshore area.

As noted above, sedimentation and turbidity would be higher during clamshell dredging than during hydraulic dredging operation. Clamshell dredging is also proposed for maintenance dredging of the slip and access channel, and potential effects are discussed below. Construction and maintenance dredging at the four marine waterway modification areas would be done via hydraulic dredging (cutter suction or hopper) or clamshell dredging, or a combination of these. Hydraulic placement of materials at the upland sites (e.g., APCO Sites 1 and 2, and Kentuck project site) is the preferred method for dredging including material transport with temporary subtidal dredge material transport pipelines (see *Dredged Material Management Plan).*[76]

As discussed above, the modeling conducted by Moffatt and Nichol (2017d) was done to determine the potential effects of all proposed actions including slip and access channel excavation, marine waterway modifications, and Eelgrass Mitigation site dredging on flow hydraulics in the bay. Construction in these areas would produce no or negligible impacts on overall tidal flow, tidal range, current velocity, and circulation in Coos Bay. Additionally, the result of the tidal flow circulation modeling and analysis predicts that there would be localized velocity reduction as well as localized small increases in velocity in portions of the bay. These would include slight velocity increases near the pile dikes at the eastern corner of the access channel. The deepening of the channel near the mouth of the bay (NRI 1 channel deepening area) at the entrance turn also appears to have resulted in locally increased currents to the north in Log-Spiral Bay. However, the model did not include effects of ocean waves that influence current velocity in this outer region of Coos Bay. Overall the effects of Project actions on the Coos Bay tidal prism were unsubstantial, and effects on tidal current velocity changes were also negligible except for a few localized areas.

Using available information on Coos Bay characteristics and the output from the hydrodynamic model, the MIKE-21 sediment transport simulation model was used to determine Project channel modification effects on the rate of sedimentation in the bay (Moffat and Nichols 2017e). The model found that overall sedimentation shoaling rates in the navigation channel within the bay would not change, although there were some local changes associated with project-related actions including a slight increase in deposition by the constructed MOF and some erosion sedimentation on the western side of the slip. While some changes in sedimentation were predicted near the two northernmost pile dikes, the projected changes in this area and rest of the bay from the Project actions were within the natural range of sedimentation rate variability.

[76] Included as Appendix N.7 of Resource Report 7 as part of Jordan Cove's September 2017 application to the FERC.

Based on the turbidity modeling conducted for both construction and maintenance dredging, the effects of maintenance dredging and disposal are predicted to be localized and relatively short term. Effects of maintenance dredging on suspended sediment concentrations and distribution in the slip, access channel, and Federal Navigation Channel would be similar to those discussed for the respective type of dredging methods used (Moffat & Nichol 2017c). However, the duration would be shorter for maintenance as less material would be removed than during construction.

Propeller wash from LNG carriers and tug boats associated with the Project, as well as ship wakes (waves) breaking on shore, could increase erosion along the shoreline and resuspend loose sediment along the shallow shoreline area, resulting in temporary increases of turbidity and sedimentation in the bay, both of which would affect water quality. The effects of these actions relating to sediment, bottom disturbance, and wave actions on marine aquatic resources are discussed in section 4.5 of this EIS.

Jordan Cove developed two models to assess propeller wash effect along the channel (Moffat & Nichol 2008; CHE 2011). The Moffat & Nichol (2008) model indicated propeller wash–induced bottom velocity along most of the main channel would be similar to the maximum velocity of peak tides (about 4 fps) whereas the CHE (2011) model indicated higher bottom velocities (13 fps) but in a very narrow range (about 80 feet wide). Both models, however, indicated that along most of the route, because the bottom of the channel consists of coarse materials (sand and sandstone), bottom material suspension would be limited and would settle rapidly, and elevated turbidity would be unlikely to occur. Moffat & Nichol (2008) estimated that near the docking location (about 0.5 mile), estimated bottom velocity would increase to about 7 to 8 fps. Some increased bottom scour and locally elevated turbidity may occur in this area, but the effects would be limited in dimension. This disturbance would occur below the intertidal area. CHE (2011) also modeled likely bottom disturbance from existing large vessel transit (assumed 106 round trips [212 channel passages] annually) in the bay and found that bottom velocity from these would be slightly greater than that of the LNG carriers (projected 120 round trips [240 channel passages] annually) so LNG effects on disturbance would be less than existing vessel traffic.

An additional model by Moffat and Nichol (2017g) estimated potential for scour and elevated turbidity while carriers are berthing and unberthing at the access channel and slip. The model assumed the LNG carrier engines and propeller would be used in addition to that of tugs for this action. While berthing had low potential for scour, unberthing, with the use of LNG carrier propeller engagement, could cause high potential for scour in the access channel and slip area. They estimate that maximum bottom velocity could be about 13.6 fps during unberthing, but less than 5.4 fps during berthing in the slip and access channel. They estimated that scour depth, with a substrate consisting of mostly medium size sand, could be up to 0.46 foot in the eastern portion of the access channel. Overall, about 12 acres of bottom could be scoured to a depth over 0.2 foot in general on a periodic basis. The bank areas of the slip would be armored, which would prevent scour there. Likely plumes of turbidity could occur briefly near the slip and access channel primarily near the bottom during the period of unberthing. The turbidity increase would be local and settle once the propellers stopped.

Jordan Cove modeled the likely effects of LNG carrier traffic on shoreline waves (Moffatt and Nichol 2017f). Wave height effects were evaluated from the access channel and slip to the mouth of the navigation channel. Moffat & Nichol estimated that the existing large bulk carriers would cause shoreline wave heights of about 0.3-0.6 foot under existing conditions. The LNG carrier transit wave height would be less under proposed channel changes, about 0.2 to 0.3 foot. These vessels' induced waves would likely occur for about 106 bulk carrier and 120 LNG carrier round trips a year CHE (2011). Tug vessels traveling at the same speed as LNG carriers would have similar wave height, but when tug vessels depart Coos Bay to bring in large vessels they may travel at about 10 knots, resulting in shoreline wave heights of about 0.5 to 0.8 foot. Day-to-day natural wave heights near the more protected bay area near the slip entrance are about 0.3 to 0.4 foot, while under windy conditions, much of Coos Bay's shoreline would have shoreline waves of 0.8 to 0.9 foot, and under severe storms even the area near the slip entrance would have wave height of about 2 feet (CHE 2011). CHE (2011) estimated that, considering the annual frequency of LNG carriers, shoreline sediment transport potential may increase by 5 to 8 percent and, considering natural range of variable wave energy, would be unmeasurable. This model assessment did not, however, consider higher speed tug transit. The tug vessel trips at these higher speeds would be about equal to LNG carrier entries (about 120 channel trips) but may not all be made at speeds as high as 10 knots. Each vessel passage would generate some form of wave for about 15 minutes (CHE 2011), with the peak wave period much less in duration. This compares to a natural wave frequency that would last much longer (e.g., hours or days). The induced waves from these additional vessels, with the possible exception of outgoing tugs, would have an unsubstantial effect on shoreline erosion as they are well within the naturally occurring, wind-generated wave heights (CHE 2011). The NMFS has concerns that higher vessel speeds may adversely increase shoreline erosion and fish stranding, potentially adversely affecting marine habitat. The NMFS recommended that vessel speeds not exceeding 8 knots within Coos Bay would be more protective. The FERC does not have the regulatory ability to dictate operational speeds of LNG carriers or tugs; however, the independent carrier operators would be required to follow all Coast Guard requirements regarding the operation of LNG carriers, including carrier speeds.

Spills or Leaks of Hazardous Materials

Project-related fluids that enter Coos Bay could affect state water quality standards. During construction of the Jordan Cove LNG Project, stormwater runoff could transport sediment and hazardous materials into Coos Bay. The introduction of sediment into Coos Bay would increase turbidity and sedimentation as discussed above and the introduction of hazardous materials would affect local water quality. To minimize stormwater runoff, construction activities would be conducted in compliance with the State of Oregon's General NPDES permit (1200-C). Additionally, stormwater runoff would be managed in accordance with a site-specific SPCC Plan. Stormwater collected in areas that have no potential for contamination would be allowed to flow or be pumped to ditches that ultimately drain to the slip or Coos Bay. Stormwater collected in areas that are potentially contaminated with oil or grease would be pumped or would flow to the oily water collection sumps. Collected stormwater from these sumps would flow to the oil-water separator packages before discharge to the industrial wastewater pipeline. Jordan Cove would apply for a new NPDES permit for this discharge prior to Project initiation. No untreated stormwater collected in areas that are potentially contaminated with oil or grease would be allowed to enter federal or state surface waters.

An inadvertent release of construction equipment–related fluids (fuel storage, equipment refueling, and equipment maintenance) could adversely affect water quality in Coos Bay. As described previously, Jordan Cove has prepared a site-specific SPCC Plan. The purpose of this SPCC Plan is to minimize the potential for accidental releases of hazardous materials and to establish proper protocols for minimization, containment, remediation, and reporting of any releases that might occur. Jordan

Cove's proposed measures to reduce the risk of hazardous material spills and minimize impacts should a spill occur include, but are not limited to:

- establishing training requirements for all employees handling fuels and other hazardous substances;
- providing storage location requirements for all hazardous substances, including chemicals, oils, and fuels, of a minimum of 150 feet from a waterbody or wetland boundary;
- requiring overnight equipment parking or any refueling operations to be located a minimum of 150 feet from a waterbody or a wetland boundary;
- requiring containment or diversionary devices for any container with a capacity of 55 gallons or larger, and providing discharge prevention measures like dikes, retaining walls, curbing, weirs, booms, diversion ponds, retention ponds, and absorbent materials;
- stipulating all secondary containment systems be capable of containing a volume equivalent to the largest container plus sufficient freeboard for precipitation (i.e., 110 percent); and
- providing for inspections to ensure no visible sheen is present on accumulated stormwater in containment systems, and the condition documented, prior to discharge.

While a hazardous material spill has the potential for significant adverse environmental impacts, adherence to the SPCC Plan would greatly reduce the likelihood of such impacts, as well as minimize the resulting impacts should a spill occur. As such, significant adverse impacts on surface water due to contamination from hazardous material spills or releases are not expected to occur.

Numerous commenters expressed concern about the impacts of an LNG spill into Coos Bay. If LNG spilled or leaked, it would turn to vapor when exposed to the warmer atmosphere, and these vapors would rise as they would be lighter than air. LNG is not soluble, would not mix with water, and would not contaminate surface water. Spills or releases of fuel or other oils into surface waters from LNG carriers are more likely to occur during fueling or bunkering at the dock when the materials are being transferred onto the carrier.

In compliance with guidelines outlined by the International Maritime Organization (IMO) under the Marine Environmental Protection Committee, vessels with 400 gross tonnage and above, like LNG carriers, are also required to develop and implement a Shipboard Oil Pollution Emergency Plan, which includes measures to be taken when an oil pollution incident has occurred or a ship is at risk of one. With the implementation each LNG carrier's shipboard oil pollution emergency plan, impacts resulting from the spill of fuel, or oil, or other hazardous liquids would be minimized.

<u>Temperature, Chemical, and Biological Effects</u>

While berthed, LNG carriers would release ballast water and engine cooling water into the marine slip. No wastewater would be discharged from the LNG carriers into the slip. The LNG carriers may arrange with licensed private entities for refueling, provisioning, and collection of sanitary and other waste waters contained within the carrier. The licensed private entities would transport the waste to a permitted treatment facility. Discharges from vessels are subject to regulation by EPA. EPA currently regulates these discharges via the Vessel General Permit.

Once arriving in Coos Bay, LNG carriers at the terminal slip would discharge ballast concurrently with the LNG cargo loading. The amount of ballast water discharged must, at a minimum, be adequate to maintain the LNG carrier in a condition of positive stability and with an adequate operating draft while the LNG cargo is loaded. Each LNG carrier would discharge approximately 9.2 million gallons of ballast water during the loading cycle to compensate for 50 percent of the mass of LNG cargo loaded.[77]

The LNG loading rate is designed to be 10,000 m^3/hr (with a peak capacity of 12,000 m^3/hr), or 4,600 metric tons per hour (t/hr) (5,520 t/hr peak), consequently the ballast water discharge rate would be approximately 20,250 gallons per minute (gpm). The typical ballast water discharge port is approximately 3.5 to 4.2 square meters covered by a screen with 4.5 mm bars, spaced every 20 to 25 mm.

LNG carriers and marine barges utilized for this Project must meet the requirements of the EPA and Coast Guard regulations. Coast Guard regulations (33 CFR 151, subpart D and 46 CFR 162.060 on "Standards for Living Organisms in Ships' Ballast Water Discharged in U.S. Waters; Final Rule" [77 FR 17254 (Mar. 23, 2012)] and Navigation and Vessel Inspection Circular 01 18) provide guidance to the maritime industry and Coast Guard personnel relative to the implementation of Ballast Water Management (BWM) system requirements. These governing regulations apply to all vessels that enter or operate within U.S. waters and are equipped with a ballast water system that has been approved by the Coast Guard and meets the applicable ballast water discharge standards.

The Coast Guard regulations require the same discharge standards as the IMO regulations, but the Coast Guard regulations also contain some requirements pertaining to a ship's operational procedures that are additional to the IMO's regulations (DNV GL 2018). These include the following:

- ballast tanks must be cleaned regularly to remove sediments;
- when retrieved, anchors and chains must be rinsed;
- fouling must be removed from the hull, piping, and tanks on a regular basis;
- a BWM Plan that includes the above in addition to BWM must be maintained (however, there is no requirement that the BWM Plan be approved);
- records of ballast and fouling management must be maintained; and
- a report form must be submitted 24 hours before calling at a U.S. port.

The EPA has additional requirements for periodic sampling, including calibration of sensors, sampling of biological indicators, and sampling of residual biocides.

The Coast Guard requires that vessels equipped with ballast tanks and bound for ports or places in the United States (except for the Great Lakes), regardless of whether the vessel operated outside the Exclusive Economic Zone (EEZ), submit the ships' BWM information to the Coast Guard no

[77] One cubic meter of LNG is 0.46 metric tons (t), which for the maximum size of LNG carrier authorized to call on the LNG terminal (148,000 m^3) would be 68,080 t of LNG per ship. Assuming 1 t of seawater is 1.027 m^3, the amount of seawater ballast discharged (50 percent of the weight of the LNG loaded) would be approximately 34,959 m^3 (approximately 9.2 million gallons).

later than 6 hours after arrival at the port or place of destination, or prior to departure from that port or place of destination, whichever is earlier.

In 2017, the International Convention for the Control and Management of Ships' Ballast Water and Sediments developed measures that must be implemented to minimize the potential for introduction of non-native species through ballast water. These measures have since been adopted by the IMO and are required to be implemented in all ships engaged in international trade. While the open sea exchange of ballast water has been used in the past and reduces the potential for non-native species introductions, on-board ballast water treatment systems are more effective at removing potential non-native species from ballast water. There are two different standards that ships must meet. All new ships must meet the "D-2" performance standard, which establishes the maximum number of viable organisms allowed to be discharged in ballast water. Conformity with the D-2 standard requires ships to utilize on-board ballast water treatment systems. Existing ships that do not currently have on-board ballast water treatment systems must continue to, at a minimum, conduct open sea exchanges of ballast water ("D-1" standard). Eventually, all ships will be required to conform with the D-2 standard. The timetable for conformity with the D-2 standard for existing ships is based on the date of the ship's International Oil Pollution Prevention Certificate renewal survey, which occurs every five years (IMO 2017). Therefore, most ships calling on the Project, estimated to begin in 2023 at the earliest, would be expected to have conformed to D-2 standards.

Any discharge of a pollutant into the navigable waters of the United States requires authorization under the CWA. Although discharges of ballast waters were historically excluded from the CWA, in 2013 the EPA issued a NPDES permit, the General Permit for Discharges Incidental to the Normal Operation of Vessels (VGP). The VGP, effective December 19, 2013, sets numeric effluent limits for ballast water discharges from certain large commercial vessels under a staggered implementation schedule. The standard is expressed as the maximum concentrations of living organisms in ballast water. The permit also includes maximum discharge limitations for biocides and residues.

Coast Guard regulations (46 CFR 162.060) were enacted in June 2012 in an effort to phase out ballast water exchange practices. The ballast water discharge standard (33 CFR 151.2030(a)) requires vessels calling at all U.S. ports to be equipped with a Coast Guard-approved BWM system. This applies to all new ships constructed on or after December 2013. All vessels over 300 gross tons or that have the capacity to discharge 2,113 gallons of ballast water must submit a notice of intent to the EPA requesting authorization under the 2013 VGP.

Discharging ballast water would not substantially affect water quality in Coos Bay. At the point of discharge, the interface with Coos Bay would experience temporary changes in salinity, temperature, pH, and dissolved oxygen. However, these changes to water quality would be highly localized and would quickly dissipate. While open ocean water has generally higher salinity (e.g., 35 practical salinity units [psu]) than typically occurs in Coos Bay (range 16 to 33 psu; Shanks et al. 2010, 2011) due to the high volume of water passing by the loading area, the contribution of ballast water would be only about 0.3 percent of the water passing by the terminal. Therefore, no measurable changes in salinity, other than directly at the discharge port, would occur.

Water temperatures are also unlikely to be significantly altered from release of ballast water. The temperature of the water in Coos Bay undergoes both seasonal and diurnal fluctuations. In

December and March, the ocean and fresh water entering the estuary had similar temperatures, around 50°F. In summer, low stream flows results in a rise of temperatures in the bay, to above 60°F in September at NCM 8 (Roye 1979). Based on LNG carrier design, a significant difference in temperature between ballast water and ambient waters is not anticipated. LNG carriers are constructed with double hulls, which increases the structural integrity of the hull system and provides protection for the cargo tanks in case of an incident. The space between the inner and outer hulls is used for water ballast. Because ballast water is stored in the ship's outer hull below the waterline, discharged water temperatures would not be expected to deviate significantly from ambient water temperatures; rather, it is anticipated that the ballast water would be equilibrated to the surrounding water temperature before being discharged. Therefore, thermal impacts from LNG carrier ballast water discharge would not be anticipated. The pH of the ballast water (reflective of open ocean conditions) may be slightly higher as compared to that of freshwater estuaries; however, this slight variation is not expected to have any impacts on existing marine organisms.

Dissolved oxygen levels are a critical component for the respiration of aquatic organisms. Among other factors, dissolved oxygen levels in water can be influenced by water temperature, water depth, phytoplankton, wind, and current. Typical water column profiles indicate a decrease in dissolved oxygen with an increase in depth. Some factors that often influence this stratification include sunlight attenuation for photosynthetic organisms that can produce oxygen, wind, wave, and current that results in mixing. Water that is collected within the ballast tanks of a ship would lack many of these important influences and could suppress dissolved oxygen levels. However, ballast water that is discharged is not expected to be anoxic (i.e., lacking all oxygen), just lower than what levels would likely be at the surface. In addition, ballast water would be discharged near the bottom of the slip where dissolved oxygen levels may already be lower. Therefore, no significant impacts are likely to occur as a result of discharging ocean water with potentially suppressed dissolved oxygen levels.

Cooling water flows while at the berth are approximately 11,000 cubic meters per hour (m^3/hr; 2.91 million gallons per hour or 48,000 gpm). For a 148,000 m^3 vessel, this would total approximately 69.7 million gallons while at berth (for 24 hours). Although LNG carriers vary in design, generally the intake port for this engine cooling water is approximately the same size and at the same location as the ballast water intake port and approximately 32 feet below the water line, or 5.6 feet from the keel of the LNG carrier. The size may vary but it is generally 3.5 to 4.2 square meters covered by a screen with 4.5 mm bars, spaced every 25 mm. The engines would be running to provide power for standard hoteling activities as well as running the ballast water pumps.

Using the numerical thermal plume dispersal model from EPA (2003) in combination with the Coos Bay hydrodynamic model (Moffat and Nichol 2017d), Jordan Cove modeled possible slip temperature changes resulting from the discharge of engine cooling water by an LNG carrier. The model assessed the temperature effects of eight different combinations of vessel type, ambient temperature, volume discharged, temperature, and velocity of discharge water were run (Moffat and Nichol 2017h). The modeling results showed that for typical ambient flow conditions the estimated water temperature of the discharged water would be up to about 2 to 3 degrees Celsius (°C; 3.6 to 5.4°F) warmer at the discharge port than ambient water. At about 40 to 80 feet from the discharge port (LNG carrier sea chest), temperatures would not exceed 0.3°C (0.54°F) above the ambient temperature (CHE 2011; Moffat and Nichol 2017h). The model results for the steam turbine power vessels typically were in the upper portion of these distance ranges. This temperature difference would decrease further with distance from the point of discharge. The average water temperature increases for the total slip volume for one day when an LNG carrier using the larger volume (steam turbine vessel) is at dock would range from 0.03 to 0.06°F. Tidal mixing would also decrease maximum slip temperature.

Potential effects of temperature increase from elevated cooling water releases would be further reduced from the cold LNG temperature entering the LNG carrier while at the terminal berth. Because of the extreme differential of the temperature of the cargo in the LNG carrier (-260°F) and that of the surrounding bay water (nominally 50°F), there is a constant uptake of heat by the LNG carrier while loading. This heat uptake is affected by LNG cargo that changes states from liquid to vapor daily. The typical LNG carrier sees 0.25 percent of its liquid cargo converted to the gaseous state each 24 hours, which requires heat uptake from the surrounding environment. It is reasonable to assume that 50 percent or more of the heat uptake by the carrier is extracted from the water during the full 24 hours of stay. Considering the volume of water in the Jordan Cove marine slip (an estimated 384 million gallons), tidal mixing in Coos Bay, and vessel hull cooling from the gas, the release of heated water from LNG carrier engine cooling operations would not substantially increase ambient bay water temperatures. In addition, ballast water discharged from the LNG carrier would also comprise some portion of the water withdrawn for cooling and affected by its discharge. The predicted temperature increases from the release of engine cooling water at the edge of the mixing zone (about 40 to 80 feet from the vessel) is only about 0.5°F above ambient temperature and that increase would be reduced farther away from the LNG carrier. We conclude that the thermal effect of LNG carrier operations at the berth would have very minimal impact on background water temperatures.

4.3.2.2 Pacific Connector Pipeline Project

The pipeline, associated workspace, and equipment bridges would be located across 19 Hydrologic Unit Code (HUC) level-5 watersheds (see table 4.3.2.2-1). An additional 5 watersheds would be crossed by the proposed access roads.

TABLE 4.3.2.2-1

Subbasins and Watersheds Crossed by Proposed Pacific Connector Pipeline

	Level 5 Watershed		
Subbasin	**Watershed Name**	**HUC a/**	**Miles Crossed b/**
Coos	Coos Bay- Frontal Pacific Ocean	1710030403	15.4
	South Fork Coos River c/	1710030401	2.0
Coquille	North Fork Coquille River	1710030504	11.5
	East Fork Coquille River	1710030503	9.7
	Middle Fork Coquille River	1710030501	15.8
South Umpqua	Olalla Creek-Lookingglass Creek	1710030212	8.8
	Clark Branch - South Umpqua River	1710030211	12.8
	Myrtle Creek	1710030210	8.9
	Days Creek - South Umpqua River	1710030205	19.2
	Elk Creek c/	1710030204	3.3
	Upper Cow Creek	1710030206	5.3

TABLE 4.3.2.2-1

Subbasins and Watersheds Crossed by Proposed Pacific Connector Pipeline

	Level 5 Watershed		
Subbasin	**Watershed Name**	**HUC a/**	**Miles Crossed b/**
Upper Rogue	Trail Creek	1710030706	10.7
	Shady Cove - Rogue River	1710030707	8.1
	Big Butte Creek	1710030704	5.1
	Little Butte Creek	1710030708	32.9
Upper Klamath	Spencer Creek	1801020601	15.1
	John C. Boyle Reservoir - Klamath River-	1801020602	5.4
Lost River	Lake Ewauna-Upper Klamath River	1801020412	16.3
	Mills Creek - Lost River	1801020409	23.0
		Total	**229.1**

a/ Hydrologic Unit Code (USGS 1987).
b/ Total miles of watershed area crossed by the pipeline in each HUC, rounded to nearest tenth of a mile.
c/ There are no waterbodies crossed in these watersheds.

The pipeline would be constructed across or near 352 waterbodies. Of the 352 waterbodies, only about 20 percent (69) are identified as perennial streams. Of the remaining affected waterbodies, 270 are intermittent streams (which includes 99 intermittent ditches[78]), 9 are perennial ponds (including stock ponds, an industrial pond, and excavated depressions), and 4 are estuaries. In Coos County, the Project would affect 52 waterbodies, in Douglas County 94 waterbodies, in Jackson County 91 waterbodies, and in Klamath County 117 waterbodies. A table of waterbody crossings, including the proposed crossing method, is included in appendix H (table H-3).

Pacific Connector proposes to use several different methods to install the pipeline across waterbodies depending on site-specific conditions (see chapter 2). Many of the waterbodies crossed by the pipeline are minor intermittent streams or ditches that are expected to be dry or non-flowing at the time of construction. For all waterbodies without flow at the time of construction, Pacific Connector would utilize standard upland, cross-country construction methods identified in Pacific Connector's ECRP. Waterbody crossing methods are characterized as dry open cut, wet open cut, diverted open cut, direct pipe, bore, and HDD. Most streams would be crossed with dry open-cut methods using dam-and-pump or flume methods which generally allow trenching across streams in the dry, minimizing potential turbidity. HDD crossings are primarily used on the largest streams and estuarine crossings in the Project area (see table 4.3.2.2-2). Only one diverted open-cut crossing would be done (South Umpqua River, table 4.3.2.2-2). No planned wet open-cut crossing, where pipeline trenching occurs with flowing water present, is planned. However, a wet open-cut crossing method may be required if all other crossing methods are attempted and fail. If a wet open-cut crossing method is required, then additional permitting and impact analysis may be required.

[78] "Ditches" include irrigation canals and laterals, roadside ditches, and pasture ditches.

TABLE 4.3.2.2-2

FERC Designated Major Waterbodies Crossed by Pacific Connector Pipeline by County and Fifth-Field Watershed a/

County - Fifth-Field Watershed (Fifth-Field HUC)	Major Waterbody	Approximate Milepost	Water Type	Length of Crossing (feet)	Crossing Type
Coos County - Coos Bay Frontal (1710030403)	Coos Bay	0.28-1.00	Estuarine	3,751	HDD
	Coos Bay	1.46-3.02	Estuarine	8,170	HDD
	Coos River	11.13R	Estuarine	516	HDD
Douglas County - Clark Branch-South Umpqua River (1710030211)	South Umpqua River	71.27	Perennial	200	Direct Pipe
Douglas County - Days Cr. South Umpqua River (1710030205)	South Umpqua River	94.73	Perennial	123	Diverted Open Cut
Jackson County - Rogue River-Shady Cove (1710030707)	Rough River	122.65	Perennial	143	HDD
Lake Ewauna-Upper Klamath (1801020412)	Klamath River	199.38	Perennial	973	HDD

a/ FERC designated major waterbodies are those greater than 100 feet wide at the water's edge at the time of construction.

Oregon Water Quality Regulations and Standards

Section 303(c) of the CWA requires states to establish, review, and revise water quality standards for all surface waters. To comply with these standards, the ODEQ has developed a classification system to describe the highest beneficial use(s) and associated minimum water quality standards of identified surface waterbodies within the state. The Oregon Water Quality Standards include beneficial use(s), fish use designations, narrative and numeric criteria to support the beneficial use(s), and anti-degradation policies. The purpose of the Anti-degradation Policy is to guide decisions that affect water quality such that unnecessary further degradation from new or increased point and nonpoint sources of pollution is prevented, and to protect, maintain, and enhance existing surface water quality to ensure the full protection of all existing beneficial uses. The state-designated beneficial use classifications for the basins crossed by the proposed Pacific Connector pipeline are similar among the basins. They include beneficial uses such as domestic and irrigation and livestock water use (excluding Coos Bay waters), industrial water, fishing and boating, wildlife and hunting, fish and aquatic life, and in some basins navigation and transportation (e.g., Coos Bay), as well as varied other uses.

Each state is required, under Section 305(b) of the CWA, to submit a report to the EPA describing the status of surface waters in the state biennially. Waterbodies are assessed to determine if their use is "fully supported," "fully supported but threatened," "partially supported," or "not supported" in accordance with the water quality standards. A use is said to be "impaired" when it is not supported or only partially supported. A list of waters that are impaired is required by Section 303(d) of the CWA, and it is provided in the 305(b) report (ODEQ 2016). To restore a waterbody to its use classification, a state may elect to impose restrictions more stringent than those normally required by the NPDES or other permitting programs, or even deny a permit for activities that could adversely affect an "impaired" waterbody.

States are also required to develop TMDLs for the impaired waterbodies. TMDLs describe the amount of each pollutant a waterbody can receive and not violate water quality standards. To comply with EPA requirements, the State of Oregon produced a combined report entitled Oregon's 2012 Integrated Report on Water Quality (Integrated Report).

The GIS coverage for the 2010 Integrated Report was reviewed to determine the locations of the water quality limited waters for Water Quality Assessment Categories 4 and 5 to determine if they are in the vicinity of Project components. Based on the ODEQ 2012 Integrated Report GIS coverage, 31 Category 4 and 5 water quality impaired waterbodies would be crossed by the pipeline and are listed in table H-5 in appendix H (ODEQ 2012c).

- TMDLs for the South Umpqua subbasin were completed in October 2006.
- TMDLs for the Upper Rogue subbasin were completed in December 2008.
- TMDLs for the Upper Klamath River, and Lost River subbasins were approved in December 2010.
- TMDLs for the Coos and Coquille Subbasins are currently in progress.

Pacific Connector proposes to cross 26 impaired waterbodies using dry/diverted open-cut crossing techniques. Conventional boring, DP, or HDD methods would be used to cross 5 of the impaired waterbodies.

Contaminated Surface Water or Sediments

As discussed in chapter 2 as well as sections 4.2 and 4.4 of this EIS, Pacific Connector has BMPs and plans in place to control runoff of any potential hazardous material found at all Project areas including TEWAs, pipe storage sites, hydrostatic test discharge sites, and right-of-way clearing areas. These procedures are intended to prevent unacceptable quantities of material (sediment, toxic substances, oils, concrete water) from entering surface waters. Additionally, sites along the pipeline project route were assessed for their potential to contain hazardous substances.

As discussed in section 4.2, a review of ODEQ's Environmental Cleanup Site Information (ECSI) database and EPA's EnviroMapper - Facility Detail Report indicated there are numerous locations within 0.25 mile of the route (see table 4.2.2.3-2) primarily considered pipeline storage sites with either cleaned-up, potential, or confirmed soil and/or groundwater contamination. As noted in section 4.2, many of these sites have the potential to encounter contaminated soil or groundwater during construction. This includes about 12 considered pipe storage sites and three near (but not on) the pipeline route. The FERC has made recommendations that Pacific Connector consult with the ODEQ regarding existing soil and groundwater contamination at these sites (see section 4.2 for the complete list of sites).

Pacific Connector's SPCC Plan is intended to prevent contamination from pipeline activities. Pacific Connector has developed a *Contaminated Substances Discovery Plan* that specifies the measures that would be implemented if unanticipated contaminated soil, surface water, or groundwater are encountered during construction. Some of the measures outlined in that plan include that all construction work in the immediate vicinity of areas where hazardous or unknown wastes are encountered would be halted. The procedures would greatly reduce the risk of hazardous substance entering water bodies along the route.

Additionally, a site with elevated natural mercury levels was found on the originally proposed pipeline route crossing East Fork Cow Creek (MP 109), and concern was expressed that disturbed soil from the crossing could cause human health risk or enter the adjacent stream. Thomason mining claims near East Fork Cow Creek have been determined to have very low concentrations of naturally occurring mercury mineralization (GeoEngineers 2017k). The pipeline route subsequently was rerouted approximately 2,500 feet from where the elevated mercury samples were taken. GeoEngineers (2017k) stated that the soils underlying the currently proposed crossing of East Fork Cow Creek would likely avoid the elevated mercury areas. The ECRP has a number of temporary and permanent erosion control and equipment-cleaning measures to minimize the potential for sediment or contaminated substances to enter wetlands or waterbodies, further reducing potential mercury contamination concerns at this crossing. Additionally, Pacific Connector would implement various site-specific actions at this crossing as recommended by the Forest Service, including:

- Provide 100 percent post-construction ground cover on all disturbed areas. Wood fiber is the preferred material. In addition, construct water bars at 50-foot intervals.
- Ensure that erosion control measures are in place before the fall rains and monitor for rilling, gullying, and other forms of active erosion and issues improve erosion control measures to preclude sedimentation.
- Inspect the construction corridor for sedimentation after each substantial storm event and, if erosion issues are found, correct them

Drinking Water Source Areas and Public Intakes

As identified in table 4.3.2.2-3, the pipeline would cross or be adjacent to 12 public drinking water source areas (DWSAs) (ODEQ 2012e). In some locations, the pipeline would be located within a particular source area for several miles, but in other locations the pipeline would be located along ridgelines meandering in and out of source areas.

TABLE 4.3.2.2-3

Surface Water Public DWSAs Crossed by the Proposed Pacific Connector Pipeline

Starting Milepost	Ending Milepost	County	Drinking Water Source Area a/	Public Drinking Water System ID	Source Water
20.06BR	35.81	Coos	City of Myrtle Point	4100551	N. F. Coquille River
35.81	41.69	Coos	City of Coquille	4100213	Coquille River
			City of Myrtle Point	4100551	Coquille River
41.69	53.21	Coos	City of Coquille	4100213	N.F. Coquille River
53.21	64.71	Douglas	Winston-Dillard Water District	4100957	S. Umpqua River
64.71	70.51	Douglas	Roseburg Forest Products-Dillard	4194300	S. Umpqua River
70.51	73.37	Douglas	Clarks Branch Water Association	4100548	S. Umpqua River
73.37	74.27	Douglas	Roseburg Forest Products-Dillard	4194300	S. Umpqua River
74.27	82.94	Douglas	Clarks Branch Water Association	4100548	S. Umpqua River
82.94	95.41	Douglas	Tri-City Water District	4100549	S. Umpqua River
95.41	101.79	Douglas	Milo Academy	4100250	S. Umpqua River
			Tri-City Water District	4100549	S. Umpqua River
101.79	101.94	Douglas	Tri-City Water District	4100549	S. Umpqua River
101.94	102.74	Douglas	Tri-City Water District	4100549	Cow Creek
			Tiller Elementary SD #15	4192139	S. Umpqua River
102.74	108.96	Douglas	City of Glendale	4192139	Cow Creek
			Tiller Elementary SD #15	4192139	S. Umpqua River
108.97	111.11	Douglas	City of Glendale	4192139	Cow Creek
111.11	125.82	Jackson	Country View Mountain Home Estates	4100808	Rogue River

TABLE 4.3.2.2-3

Surface Water Public DWSAs Crossed by the Proposed Pacific Connector Pipeline

Starting Milepost	Ending Milepost	County	Drinking Water Source Area a/	Public Drinking Water System ID	Source Water
125.82	130.00	Jackson	Anglers Cover /SCHWC	4100808	Rogue River
			Country View Mountain Home Estates	4100513	Rogue River
135.00	168.01	Jackson	Medford Water Commission	4100513	Rogue River

a/ The proposed route meanders in and out of Surface Water DWSAs where there are two DWSAs listed.

Table 4.3.2.2-4 lists the public water systems with surface water intakes within 3 miles downstream of waterbodies that would be crossed by the pipeline (ODEQ 2013a).

TABLE 4.3.2.2-4

Surface Water Intakes for Potable Drinking Water Supply

Intake	Public Water System	Source Water for Intake	Waterbody Crossing	Intake Distance Downstream a/	County
4194300	Roseburg Forest Products – Dillard	S. Umpqua River	Rice Creek – MP 65.76 Tributary to S. Umpqua River	0.8 mile	Douglas
4194300	Roseburg Forest Products – Dillard	S. Umpqua River	Willis Creek MP 66.95 Tributary to S. Umpqua River	1.8 miles	Douglas
4100808	Country View Mountain Home Estates	Rogue River	Rogue River MP 122.65	1.4 miles	Jackson
4101483	Anglers Cove Subdivision	Rogue River	Rogue River MP 122.65	Approx. 3 miles	Jackson

Note: All intakes located within 3 miles downstream of proposed waterbody crossings for the Pacific Connector pipeline.
a/ Location of intake downstream from proposed waterbody crossing.

Points of Diversion

Surface water diversions for irrigation, livestock watering, and industry are located within 150 feet of 44 waterbody crossings (see table 4.3.2.2-5).

TABLE 4.3.2.2-5

Points of Diversion within 150 feet of Pacific Connector Construction Work Area

Water Right Type	Water Right Owner	County	Nearest Milepost	Permit/ Certificate Number	Type of Diversion	Diversion Source	Usage Description	Distance to Construction Work Area (feet)	Type of Construction Work Area Containing Points of Diversion a/	Number of Water Rights
Storage	Private	Douglas	60.73	44288	Stream	Perron Creek	Livestock	35.90	-	1
			65.35	T 6708	Stream	South Umpqua River/Reservoir 1	Industrial/manufacturing uses	0.00	Pipe Yards	1
			67.12	R 14589	Stream	Unnamed Stream	Multiple purpose	108.39	-	2
			74.20	69536	Winter Runoff	Runoff/Reservoir 13	Fire protection	0.00	Construction Right-of-Way	1
			74.20	69536	Winter Runoff	Runoff/Reservoir 13	Livestock	0.00	Construction Right-of-Way	1
			75.49	17241	Stream	Sutherlin Creek	Industrial/manufacturing uses	0.00	Pipe Yards	1
			75.49	30362	Stream	Sutherlin Creek	Industrial/manufacturing uses	0.00	Pipe Yards	1
									Storage Total	***8***
Surface Water	Private	Coos	12.07	53679	Stream	Unnamed Stream	Domestic including Lawn and Garden	79.83	-	1
			13.80	36042	Spring	A spring	Domestic	0.00	Construction Right-of-Way	1
			29.48	S 44450	Stream	Stemmler Creek	Domestic including Lawn and Garden	134.81	-	1
			29.48	S 44450	Stream	Stemmler Creek	Livestock	134.81	-	1
			29.86	60877	Stream	East Fork Coquille River	Irrigation	56.92	-	1
			30.00	39940	Stream	East Fork Coquille River	Irrigation	0.00	Construction Right-of-Way	1
		Douglas	49.53	44065	Stream	Lang Creek	Irrigation	109.26	-	1
			58.64	S 54735	Stream	Olalla Creek	Domestic Expanded	117.96	-	1
			67.19	15423	Stream	South Umpqua River	Irrigation	132.51	-	1
			67.19	22390	Stream	South Umpqua River	Irrigation	67.80	-	1
			67.19	23826	Stream	South Umpqua River	Industrial/Manufacturing Uses	0.00	Pipe Yards	1
			70.36	29340	Stream	South Umpqua River	Irrigation	120.06	-	1
			70.36	65231	Stream	South Umpqua River	Irrigation	64.53	-	1
			70.36	68634	Stream	South Umpqua River	Irrigation	64.53	-	1
			75.49	15598	Stream	Sutherlin Creek	Industrial/Manufacturing Uses	0.00	Pipe Yards	2
			75.49	17292	Stream	Camas Swale/Log Pond	Industrial/Manufacturing Uses	0.00	Pipe Yards	1
			75.49	30363	Stream	Sutherlin Cr/Pond	Industrial/Manufacturing Uses	0.00	Pipe Yards	1
			81.23	55163	Stream	South Myrtle Creek	Irrigation	67.96	-	1
			82.27	80544	Stream	South Umpqua River	Irrigation	0.00	Pipe Yards	1
			88.16	43561	Stream	Fate Creek	Irrigation	90.46	-	1
			88.16	52977	Stream	Fate Creek	Irrigation	90.46	-	1
			88.52	56872	Stream	Fate Creek	Irrigation	147.03	-	1

TABLE 4.3.2.2-5 (continued)

Points of Diversion within 150 feet of Pacific Connector Construction Work Area

Water Right Type	Water Right Owner	County	Nearest Milepost	Permit/ Certificate Number	Type of Diversion	Diversion Source	Usage Description	Distance to Construction Work Area (feet)	Type of Construction Work Area Containing Points of Diversion a/	Number of Water Rights
Surface Water (cont.)		Jackson	122.67	34473	Stream	Rogue River	Irrigation	132.95	-	1
			122.83	65482	Stream	Rogue River	Irrigation	22.39	-	1
			145.77	2170	Stream	Little Butte Creek	Irrigation	100.10	-	1
			145.77	2470	Stream	Little Butte Creek	Irrigation	129.80	-	1
			145.77	57753	Stream	North Fork Little Butte Creek	Irrigation	129.80	-	1
			145.82	17215	Stream	North Fork Little Butte Creek	Irrigation	103.16	-	1
		Klamath	199.96	67512	Stream	Klamath River	Fire Protection	23.69	-	1
	State	Coos	22.30	9712	Spring	A spring	Domestic	119.11	-	1
			27.20	60812	Stream	Middle Creek	Irrigation	127.86	-	1
		Douglas	67.19	S 51632	Stream	South Umpqua River/Con 18714	Primary and Supplemental Irrigation	0.00	Pipe Yards	1
			67.30	S 51924	Reservoir	South Umpqua/Galesville	Supplemental Irrigation	0.00	Pipe Yards	1
			70.36	S 52930	Stream	South Umpqua River	Primary and Supplemental Irrigation	0.00	Pipe Yards	1
			71.31	S 51924	Stream	South Umpqua River	Irrigation	0.00	Temporary Extra Work Space	1
		Jackson	128.61	73043	Stream	Indian Creek	Anadromous and Resident Fish Rearing	9.87	-	12
			135.65	41308	Reservoir	Reservoir	Wildlife	100.42	-	1
									Surface Water Total	***49***
									Grand Total	**57**

a/ Dash indicated a facility (e.g., pipe yard, ROW, TEWA) that does not intersect a water right location.

Nationwide Rivers Inventory

The Nationwide Rivers Inventory lists more than 3,400 free-flowing river segments in the United States characterized as possessing one or more "outstandingly remarkable" natural or cultural values judged to be of more than local or regional significance. The proposed pipeline would cross three rivers that are listed on the Nationwide Rivers Inventory (NPS 2013):

- The **North Fork of the Coquille River** listing includes its headwaters in Section 16, T.26S., R.10W. and extends to the confluence with the South Fork Coquille River in Section 5, T.29S., R.12W. This segment was added to the list in 1993 for outstandingly remarkable fish, wildlife, and cultural (prehistoric Indian sites) values. The pipeline would cross this river segment at MP 23.1.
- The **East Fork of the Coquille River** listing extends from its headwaters in Section 18, T.28S., R.8W. to the confluence with the North Fork of the Coquille River in Section 36, T.28S., R.12W. It was added to the list in 1993 for outstandingly remarkable fish, wildlife, boating and fishing. The pipeline would cross this river at MP 29.9.
- The **South Umpqua River** listing includes the reach from Tiller (Section 33, T.30S., R.2W.) downstream to the confluence with the North Umpqua River at River Forks (Sections 31 and 32, T.26S., R.6W.). This reach was added to the list in 1993 for outstanding and remarkable fish and historical values. The pipeline would cross this section of river in two locations, MP 71.3 and MP 94.7.

Impacts and Mitigation

Impacts resulting from the pipeline's construction (see chapter 2 for a description of the pipeline's construction techniques) would be temporary and would affect crossed waterbodies. Construction actions may affect the following parameters:

- turbidity and sedimentation;
- channel and streambank integrity and stability
- in-stream flow
- risk of hazardous material spills and
- waterbody status and water use related to:
  - Oregon Water Quality Regulations and Standards effects
  - contaminated surface water or sediment effects
  - drinking water sources areas and public intakes effects
  - point of diversion effects
  - National Rivers Inventory effects

To minimize potential adverse impacts along the construction right-of-way and at waterbody crossings, Pacific Connector would implement its ECRP during construction, restoration, and operation of its proposed facilities.

Project-specific stream crossing evaluations have been conducted and crossing procedures and mitigative actions would also be implemented. Pacific Connector conducted an initial assessment of crossing conditions of all streams suitable for this analysis (GeoEngineers 2017d, 2018a, 2018b). GeoEngineers (2017d) applied the FWS's Stream Crossing Screening Matrix to all stream crossings that display fluvial characteristics. This assessment was intended to determine where stream crossings may pose a substantial risk of increasing streambank erosion and streambed instability. GeoEngineers, using a combination of field and GIS data, rated the 173 fluvial pipeline stream crossings based on the matrix (GeoEngineers 2018a). Some streams could not be accessed, and evaluation was based on desktop analysis for those streams. The matrix has two axes rating the crossing based on the potential Project effects on the crossing and the relative stream response at the crossing. Each crossing was rated as low, medium, or high for each of the two axes (all stream crossings were placed into one of nine categories, such as Low–Low, Low–Medium, or Medium–High).

No crossing was rated as having both high risk of Project impact potential (i.e., high risk of Project impacts) and high risk of site response potential (high risk of stream and site response). If any crossing had been in this category, Pacific Connector indicated that a site-specific crossing plan would be developed. Should later assessment of the crossings (see below) find that a crossing is in this category, a site-specific plan would be developed prior to construction.

GeoEngineers (2017d, 2018b) grouped the nine risk categories into five categories based on generally similar risk of streams being affected and labeled these as color management categories (Blue, Green, Yellow, Orange, and Red). The assessments included an initial survey and follow-up surveys that resulted in the current assessment of streams into these categories.

After the follow-up surveys, stream crossings with the lowest stream response potential and a low or moderate project impact potential (94 total) were designated as the Blue category and would be crossed using project-typical BMPs. These project-typical BMPs would be applied to all streams while additional BMPs would be applied to the other crossings depending on their rated category of risk. The remaining stream crossings (79) included 68 Yellow and 11 Orange crossings with some greater risk potential at the crossings than Blue crossings. These two categories would have specific additional BMPs applied in addition to the project typical BMPs with the purpose of protecting stream and bank processes following pipeline installation at sites with this category of potential risks. The details of these category specific actions are described in GeoEngineers (2017d, 2018b). After follow-up survey some additional BMPs were added to some of these streams including seven surveyed Orange category crossings (Middle Creek [MP 27.04], Elk Creek [MP 32.40], Tributary to Big Creek [MP 37.35], Upper Rock Creek [MP 44.21], East Fork Cow Creek [MP 109.47], West Fork Trail Creek [MP 118.89], and South Fork Little Butte Creek [MP 162.45]), and had specific crossing plans developed that designate the types of bed and bank restoration that would occur at each of these sites GeoEngineers (2017b, 2018a). Additional specific actions would occur at some streams on federal lands (see section 4.7 and appendix F).

Substrate characteristics and physical habitat features have been or would be determined through pre-construction surveys[79], and the upper 1 foot of existing substrate would be replaced, and other physical conditions matched during reconstruction after pipe installation. Clean spawning gravel would be top dressed as appropriate, and composition would be based on pebble counts or other appropriate methods on a site-specific basis; this would require review and approval by agency staff prior to implementation. Many of these actions would be determined prior to construction based on results of the pre-construction survey (see below) and determined by a qualified EI

[79] Some stream crossings were not accessible and would be surveyed prior to construction once approval and land owner access agreements are obtained.

specifically trained to determine proper restoration actions to implement based on river channel processes or a suitably trained professional. On non-federal lands, this person would have the authority to select appropriate additional BMP construction methods, bank stability actions, revegetation types and methods to help reduce the risk of instability of the crossing and potential for future erosion (GeoEngineers 2017d, 2018a).

A pre-construction survey[80] would be conducted by a technically qualified team on all stream crossings to confirm and clarify conditions developed in the aforementioned matrix analysis. This would include surveys of sites currently not accessible due to property ownership issues. Following these surveys, if significant changes were to occur to parameters of the risk matrix for a crossing, changes would be made to risk level and appropriate final methods of crossing and BMPs made at each stream crossing. If any crossing is moved into the “high” project impact and “high” stream response risk matrix category, a site-specific crossing design would be developed for that site. Following the final surveys, special additional BMPs, as described in GeoEngineers (2017d, 2018a), would be implemented depending on individual site conditions and may include such actions as changes in bank material and bank angle modifications, specific substrate composition used, plants used on the bank, artificial stabilizing bank material, rootwad enhancement, type of bed and bank restoration structure, and various other actions.

The approach described above, which would include more site-specific information and possibly more site-specific designs based on the pre-construction survey, is expected to be suitable for the protection of aquatic resources at waterbody crossings. The final procedures would ultimately need to obtain other permit-process approval (e.g., Section 401 water quality certification) before construction is conducted at specific sites.

As a measure to help ensure crossing actions would not adversely affect stream bank and channel structure, Pacific Connector, as part of their pipeline integrity monitoring, would observe all stream crossings, regardless of risk, annually for the life of the Project and note any obvious signs of channel erosion, pipeline exposure, or major shifts in restoration elements. Where any problems were noted during this annual assessment, a follow-up visit by geo-professionals would occur (GeoEngineers 2018a). On a quarterly basis, over two years after construction at all perennial crossings on federal lands as well as the highest risk sites identified on non-federal lands (Orange category), monitoring of vegetation success, stability of restoration elements, fish passage status, channel migration, erosion, head cutting, and other channel characteristics would be conducted. Additional forms of monitoring (e.g., vegetation, animal browse, and continued channel/restoration status) would occur at varied sites over varied intermittent periods over a 10-year period, with the highest frequency and intensity of monitoring effort at those sites of greatest risk of channel and bank instability. Frequency and type of monitoring may be adjusted based on site-specific conditions. In addition, flow and rainfall events would be recorded to understand the response of sites to flow events. Additional monitoring would occur on streams on federal lands. Remediation of adverse conditions with channel stability or habitat found during the monitoring would occur. Reports of the monitoring would be developed for years 1, 2, 3, 5, 7, and 10 after construction describing observations made and any remedial actions taken.

[80] Some stream crossing were not accessible and will be surveyed prior to construction once approval and land owner access agreements are obtained

Construction of New TARs, New PARs, Existing Access Roads (EAR), and TEWAs

Construction of roads and facilities have the potential to contribute sediment to streams. Of the existing roads that would be used for construction, approximately 47 would cross waterbodies. All access roads would use the existing crossing facility (e.g., bridge, culvert, ford), except for one that would use a temporary bridge and another with a temporary culvert. It is possible that other crossings may need to be improved or replaced, once final plans are developed prior to construction. These crossings would have to be reviewed and approved by the applicable agencies prior to their implementation.

Currently, there are 8 TARs and 11 PARs that would be built in the range of coho salmon–bearing watersheds along the proposed route. Of these, 2 PARs would directly cross streams and 4 TARs and 3 PARs would be within 200 feet of streams in these watersheds. There would be about 23 EAR segments that would be improved (e.g., by widening, resurfacing, or brush removal) that are within 200 feet of coho salmon-bearing streams, 7 of which would directly cross streams. While there are additional roads that are near or cross streams in other areas along the Project, their numbers are few, especially where fish would potentially be present. Potential sediment delivery to streams would occur from gravel and dirt roads, either newly built or improved ones. Dube et al. (2004) provided a summary table of distance categories for sediment delivery. The table indicated that where roads directly cross streams all sediment (100 percent) that runs off the road at the crossing would be considered to enter the streams, while potential sediment delivery to streams from road runoff decreases exponentially by distance from a stream. Dube et al. (2004) indicated that, from about 1 to 100 feet from a stream, 35 percent of road runoff would reach a stream; between 100 and 200 feet about 10 percent; and beyond 200 feet, no runoff would be considered to reach a stream. Given the locations of these roads, a total of 4 TARs, 3 PARs, and 21 EAR road segments related to the Project could potentially deliver sediment to streams, either from directly crossing streams or being with 200 feet upslope of them. Such sediment delivery would increase turbidity and fine sediment deposits, especially if BMPs were not properly instituted in these areas.

Several actions would be taken to reduce sediment runoff from roads and stream crossing structures. Where road improvements would be required, Pacific Connector would ensure that existing drainage features (e.g., culverts, ditches, dips, and grade sags) continue to function properly or they would employ suitable substitute measures to ensure that drainage is controlled to prevent off-site erosion or other resource damage. Surfaces of all new PARs would be graveled, thereby decreasing their erosion potential. Further, PARs and TARs would meet land-managing agencies' engineering design and road management standards consistent with the intended use of the road, and all applicable agency BMPs for erosion control would be implemented. All TARs would also be restored to preconstruction conditions following completion of construction.

TEWAs, which are common along the route, many near streams, represent another potential source of elevated sediment runoff. To reduce the chance of sediment entry to streams from TEWAs, Pacific Connector would install BMPs according to their ECRP for all related construction actions. BMPs may include silt fence/straw bale, sediment barriers, temporary slope breakers, or prefabricated construction mats to prevent rutting/compaction impacts and mulch, dust control, and permanent erosion control measures that would further minimize sediment discharges from a site after construction is complete. In forested areas, slash-filter windrows may be constructed on the downhill edge of the construction right-of-way and TEWAs, as directed by the EI.

While some additional sediment may enter streams, several factors would minimize or eliminate these occurrences:

- the relatively small area that would be disturbed from these actions,
- the provisions in the *Transportation Management Plan* that would be followed, and
- the ECRP and BMPs that would be implemented for Project roads, right-of-way clearing, and TEWAs.

The result would be that noticeable adverse effects on stream sediment or water quality are unlikely to occur.

Turbidity and Sedimentation

Turbidity and sedimentation affect water clarity and future substrate characteristics. Increases in both can be detrimental to drinking water quality and adversely affect aquatic organisms by impeding light penetration, benthic organism survival, and quality of substrate for invertebrate production and fish spawning success (see section 4.5). Turbidity in streams is often regulated, and levels allowed are usually designated in state water quality certification permits. To minimize increases in turbidity and suspended sediment at waterbody crossings, Pacific Connector would utilize the dry crossing methods (i.e., flume and dam-and-pump) for most of the flowing waterbodies crossed by the pipeline (as discussed above). The remainder would be crossed by conventional bore, diverted open-cut, HDD, and DP. Turbidity and sedimentation resulting from dry open-cut methods are generally minor and temporary and are associated with (1) installation and removal of the upstream and downstream dams used to isolate the construction area; (2) water leaking through the upstream dam and collecting sediments as it flows across the work area and continues through the downstream dam; (3) movement of in-stream rocks and boulders to allow proper alignment and installation of the flume and dams; and (4) when streamflow is returned to the construction work area after the crossing is complete and the dams and flume are removed. Dry methods have been reported to produce one-seventh the suspended sediment in streams than “wet” methods (Reid et al. 2002). According to Pacific Connector, during construction of Williams Northwest Pipeline’s Capacity Replacement Project in Washington State (completed in 2006), a total of 67 waterbodies were crossed using dry open-cut crossing methods (fluming and/or dam and pump). During these crossings, there was only one event where state water quality turbidity limits were exceeded. The exceedance occurred through a failure of the pumps during the night when a monitor was not on site to restart the pump.

Some turbidity would result during instream activities and when the water is diverted to the backfilled areas. GeoEngineers (2017e) evaluated the potential risk of turbidity during construction across waterbodies and assigned waterbodies a score from 1 (low) to 5 (high). Of 299 waterbodies evaluated[81], 110 were scored with a low risk (score of 1 or 2) of turbidity increase over a 24-hour period and 189 were scored with a moderate risk (score of 3 or 4), generally due to soil erosion potential, presence of clay or mud, and/or the presence of steep slope or an incised channel that would require construction of a deep trench.

Monitoring studies of varied dry stream crossing pipeline activities have found moderately elevated suspended sediment near these crossings sites. Reid et al. (2004) measured suspended

[81] Excludes ponds, estuaries, streams and canals crossed using trenchless methods and water bodies in right way not crossed.

sediment downstream from 12 flumed pipeline crossings and 23 dam-and-pump crossings in North American streams. The study estimated that suspended sediment concentrations averaged 99 mg/l for flumed crossings and 23 mg/l at the dam-and-pump crossings. Reid et al. (2002) found that below four separate dam-and-pump crossings, mean suspended sediment was less than 20 mg/l within 30 meters (100 feet) downstream.

For Project area streams, average watershed suspended sediment values within 50 meters downstream of the stream crossings were modeled.[82] During a standard crossing using dam-and-pump or flumed crossing methods, when water diversion and sediment control methods are in place, values would range from 27 to 153 mg/l for flumed crossing and 7 to 35 mg/l with dam-and-pump crossings for the affected watersheds. These values are similar to those found by Reid et al. (2004) noted above. However, values would be much higher should the crossing sediment control method fail, with modeled suspended sediment values ranging from 712 to 4,102 mg/l if wet open cut methods were used during crossing failure. Duration of elevated values from failure would likely be short, less than about 2 to 4 hours for small streams and possibly up to about 6 hours for large stream crossings. While failures of diversion control systems during crossings are uncommon (Reid et al. 2004), they would likely occur at some crossings during construction. Suspended sediment concentrations from any crossing method would decrease to background levels (about 2 mg/l) within about 0.6 to 19 km (approximately 0.4 to 11.8 miles) downstream of a crossing, among the 14 watersheds.

The South Umpqua River diverted open-cut crossing would have similar effects on downstream sediment and turbidity, in the short term, to those from other dry crossings. These effects would mostly end once the diversion is in place as stream construction would occur in the dry. There would be short-term turbidity increases for short distances, lasting for several hours during portions of the installation and removal of the diversion structures for the proposed diverted open-cut crossing. Suspended sediment generated during construction at this crossing would likely be low and limited in distribution and downstream transport distance because of the very coarse pebble substrate at the crossing.

Temporary bridge installation may occasionally add turbidity to streams. Temporary stream crossings may occur outside of the fish in-water work window. Pacific Connector's crossing plans include installing temporary bridges from the bank without entering the water. These may include such items as flat-beds that are typically 30 to 40 feet long, some as long as 90 feet. If such bridges are not considered safe to install from the bank, only the equipment needed to cross the stream to install the bridge would cross the stream. Once installed, no further vehicle passage would occur in the channel. Therefore, while a small number of stream channels may be disturbed during installation causing elevated sediment levels, the limited vehicle traffic and number of such crossing locations would minimize water quality effects from turbidity in location and duration along the proposed route.

Potential effects from turbidity from construction across streams are expected to be temporary and minor for the following reasons:

- all but one crossing of perennial streams would be completed either using dry open-cut crossing methods or methods that avoid impacts altogether;

[82] See Pacific Connector's response to a FERC information request related to Resource Report 2, filed May 4, 2018.

- crossings would be completed during ODFW and NMFS recommended in-water work periods when the flow volumes and velocities will be low;
- most dry open-cut crossings would be completed in less than 48 hours;
- headwater streams are typically dominated by gravel/cobble substrates reducing the potential to generate turbidity during crossings; crossings would be scheduled individually, several days apart, and not completed concurrently;
- erosion control BMPs, as outlined in Pacific Connector's ECRP, would be implemented to minimize the potential for erosion and sedimentation; and
- bridge installation where vehicles enter streams would only occur in limited locations and duration, with most areas spanned by bridges without water entry, and Pacific Connector would follow BMPs and procedures approved by state and applicable federal agencies where temporary bridges would be installed.

The *Turbidity-Nutrients-Metals Water Quality Impact Analysis* (GeoEngineers 2017e) concluded that turbidity may exceed Oregon numerical water quality standards for short distances and short durations downstream from each crossing, either during and shortly after construction (in perennial waterbodies) or after fall rains begin (for intermittent and ephemeral streams). Such exceedances are allowed as part of the narrative turbidity standard if recognized in a CWA Section 401 water quality certification if every practicable means to control turbidity has been used.

Contribution of turbidity or sediment from other crossing methods, including DP, bore, and HDD, would be unlikely. DPs and bores would go under waterbodies and avoid contact with flowing streams. Start and end points would be back from the stream banks so standard BMPs for erosion control would reduce potential for sediment to enter streams from their use.

The details of the HDD crossing are described in chapter 2. Pacific Connector proposes to use the HDD method to cross under two spans of 0.7 and 1.6 miles of Coos Bay, and also the Coos, Rogue, and Klamath Rivers. Generally, an HDD would avoid direct effects on the bay and associated estuarine resources; stream habitat and water quality. However, an HDD requires the use of drilling mud as a lubricant during the process. This fluid is under pressure and there is a possibility of an inadvertent release of drilling mud through a substrata fracture, allowing it to rise to the surface (frac-out). The drilling fluid is typically comprised of inert muds, so an inadvertent release would likely be benign. Drilling mud may accumulate locally and be washed downstream, temporarily increasing rates of turbidity and sedimentation. In addition, inadvertent releases most often occur near the entry and exit locations, which are often landward of the stream or estuarine channels, reducing the likelihood that drilling mud would enter surface waters. Pacific Connector prepared detailed surveys and crossing plans[83] for each of the HDD crossing sites, further reducing the chances of HDD crossing problems. To prevent an inadvertent release or address impacts should one occur, Pacific Connector developed its *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations*[84] as discussed in chapter 2.

[83] See Appendix G.2 of Pacific Connector's Resource Report 2.
[84] This plan was attached as Appendix 2.H of Resource Report 2, in Pacific Connector's September 2017 application to the FERC.

Overall, drilling mud releases to any waterbody would be short term and would be diluted from large river water volumes and swift flows. We conclude that an inadvertent release of drilling mud from an HDD would have minor, short-term adverse effects on resources in estuarine channels or rivers.

Trench spoil excavated from within the waterbody would be placed at least 10 feet from the water's edge or in a TEWA and may have the potential to contribute sediment and turbidity to streams. In some waterbodies, native washed streambed boulders, cobbles, and gravels removed from the surface of the trench may be stored within the construction right-of-way in the streambed in areas isolated from streamflow (i.e., within the dammed area for flumes or dam-and-pump crossing). Storing this material in the streambed would minimize handling and help to ensure the material would be available for backfill and streambed restoration. This storage procedure requires a modification from Section V.B.4.a. of the FERC's *Procedures* (which require spoil store more than 10 feet from the edge of waterbody). This modification has been requested as part of the license application (see appendix E). Staging areas and additional spoil storage areas would be located at least 50 feet away from waterbody boundaries, where topographic conditions and other site-specific conditions allow. Where topographic conditions do not allow a 50-foot setback, spoil storage areas would be located at least 10 feet from the water's edge. Sediment control devices, such as silt fences and straw bales, would be placed around the spoil piles to prevent spoil flow back into the waterbody reducing the chance of increasing turbidity.

Channel and Stream Bank Integrity

Constructing the pipeline would modify streambanks, resulting in an increase in the rates of erosion, turbidity, and sedimentation into the crossed waterbody. An increase in soil compaction and vegetation clearing could also potentially increase runoff and subsequent streamflow or peak flows. The extent of these impacts would depend on streambank composition and vegetation stream type, velocity, and sediment particle size.

To minimize these impacts, equipment bridges and mats would be used, as necessary, to provide stable work areas and isolate equipment from waterbodies. TEWAs for spoil storage and pipe staging would be set back from the bank as discussed below, and temporary sediment barriers would be installed around disturbed areas, where necessary, in accordance with Pacific Connector's ECRP.

To restore streambanks on non-federal lands, Pacific Connector would return affected lands to preconstruction contours or shaped to a stable angle (see section 4.3.4 for a discussion of requirements on federal lands). Erosion control measures including fiber fabric or matting would be installed on slopes adjacent to streams. On some banks, depending on site-specific conditions, fiber rolls may also be installed to stabilize bank toes. The streambanks would be seeded, and woody riparian vegetation planted for stabilization according to Pacific Connector's ECRP. Pacific Connector does not anticipate that riprap would be required for streambank stabilization, but if used would be limited to the areas where flow conditions preclude effective vegetation stabilization techniques. Pacific Connector may also implement tree revetments, stream barbs/flow deflectors, toe-rock, and vegetation riprap before using hard bank protection. The NMFS has expressed concern with the potential use of riprap or barb/flow deflectors for this Project and has requested that only bioengineered methods (such as LWD) be used for bank protection or flow control for the Project. This NMFS request may also become a condition within their BO for the Project or a requirement during the NMFS permitting process.

Fluvial erosion represents a potential hazard to the pipeline where streams can expose the pipe as a result of channel migration, avulsion, widening, and/or streambed scour. The pipeline would be designed to ensure it does not become exposed from bed scour or channel migration, which may include increasing the depth of cover to more than the 5-foot minimum to accommodate the potential for long-term channel changes. A channel migration and scour analysis was performed and rated crossings as to their risk of pipe exposure. Those sites considered to have potential risk of pipe exposure were evaluated in more detail including site-specific data and, where deemed necessary, would have additional procedures taken to ensure that likelihood of pipe exposure is eliminated. Ten crossings were identified as Level 2 (listed below on table 4.3.2.2-6), which have large or complex channels with a high potential for migration, avulsion, or scour, and required site-specific additional analyses. From the results of the channel migration and scour analysis, Pacific Connector would design all crossings that were assessed in detail to bury the pipe below the 100-year scour depth or into competent bedrock, whichever is shallower, and, for streams likely to have channel migration, outside and below the 50-year channel migration zone. Additional analysis prior to construction would be needed for sites that were not accessible due to property rights. All crossing sites would have pre- and post-construction surveys conducted to document (by post-construction conditions monitoring) that each crossing has been restored to pre-construction conditions (or better) after project construction. A summary of the survey findings would be filed with the FERC. Crossing of various risk categories would have additional BMPs as described below.

TABLE 4.3.2.2-6

Streams Crossed by the Pacific Connector Pipeline Route That Have a High Potential for Scour or Migration

Watershed	Stream Name	MP	Maximum Scour Depth a/	Other Hazards	Mitigation Measures
Coquille	Middle Park Creek	27.0	10.5 feet	Channel widening	Dry open-cut
Coquille	South Fork Elk Creek	34.5	6.0 feet	Channel widening	Bury in bedrock
S. Umpqua	Olalla Creek	58.8	7.5 feet	Migration	Bury in bedrock
S. Umpqua	Western Crossing of the South Fork Umpqua River	71.3	unknown	unknown	DP
S. Umpqua	North Myrtle Creek	79.1	6.5 feet	Migration	Bury in bedrock
S. Umpqua	South Myrtle Creek	81.2	unknown	Migration	Bury in bedrock
S. Umpqua	Eastern Crossing of the South Fork Umpqua River	94.7	18.0 feet	unknown	Diverted open-cut
Rogue	West Fork Trail Creek	118.9	unknown	unknown	Bury in bedrock
Rogue	Rogue River	122.7	20.5 feet	Channel widening	HDD
Rogue	North Fork Little Butte Creek	145.7	unknown	unknown	Dry open-cut

a/ 100-year flood recurrence

Pacific Connector would follow the procedures described in chapter 2 for placement of sediment cover in streams but has requested a modification, where the existing substrate is not gravel or cobbles and site access is limited, only native materials removed from the stream be used for backfilling. Pacific Connector has provided site-specific modification to our *Procedures* (see appendix E). Any subsequent need to place fill within a stream would require a permit from the COE under Section 404 of the CWA and from the ODSL under the ORS.

In-Stream Flow

Flow changes because of Project actions can have effects on water user's access to water and physical and biological conditions of streams. Flow reductions can partially affect stream temperature as well as aquatic habitat.

Project water withdrawal from waterbodies would occur from two main activities: hydrostatic testing and water needed for project dust control. Pacific Connector estimates between 31 and 65 million gallons of water would be required to test the pipeline during hydrostatic testing (see table 4.3.2.2-7).

Water for hydrostatic testing would be primarily obtained from surface water sources, but some private supply wells or other surface water rights may be drawn upon as well (see table 4.3.2.2-7). If water for hydrostatic testing would be acquired from any source other than a municipality, including surface water sources as noted in table 4.3.2.2-7, Pacific Connector would obtain all necessary appropriations and withdrawal permits, including from the ODWR, prior to use.

Pacific Connector would apply for permission from ODEQ to discharge the hydrostatic test water. Where test water cannot be returned to its withdrawal source, the water would be treated with a mild chlorine treatment and discharged to an upland location (at least 150 feet from streams with no direct discharge features) through a dewatering structure at a rate to prevent scour and erosion and to promote infiltration. Hydrostatic discharge points have been located in upland areas where feasible, and at an appropriate distance from wetlands and waterbodies to promote infiltration and to ensure that sedimentation of wetlands, waterbodies, or other sensitive areas do not occur (identified in table D-3 in appendix D). Pacific Connector's EIs would visually monitor the release of hydrostatic test water and trench dewatering activities to ensure that no erosion or sedimentation occurs. In addition, the EIs would ensure that turbid water is not discharged to waters of the state. If an EI determines that a discharge is occurring from trench dewatering, the receiving water would be visually monitored for turbidity. If a turbidity plume is observed, the trench dewatering operations would be immediately adjusted/reinstalled/maintained to ensure that the discharge of sediment to surface water is stopped and water quality standards are not exceeded. In addition, a total of 32 test header section breaks where water would be discharged are located within the construction right-of-way or TEWAs (identified in table D-3 in appendix D).

TABLE 4.3.2.2-7

Potential Hydrostatic Test Water Quantity and Source Locations

Spread	Test Sections	MP Range	Estimated Volume (gal) a/	Additional Water Required for HDD/Direct Pipe Pre-Test	Minimum + Additional Pre-Test Water b/	Source c/	Additional Potential Sources Recently Sited by Construction Management Team
South Coast Water Basin (MP 0.00 – 53.15)							
EW.	1-2	0.00-8.35R	1,547,000	757,000	1,938,000	MP 0.00 – North Spit Pump House (Coos Bay) MP 1.31 – Fire Hydrant on Westside of Hwy 101 Bridge	–
1	3-6	8.35R-29.54	6,836,000	276,000	2,825,000	MP 11.08R – Coos River MP 29.64 – East Fork Coquille River	Steinnon Creek: North Fork of Coquille River
2	7-10	29.5451.58	6,154,000	85,000	2,458,000	MP 29.64 – East Fork Coquille River MP 50.28 – Middle Fork Coquille River	Upper Rock Creek
Umpqua Water Basin (MP 53.15 – 111.11)							
3	11-12	51.58-71.37	5.692.000	75,000	4,042000	MP 57.30 – Ben Irving Reservoir MP 58.79 – Ollala Creek MP 71.25 – South Umpqua River	Middle Fork Coquille
4	13-17	71.37-94.65	6,499,000	106,000	2,878,000	MP 71.25 – South Umpqua River MP 94.70 – South Umpqua River	South Myrtle Creek
5	18-20	94.65-110.23	4,350,000	–	2,535,000	MP 94.70 – South Umpqua River	South Myrtle Creek; Indian Lake
Rogue Water Basin (MP 111.11 – 167.58)							
5	21-24	110.23-132.50	6,218,000	164,000	2,872,000	MP 122.80 – Roque River	South Myrtle Creek; Indian Lake
6	25-27	132.50-162.00	8,348,000	–	3,060,000	MP 141 .00 – Star Lake MP 133.4 – Medford Aquifer (if this is used, will have to cut in another test)	–
7	28	162.00-179.00	1,635,000	124,000	4,817,000	MP 199.2 – Klamath River MP 212.00 – Lost River	–
Klamath Water Basin (MP 167.58–228.81)							
7	29-32	179.00-228.81	13,906,000	124,000	4,817,000	MP 199.2 – Klamath River MP 212.00 – Lost River	Lost River Anthony Blair Deep Well Gavin Rajnus Deep Well Ryan Hartmen Deep Well
Total			**64,896,000**	**1,722,000**	**32,242,000**		

a/ Total amount of water needed without any cascading of water between sections, which would not occur.
b/ Total assuming likely cascading of water between test section
c/ Currently expected sources of water but alternative or additions sources may be used as noted.
Source: Data response table based on April 12, 2018 design (Pacific Connector Response date May 24, 2018 from Attachment – FERC-PCGP-RR10-1)

To address concerns regarding water withdrawals and hydrostatic testing, Pacific Connector developed a *Hydrostatic Testing Plan*.[85] The plan would be updated in consultation with the BLM and Forest Service, as well as the Center for Lakes and Reservoirs and Aquatic Bioinvasion Research and Policy Institute (Portland State University). The plan includes measures to prevent the transfer of aquatic invasive species and pathogens from one watershed to another. Where possible, test water would be released within the same basin from which it was withdrawn. However, cascading water from one test section to another to minimize water withdrawal requirements may make it impractical to release water within the same basin where the water was withdrawn in all cases. If hydrostatic test source water cannot be returned to the same water basin from where it was withdrawn, Pacific Connector would disinfect the water that would be transferred across water basin boundaries. The hydrostatic test water treatment process would incorporate screening during water withdrawal that would meet NMFS and ODFW criteria to prevent the entrainment of small fish. Water would be discharged according to ODEQ requirements for chlorinated water discharges as noted in the *Hydrostatic Testing Plan*. All discharge locations would be monitored after construction for potential noxious weed establishment and treated if necessary.

Potential effects on stream flow associated with hydrostatic testing include reduced downstream flows, erosion and scouring at release points, and the transfer of aquatic nuisance species through the test water from one water basin to another. Estimates of potential water intake amounts from streams indicate flows below intake would be reduced by less than 10 percent of typical monthly instantaneous flow rates during the month of withdrawal for all but one (at 35 percent of flow) potential locations during withdrawal (duration about 6 to 11 days at each potential location; Ambrose 2018, see also table 4.5.2.3-6 in section 4.5 for withdrawal amounts by stream). Final selection of intake rates and sites would be reviewed by ODFW and OWRD prior to testing, so that potential effects from flow reductions would be unlikely.

While it is not possible to know how much water would be needed for dust suppression on the pipeline construction right-of-way, during dry seasons, Pacific Connector estimates that there would be approximately five 3,000-gallon water trucks per construction spread on a given day. Pacific Connector anticipates using five construction spreads, which would total 75,000 gallons for 25 water trucks per day. While the total amount of water needed is unknown, the amount needed for each truck is relatively small. For example, if filling one truck occurred in 30 minutes of water withdrawal, the rate would be about 1.7 gallons per second or 0.2 cfs. This flow reduction would be a small portion of the flow of perennial streams or rivers that are likely to be used for water supply. Therefore, the overall change in any specific reduction in streamflow from this water use would likely be unsubstantial.

Watering trucks would spray only enough water to control the dust or to reach the optimum soil moisture content to create a surface crust. Runoff should not be generated during this operation. All appropriate permits/approvals would be obtained prior to withdrawal. Table 4.3.2.2-8 lists potential dust control water sources that have been identified by Pacific Connector.

[85] Included as Appendix M to Pacific Connector's POD.

TABLE 4.3.2.2-8

Potential Dust Control Water Sources for the Pacific Connector Pipeline

County	Nearest PM	Source
Coos	16.5	Aqueduct Lake
Coos	37.0	Brewster Lake (WI-602)
Douglas	50.2	Lang Creek Reservoir
Douglas	79.0	Big Lick Reservoir
Jackson	128.5	Indian Lake Reservoir
Jackson	133.4	Eagle Point Irrigation Canal Crossing
Jackson	141.0	Star Ranch Lake
Jackson	144.0	Unnamed Reservoir
Jackson	145.0	Gardener Reservoir
Klamath	228.5	High Line Canal
Klamath	228.7	Capek Reservoir
Klamath	229.4	Low Line Canal

Additionally, Pacific Connector has indicated it may utilize a synthetic product such as Dustlock®, in addition to water, for dust control. Dustlock is a naturally occurring byproduct of the vegetable oil refining process. Dustlock penetrates the bed of the material and bonds to make a barrier that is naturally biodegradable, ensuring that the surrounding ground and water are not contaminated, and minimizing any potential effects on fish and wildlife. However, Pacific Connector would not use Dustlock within 150 feet of riparian areas or wetlands.

For dust control water use Pacific connector would be restricted to water withdrawal from permitted waterbodies where flows would not be adversely affected as they would obtain. If water for dust control would be acquired from any source other than a municipality, including surface water sources as noted in table 4.3.2.2-8, Pacific Connector would obtain all necessary appropriations and withdrawal permits, including from the ODWR, prior to use.

According to the Forest Service, vegetation clearing and management that creates sizable canopy openings can increase water yields and subsequently, waterbody flows (Forest Service 2000). Sizeable canopy openings can result in other factors affecting watershed water storage and runoff amount, peak amount and time of runoff (Forest Service 2008). The relatively small percentage of the watersheds affected by the right-of-way and the total area of the watershed within the transient snow zone would, however, greatly limit this potential effect. Although permanent canopy removal in forested areas along the right-of-way would increase the potential for snow accumulation, the forest clearing within any of the watersheds would be so small as to not have a measurable influence on peak flows.

Surface waters could be affected due to alteration of groundwater flow where the pipeline intersects waterbodies. The hyporheic zone is a region beneath and alongside a stream bed where there is mixing of shallow groundwater and surface water. The flow dynamics and behavior in this zone is recognized to be important for surface water and groundwater interactions, as well as fish spawning, among other processes. Pacific Connector conducted a hyporheic exchange analysis on the waterbodies crossed by the pipeline (GeoEngineers 2017g). The assessment focused on determining if construction has the potential to affect the structure and function of the hyporheic zone, and if so, which stream crossing may be most sensitive to changes in hyporheic zone structure and organization. Historically, pipeline construction has not typically been considered as having a potential effect on hyporheic zone function, presumably because of the nature of the construction process having relatively limited, localized and temporary change to the subsurface conditions under streams and rivers. It is difficult to measure hyporheic exchange without detailed site-specific study, but qualitative observations of bed and bank material, stream gradient, location within a watershed, and morphological features can help indicate whether a stream has an active and functional hyporheic zone. GeoEngineers (2017g) developed weighting factors to assign criteria of high, moderate, and low sensitivity to the crossing locations. The analysis used these qualitative parameters to rank how sensitive a stream crossing may be to potential hyporheic zone alteration.

Fifteen stream crossings were categorized as having a high sensitivity to hyporheic zone alteration, which would suggest a high likelihood of a functioning hyporheic zone, mostly associated with larger waterbodies with greater floodplain widths and instream morphologic features. Two of the ‘high’ sensitivity crossings, including the Coos River crossing at MP 11.13R and the Rogue River crossing at MP 122.65, would be crossed by HDD rather than open trenching across the stream channel.

A “moderate” sensitivity indicates that the stream crossing displays some indicators that a hyporheic zone is active and functional; approximately 66 crossings fit this category, most of them upper to middle watershed streams. A “low” sensitivity indicates that the stream crossing does not likely support either an extensive or functional hyporheic zone; approximately 123 stream crossings fit into this category. Many of these low scoring stream crossings are bedrock-controlled, are dominated by finer-grained material, or are canals and ditches. Eleven stream crossings were not assigned any point values or ranking due to there being no channel or channel forming processes observed at the crossing location in the field.

Water quality parameters, including water temperature and intragravel dissolved oxygen, might potentially be affected at crossings where hyporheic exchange is extensive and active. Thus, streams with a “high” and “moderate” sensitivity would be the streams where water quality could potentially be compromised due to alteration of the hyporheic zone. Those crossings with a ‘low’ sensitivity indicate that little hyporheic exchange is currently operating in the stream, and thus would not likely impact water quality. Overall, most of the Pacific Connector pipeline crossings fall into a “low” sensitivity category, where water quality (including water temperature and intragravel dissolved oxygen) is unlikely to be significantly or measurably altered by pipeline construction.

The pipeline construction methods and BMPs described in the GeoEngineers (2017g) report, as well as the site-specific restoration plans for crossings of perennial stream on federal lands (NSR 2014) further reduce the potential for pipeline construction to adversely alter the hyporheic zone. Specifically, the BMPs which are of importance to reduce the potential impacts on the hyporheic zone include the following:

- native material that is removed from the pipeline trench during excavation across stream channels would be used to backfill once the pipe is in place to minimize potential changes to preconstruction permeability; and
- trench plugs would be installed at the base of slopes adjacent to wetlands and waterbodies and where needed to avoid draining of wetlands or affecting the original wetland or waterbody hydrology.

While the potential impact of pipeline construction on hyporheic exchange is considered to be low, Pacific Connector would implement the following measures to further reduce this potential:

- Document streambed stratigraphy prior to construction to aid in site restoration.
- As described in the *Stream Crossing Risk Analysis* and *Stream Crossing Risk Analysis Addendum* (GeoEngineers 2017d, 2018a), implement additional site-specific stream crossing restorations plans, of streams not yet field surveyed, after final pre-construction surveys.
- Segregate actively movable streambed gravels and cobbles from underlying streambed materials (including fractured bedrock; i.e., do not mix actively moveable stream bed material with that below that depth). Replace all removed material to their natural pre-construction depths, including removed gravels/cobbles.
- Below active stream gravels, replace native material in a manner to match upstream and downstream stratigraphy and permeability to the maximum extent practicable.

Blasting could alter the in-channel characteristics and hydrology of the stream, potentially decreasing flows due to increased infiltration where bedrock would be fractured. Where blasting is required in streambeds, Pacific Connector would use the dam-and-pump crossing method so that blasting activities can be completed in the dry. For further discussion on minimizing impacts related to blasting, see the *Blasting Plan* discussed in chapter 2.

<u>Stream Temperature</u>

Several comments received by the Commission expressed concern that the removal of vegetation near waterbodies would result in changes to waterbody temperatures. However, available information on the effects of linear pipeline crossings of streams on water temperature indicates there is little to no change. Water has a very high specific heat capacity. That is, the amount of heat needed to raise its temperature is relatively high. Typically pipeline rights-of-way are narrow, and water would flow quickly through the crossing locations, Smaller, slower moving streams have a longer exposure time, but typically do not support temperature sensitive fish species. In general, streamwater exposure to the lack of shade at pipeline crossings would be temporary and limited (see an expanded discussion in section 4.3.4.2 for federal lands).

Pacific Connector conducted research on the potential for its pipeline crossings to increase stream water temperatures (GeoEngineers 2017d). This analysis also used the Stream Segment Temperature Model (SSTEMP) by Bartholow (2002) to estimate potential temperature effects at 15 pipeline crossing locations (each a 75-to 95-foot-wide clearing) along the whole route (table 4.3.2.2-9). The streams selected varied in size from 2 to 135 feet wide with only eight of these having less than a 10-foot flowing width. Conditions modeled were based on conditions measured during late August 2010. The average modeled temperature increase across a cleared right-of-way for these 15 streams were slight, 0.03°F, and the maximum increase among the streams was 0.3°F.

TABLE 4.3.2.2-9

Predicted Modeled Temperatures at Selected Stream Crossings Along the Pacific Connector Pipeline Route

MP	Watershed	Stream	Width (feet)	Ambient Water Temperature (°F)	Post-Construction Water Temperature (°F)	Temperature Change (°F)
10.3 a/	Coos	Stock Slough	18	56.30	56.32	0.01
17.5 a/	Coos	Catching Creek	7	56.30	56.30	<0.01
23.1	Coquille	North Fork Coquille River	44	74.30	74.23	-0.07
29.2 a/	Coquille	Tributary to East Fork Coquille River	9	58.82	58.78	-0.04
29.5 a/	Coquille	Tributary to East Fork Coquille River	6	59.72	59.72	<0.01
29.9	Coquille	East Fork Coquille River	74	64.22	64.24	0.02
32.4	Coquille	Elk Creek	7	58.46	58.47	0.01
58.8	South Umpqua	Ollalla Creek	84	58.46	58.48	0.02
73.2	South Umpqua	Tributary to South Umpqua River	2	58.46	58.59	0.13
84.2	South Umpqua	Wood Creek	7	58.46	58.5	0.04
94.7	South Umpqua	South Fork Umpqua River	135	58.46	58.49	0.03
109.5	South Umpqua	East Fork Cow Creek	6	55.40	55.44	0.04
132.8	Rogue	Quartz Creek	6	58.64	58.94	0.30
162.5	Upper Rogue	South Fork Little Butte Creek	13			0.01
212.1	Lost River	Lost Rover	73	70.70	70.68	-0.02

a/ Not crossed with current route

The total amount of riparian vegetation within one site potential tree height that would be reduced during construction and operations is discussed in section 4.5.2 of this EIS. The reduction occurs primarily from construction of the pipeline right-of-way clearing over streams but also includes right-of-way clearing that does not cross streams, and development of TARs, PARs, and TEWAs outside of the right-of-way clearing. This would include loss of about of forest during construction and operations, which would remain as non-forested habitat along the route (see table 4.5.2.3-5 in section 4.5.2 of this EIS). This cleared acreage is spread across the entire pipeline route and includes loss from all sources of construction and operations as well as vegetation that would potentially help shade streams. As discussed below, loss of this vegetation is not likely to have a marked cumulative effect on stream temperature, although some local stream increases may occur.

Potential cumulative watershed temperature increases from project riparian clearing would be unlikely. The number of crossings resulting in riparian shade area cleared in any watershed would be slight. No more than nine perennial streams would be crossed in any one of the 19 watersheds crossed by the pipeline route. Primarily perennial stream clearings are likely to have effects on temperature during the warmest part of the year, because many intermittent streams would be dry during the peak temperature periods (July–September). Thus, peak seasonal temperatures would be unlikely to affect many intermittent streams. Even considering the total number of streams crossed in watersheds, which ranges from 3 to 44 crossings per watershed, most watersheds would have less than 16 crossings (see section 4.5.2.3). The riparian area lost that could affect watershed stream temperature relative to all available riparian areas in the watershed would be slight. About

9 linear stream miles of streambank could be affected along the whole Project route (GeoEngineers 2017f; note this counts both banks separately so stream length affected would be half of this value).

To minimize the potential effects of pipeline construction on stream temperatures by the removal of riparian vegetation, Pacific Connector has incorporated the following measures into its Project design:

- narrowing the construction right-of-way at waterbody crossings to 75 feet where feasible based on site-specific topographic conditions;
- locating TEWAs 50 feet back from waterbody crossings to minimize impacts on riparian vegetation, where feasible;
- replanting the streambanks after construction to stabilize banks and to re-establish a riparian strip across the right-of-way for a minimum width of 25 feet back from the streambanks; and
- replanting riparian areas equal to 1:1 ratio to temporary riparian shading vegetation losses and 2:1 ratio for permanent riparian losses from the 30-foot operational easement clearing.

Based on these measures and the studies summarized above, we conclude that the construction and operation of the pipeline would have no discernible effect on stream temperature.

<u>Spills of Hazardous Materials</u>

An inadvertent release of equipment-related fluids would temporarily impact surface water quality. Equipment fluids such as gas and oil can be toxic to aquatic organisms and can affect downstream water uses including drinking water and crop irrigation. Pacific Connector has developed a SPCC Plan that describes measures to be implemented by Project personnel and contractors to prevent and, if necessary, control any inadvertent spill of hazardous materials.

<u>Waterbody Status and Water Use</u>

The construction and operation of the pipeline route could have effects on the status of special features including the water quality limited conditions and special uses, including water diversions and national river status. Actions described below indicate potential effects on these and Project mitigative actions implemented to aid in maintaining the current conditions and regulatory requirements relative to surface waters.

Oregon Water Quality Regulations and Standards Effects

Studies requested by ODEQ are part of a broad evaluation of potential impacts on water quality, stream channel stability, and riparian zones resulting from pipeline construction and maintenance activities. GeoEngineers conducted studies to help evaluate potential impacts including a stream crossing risk analysis, a hyporheic exchange impacts analysis, and a study of the impact to water quality from additional turbidity, nutrients, and metals caused by pipeline construction activities at stream crossings (GeoEngineers 2013a, 2013b, 2013c, and 2018a). The intent of the evaluations is to help focus management resources on those waterbody crossings to which the pipeline would present the greatest risk of impacting beneficial uses. ODEQ's regulatory authority under the CWA and OAR is provided to maintain beneficial uses through enforcement of water quality standards.

During the ODEQ CWA Section 401 process, Pacific Connector would develop a source-specific implementation plan in accordance with OAR 340-042-0080 for areas with existing TMDLs, and Pacific Connector would be identified as a new nonpoint source. The source-specific implementation plan would be reviewed and approved by ODEQ.

BMPs to minimize sedimentation during construction would be employed on all streams. However, to reduce potential stream channel impacts, including increased erosion/sedimentation, additional site-specific BMPs would be installed at sites considered to be at higher potential risk, as discussed earlier under "Impacts and Mitigation" based on the risk matrix analysis. These additional protections may include such items as additional upslope bank protections, hillslope drainage structures, additional wood instream or on bank, wood armoring, enhanced substrate, or reduction in bank slope to further ensure reduced erosion. The plans to keep riparian stream crossing clearing to a minimum (75 feet wide at most crossings) would also result in less removal of woody riparian vegetation and help temperature-impaired streams. Because of the water quality and stream habitat benefits, the NMFS endorses keeping near stream riparian vegetation clearing to a minimum, as is currently proposed; this NMFS request may become a condition within their BO for the Project or a requirement during the NMFS permitting process. Overall, the small reduction in shade is not likely to change stream temperatures substantially downstream of the pipeline crossing in temperature limited streams. However, removal of vegetation that once shaded the stream could cause slight local and temporary (daily) increases in temperature, in small streams with low flow discharge rates during the warm summer months. However, discernible temperature changes are very unlikely due to the limited exposure time as water passes through the 75-foot-wide clearing and the high specific heat capacity of water.

A potential new nonpoint source of nutrients and/or oxygen-demanding pollutants would be the use of fertilizer for revegetation of disturbed areas. Pacific Connector plans to apply fertilizer to disturbed areas to be reseeded, as needed. Additionally, some BLM districts along the Project route have specific recommendation for slow release fertilizer application in specific soil types in planting holes as part of any reforestation. Fertilizer would only be applied at the recommended rates of the land-managing agencies and, if applied by broadcast spreader, worked into the upper 2 inches of soil as soon as practical (see Pacific Connector's ECRP). Application would need approval by the land-managing agency or landowner. No application would occur within 100 feet of flowing water and would be avoided during heavy rain and windy conditions. Aerial broadcast spreaders would only occur with federal land-managing agency approval. Fertilizer would be added directly to hydroseeding slurry. Fertilizer would be stored away from streams and outside of federal Riparian Reserves. The NMFS has expressed concern that fertilizer application has the potential to enter waters and recommends that no application within 150 feet of waterbodies occur; this NMFS request may become a condition within their BO for the Project or a requirement during the NMFS permitting process. Any monitoring required for nutrients at locations where fertilizer is likely to contribute to run-off to waterbodies will be addressed in the state permit process and be included in a source-specific implementation plan as required by OAR 340-042-0080.

Drinking Water Sources Areas and Public Intakes Effects

Prior to construction, Pacific Connector would consult with all surface water intake operators listed in table 4.3.2.2-5 that are still active and establish a process for advanced notification of instream work. A summary of the consultations will be filed with the FERC prior to construction of the pipeline. In the event of an inadvertent spill, or a disruption of flow and/or a possible introduction of sediments into waters upstream of the intakes, Pacific Connector would notify potable water intake users of the conditions so that necessary precautions could be implemented.

Point of Diversion Effects

Pacific Connector would consult with the landowner if impacts on a water supply's point of diversion cannot be avoided, and prior to construction would work together to identify an alternate location to establish the diversion. Should that landowner determined that there has been an impact on the water supply, Pacific Connector would work with the landowner to ensure a temporary supply of water. In addition, if deemed necessary, Pacific Connector would replace the affected water supply with a replacement, permanent water supply. Mitigation measures would be specific to each property and would be determined during landowner negotiations. Points of diversion (both public and private) beyond 150 feet of the construction work areas are not expected to be affected by the pipeline.

National Rivers Inventory Effects

As noted earlier, the pipeline would cross three rivers that are listed on the Nationwide Rivers Inventory. Pacific Connector has developed specific plans for each of these crossing to maintain the quality of these rivers. For the North Fork of the Coquille River and East Fork of the Coquille River, Pacific Connector has developed a site-specific crossing plan for both rivers using a dry open-cut method to contain disturbed sediments. The western South Umpqua River crossing would use a DP installation process to eliminate an open-cut and minimize impacts by drilling under both the river and I-5 in a single operation. The site-specific crossing plan developed for the eastern South Umpqua River crossing would use a diverted open-cut method to limit water quality impacts by creating a "dry" working area isolated from the river. These procedures would maintain stream conditions and quality, and would not adversely affecting the streams' river status(i..e, the National River Inventory status).

4.3.2.3 Conclusion

Constructing and operating the Project would result in short-term and long-term impacts to surface water resources. However, based on Jordan Cove's proposed dredging and vessel operation methods and its impact minimization and mitigation measures (including its implementation of erosion controls, dredging procedures, construction and stormwater management procedures, and construction timing), as well as Pacific Connector's proposed waterbody crossing and restoration methods and its impact minimization and mitigation measures, we conclude that the Project would result in short-term, localized, construction-related water quality impacts, but would not significantly affect surface water resources.

4.3.3 Wetlands

Wetlands are defined by the *Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory 1987) as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

Wetlands are regulated at the federal, state, and local level. At the federal level, wetlands may be deemed Waters of the United States (33 CFR 328.3) and may be subject to regulation through Sections 401 and 404 of the CWA. Section 401 of the CWA requires that proposed dredge and fill activities under Section 404 be reviewed and certified by the designated state agency and that the project meets state water quality standards. In this case, the ODEQ has been delegated this authority and is charged with verifying that the project meets state water quality standards. In Oregon, wetlands are also regulated at the state level by the ODSL and at the local level by some city and county land-use ordinances. ODSL administers Oregon's Removal-Fill Law (ORS 196.800) to protect waterways and wetlands (see sections 1.3.6 and 1.5.1 for additional details).

Through the state's notification process, provisions for wetlands are included under the ODF's Forest Practices Act and rules will be addressed, if applicable. Details would be submitted to the ODF in either a written plan or alternate plan to include specific provisions for meeting the Forest Practices Act, including those related to wetlands.

On federally managed land, EO 11990, amended in 42 U.S.C. 4321 *et seq.*, requires the federal agencies "to avoid adverse impacts associated with the destruction or modification of wetlands wherever there is a practicable alternative" and to "include all practicable measures to minimize harm to wetlands." Further, the agencies are required to preserve and enhance the natural and beneficial values of wetlands in carrying out their responsibilities.

The *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987), the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* (COE 2010) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0)* (COE 2008) provide the standards for wetlands determinations. Wetland delineations for the Project were conducted in accordance with these federal regulations and methodologies.

4.3.3.1 Jordan Cove LNG Project

Wetlands identified during surveys of the terminal site and associated sites between 2013 and 2017 are shown in figure 4.3-1.[86] Wetlands identified in the area include estuarine subtidal, estuarine intertidal, palustrine unconsolidated bottom, palustrine aquatic bed, palustrine emergent, palustrine scrub-shrub, and palustrine forested wetlands.

[86] The COE reviewed Jordan Cove's 2013 and 2016 wetland delineation and determinations, and provided Preliminary Jurisdictional Determinations on March 13, 2014, October 28, 2014, and March 16, 2017. Requests for Preliminary Jurisdictional Determinations for delineations conducted in 2017 have been submitted to the COE. Additionally, because it has been several years since the Preliminary Jurisdictional Determinations have been issued, Jordan Cove has requested new or revised Jurisdictional Determinations from the COE.

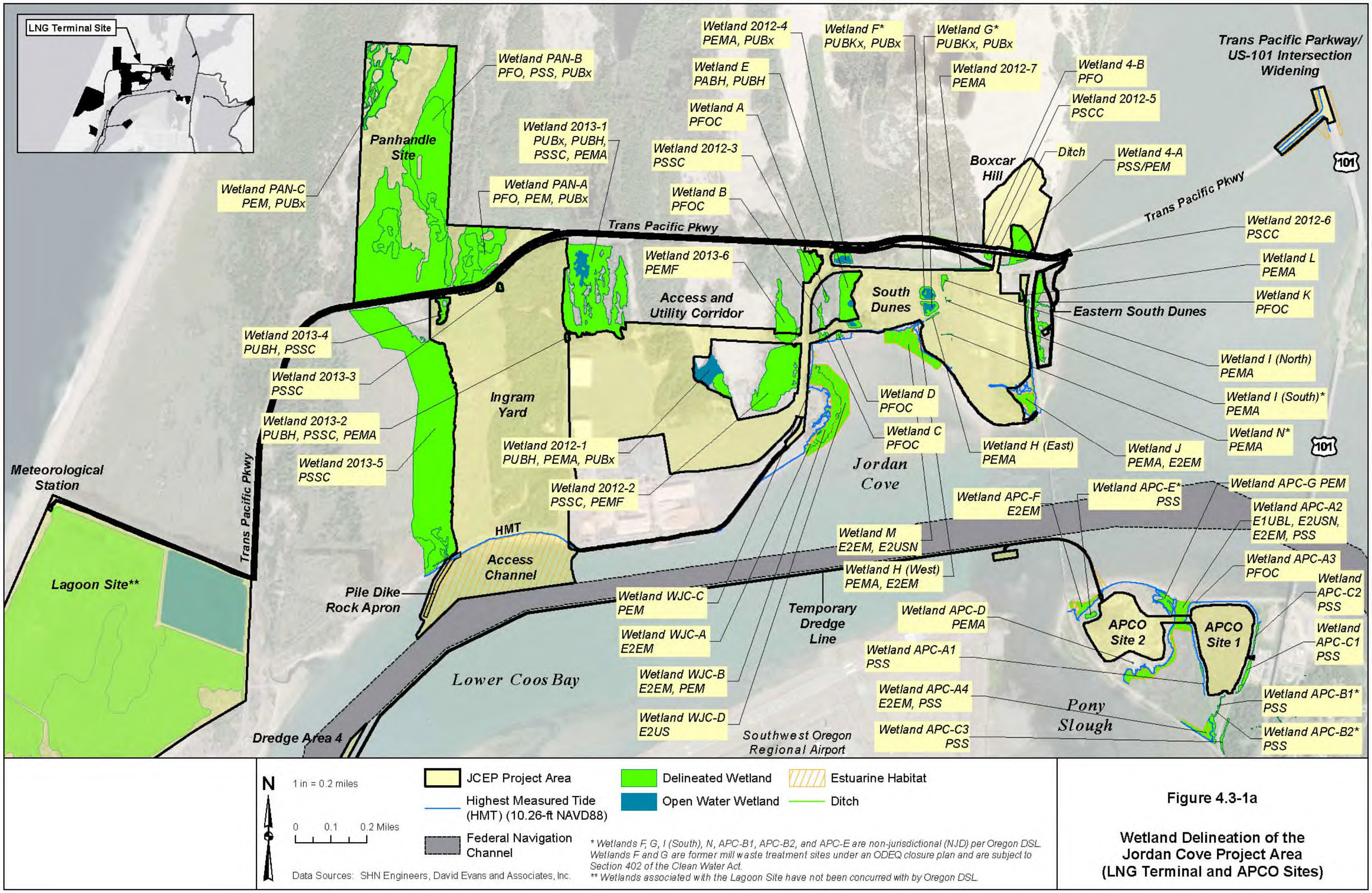


Figure 4.3-1a

Wetland Delineation of the Jordan Cove Project Area (LNG Terminal and APCO Sites)

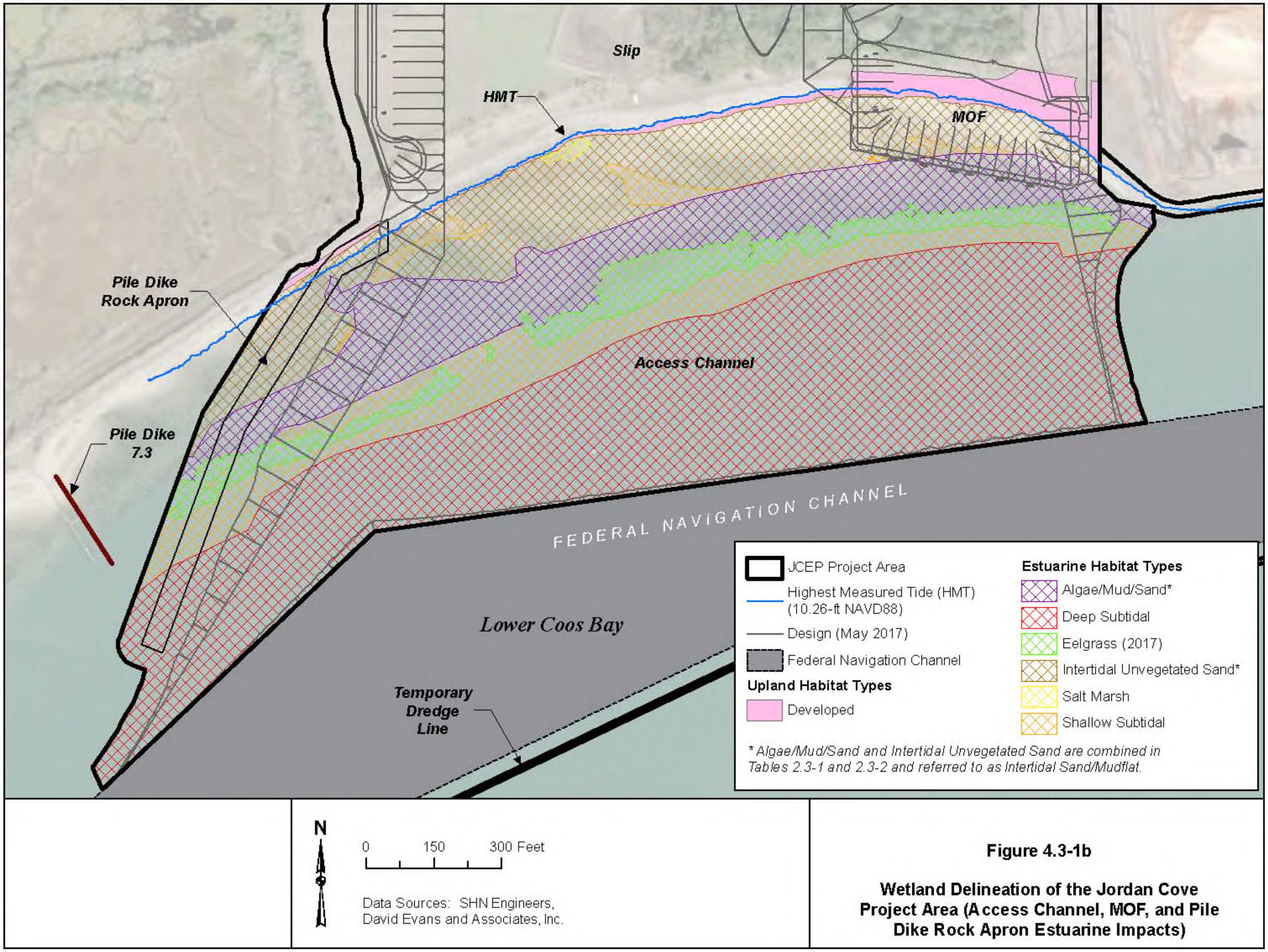


Figure 4.3-1b

Wetland Delineation of the Jordan Cove Project Area (Access Channel, MOF, and Pile Dike Rock Apron Estuarine Impacts)

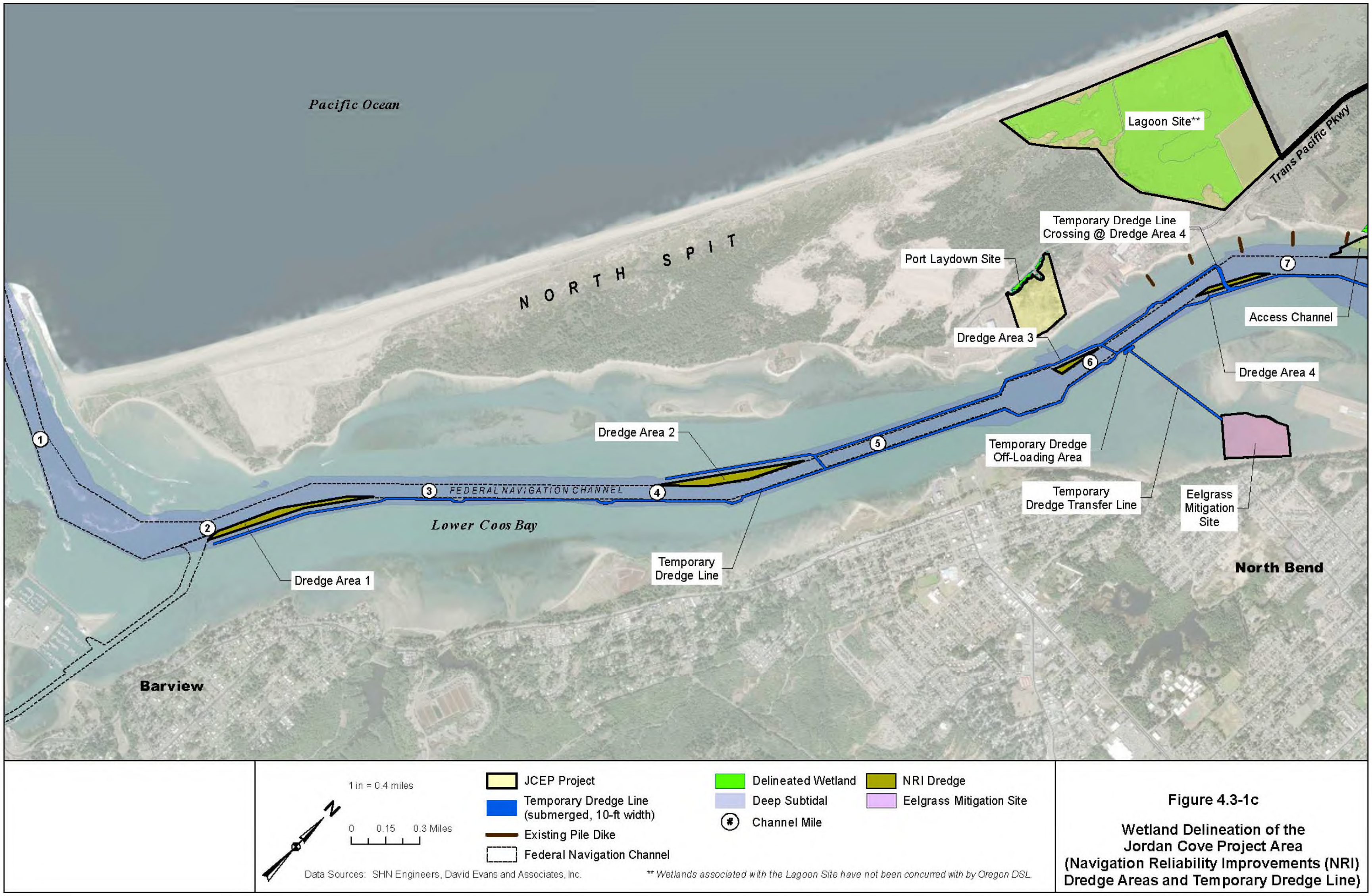
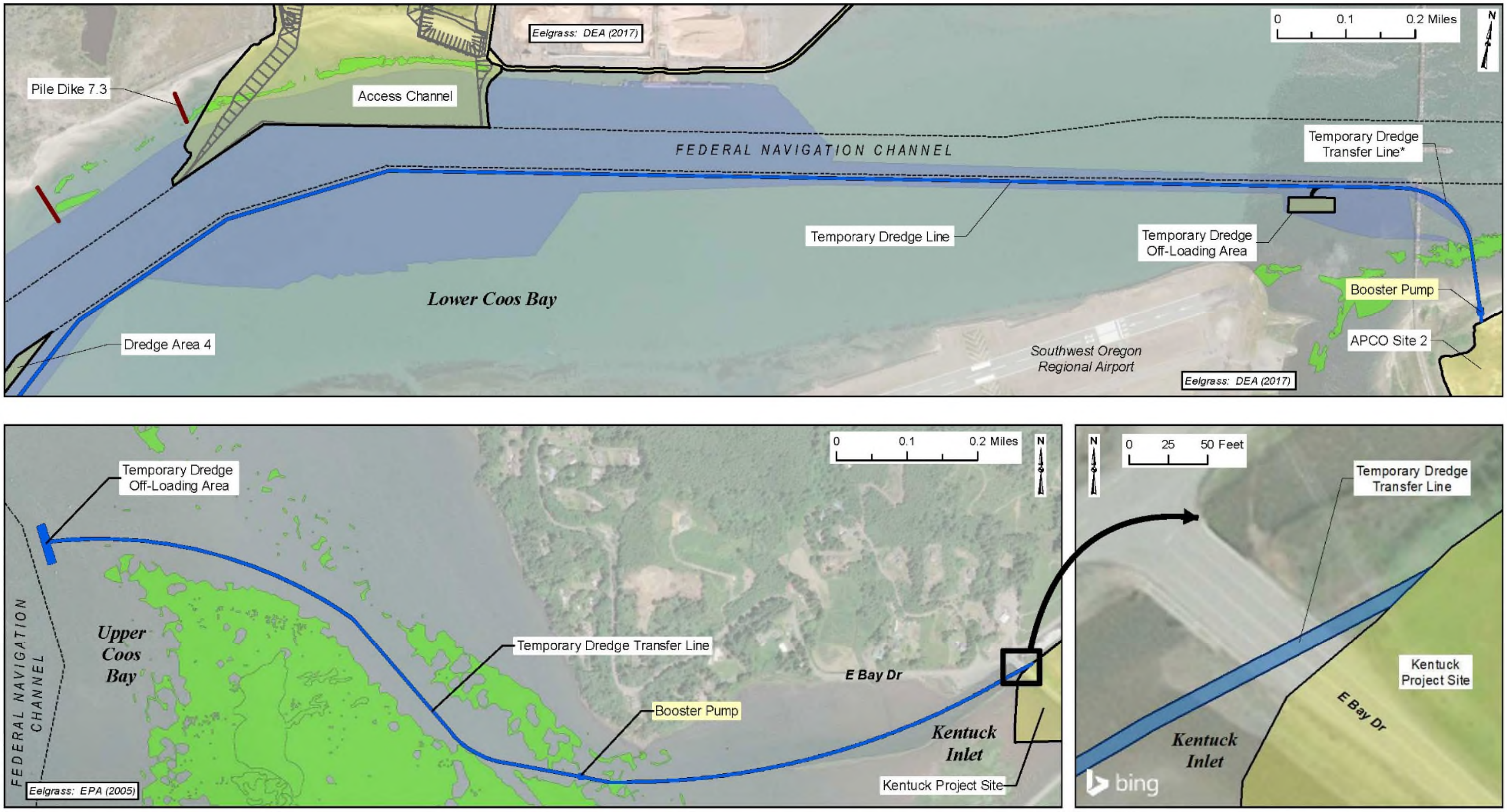


Figure 4.3-1c

Wetland Delineation of the Jordan Cove Project Area (Navigation Reliability Improvements (NRI) Dredge Areas and Temporary Dredge Line)



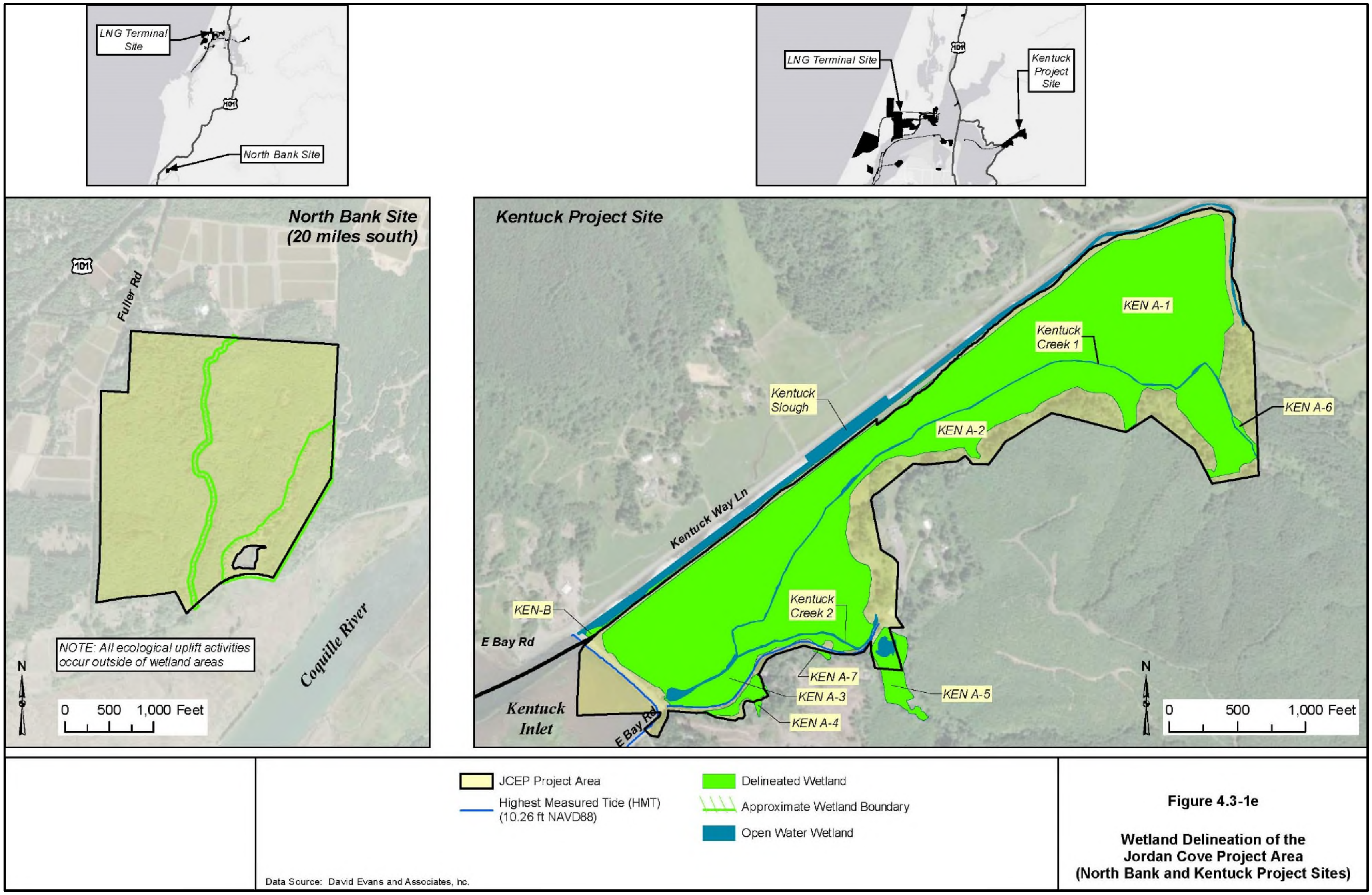
JCEP Project Area	Federal Navigation Channel
Design (May 2017)	Eelgrass
Temporary Dredge Line (submerged, 10-ft width)*	Deep Subtidal
Existing Pile Dike	(#) Channel Mile

Data Sources: SHN Engineers, David Evans and Associates, Inc.

* Temporary Dredge Transfer Line will be suspended where it crosses the eelgrass at the entrance to APCO Site 2

Figure 4.3-1d

Wetland Delineation of the Jordan Cove Project Area (Temporary Dredge Line to APCO Site 2 and Kentuck Temporary Dredge Transfer Line)



Data Source: David Evans and Associates, Inc.

Figure 4.3-1e

Wetland Delineation of the Jordan Cove Project Area (North Bank and Kentuck Project Sites)

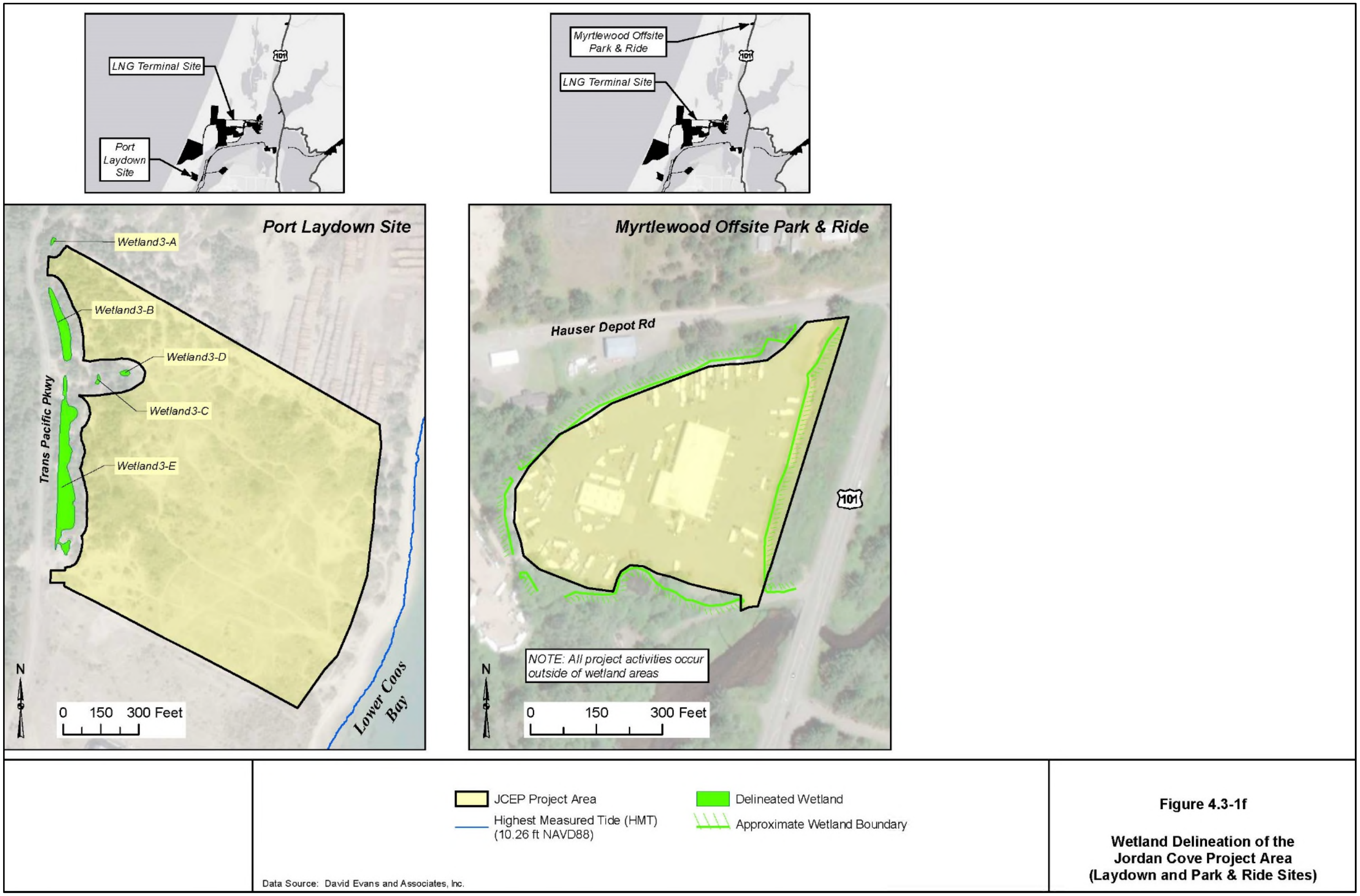


Figure 4.3-1f

Wetland Delineation of the Jordan Cove Project Area (Laydown and Park & Ride Sites)

Estuarine intertidal wetlands are intertidal systems that are regularly flooded and have an unconsolidated shore (i.e., tidal mud/sand flats). Vegetation in tidal flats, with the exception of sea grass beds and algal mats, is generally restricted to small areas of accretion in the tidal marsh-mudflat boundary (Seliskar and Gallagher 1983). Estuarine subtidal wetlands occur below mean low tide and are adjacent to tidal mudflats. Subtidal wetlands provide important ecological functions including providing fish and invertebrate shelter during low tides, supporting sea grass communities and acting as nursery areas for some aquatic species (ODFW 2017a). Estuarine wetlands within Coos Bay are characterized by sandy, muddy, or rocky substrates that are regularly inundated by brackish water and influenced by tidal flux, resulting in cycles of saturation and exposure. Plant life is not typically abundant within these types of wetlands, though macro- and microalgae and phytoplankton can be present. Estuarine intertidal and subtidal wetlands occur throughout Coos Bay.

Palustrine unconsolidated bottom wetlands are wetlands have less than 30 percent vegetation cover and a surface with less than 25 percent of the particles smaller than stones. The closely related aquatic bed wetland class has less than 30 percent vegetation cover of plants growing on or below the water's surface for most of the growing season. These wetland types occur along the South Dunes Site and the access/utility corridor.

Palustrine emergent wetlands are freshwater wetlands dominated by erect, rooted, herbaceous wetland plants that generally persist for most of the growing season. Plant species found in emergent wetlands on the Jordan Cove LNG Project area include slough sedge (*Carex obnupta*), Hooker's willow (*Salix hookeriana*), toad rush (*Juncus bufonius*), dagger-leaved rush (*Juncus ensifolius*), tinker's penny (*Hypericum anagalloides*), devil's beggartick (*Bidens frondosa*), knotgrass (*Paspalum distichum*), Yorkshire fog (*Holcus lanatus*), creeping bent-grass (*Agrostis stolonifera*), yellow pond lily (*Nuphar lutea* ssp. *polysepala*), and floating-leaved pondweed (*Potamogeton natans*). Emergent wetlands occur in various portions of the LNG terminal area as well as at the APCO and Kentuck project sites.

Palustrine scrub-shrub wetlands are freshwater wetlands that include areas dominated by woody vegetation less than 20 feet tall and are vegetated with true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. Species found within scrub-shrub wetlands on the LNG terminal area include Hooker's willow, Sitka willow (*Salix sitchensis*), Douglas spiraea (*Spiraea douglasii*), twinberry (*Lonicera involucrata*), slough sedge, soft rush (*Juncus effusus*), dagger-leaved rush, toad rush, western bent-grass (*Agrostis exarata*), creeping bent-grass, reed canary grass (*Phalaris arundinacea*), northern willowherb (*Epilobium ciliatum*), tall mannagrass (*Glyceria striata* [*G. elata*]), and lowland cudweed (*Gnaphalium palustre*). Scrub-shrub wetlands occur in the various portions of the LNG terminal area, and at the APCO site.

Palustrine forested wetlands are freshwater wetlands that contain woody vegetation that is 20 feet or taller. Coniferous species found in the forested wetlands on the LNG terminal area include shore pine (*Pinus contorta*), Douglas-fir (*Pseudotsuga menziesii*), Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*) and scattered Port-Orford cedar (*Chamaecyparis lawsoniana*). Shrubs within the forest wetland areas include scotch broom (*Cytisus scoparius*), coyote brush (*Baccharis pilularis*), hairy manzanita (*Arctostaphylos columbiana*), evergreen huckleberry (*Vaccinium ovatum*), salal (*Gaultheria shallon*), wax myrtle (*Morella* [*Myrica*] *californica*) and scattered rhododendron (*Rhododendron macrophyllum*). Herbaceous species include European beachgrass (*Ammophila arenaria*), silver hairgrass (*Aira caryophyllea*), little hairgrass (*A. praecox*), hairy cat's ear (*Hypochaeris radicata*), bracken fern (*Pteridium aquilinum*), sheep sorrel (*Rumex acetosella*), candy-stick (*Allotropa virgata*), and rattlesnake plantain (*Goodyera oblongifolia*). Forested wetlands occur in the north-central portion of the LNG terminal area and at the APCO and Kentuck project sites.

Impacts and Mitigation

Table 4.3.3.1-1 identifies the wetlands located at Jordan Cove's terminal site and associated sites. Approximately 86.1 acres of wetlands would be affected by construction of the proposed Jordan Cove LNG Project and approximately 22.3 acres of wetlands would be permanently lost due to construction and operation of the Project (see table 4.3.3.1-1). Approximately 0.5 acre of this impact would occur to wetlands as a result on non-jurisdictional facilities (e.g., the Trans-Pacific Parkway/U.S. 101 intersection and the industrial wastewater pipeline). The vast majority of impacts are associated with wetlands affected by construction of the ship and access channel and MOF and navigation reliability improvement dredge areas (which would impact 77.4 acres of wetlands).

TABLE 4.3.3.1-1

Wetlands Impacts on the LNG Project Area

Wetland Type	Acres Affected By Construction a/	Acres Affected By Operation
Slip and Access Channel and Material Offloading Facility (MOF)		
Estuarine b/, c/	37.3	18.3
Subtotal	**37.3**	**18.3**
Access /Utility Corridor		
Palustrine Emergent	0.8	0.6
Palustrine Scrub-Shrub	<0.1	<0.1
Subtotal	**0.9**	**0.6**
South Dunes Site		
Estuarine	0.1	0.1
Palustrine Aquatic Bed and Palustrine Unconsolidated Bottom	2.3	2.1
Palustrine Emergent	0.5	0.5
Palustrine Scrub-shrub	<0.1	<0.1
Palustrine Forested	0.3	0.3
Subtotal	**3.1**	**2.9**
Hydraulic Dredge Pipeline		
Estuarine	0.2	0.0
Subtotal	**0.2**	**0.0**
Industrial Wastewater Pipeline (IWWP)		
Palustrine Scrub-shrub	<0.1	0.0
Subtotal	**<0.1**	**0.0**
Trans Pacific Parkway/US-101 Intersection		
Estuarine	0.5	0.5
Subtotal	**0.5**	**0.5**
Marine Waterway Modifications – Dredge Areas 1 - 4		
Estuarine c/	27.0	0.0
Subtotal	**27.0**	**0.0**
Marine Waterway Modifications – Temporary Dredge Line		
Estuarine b/, c/	13.1	0.0
Subtotal	**13.1**	**0.0**
APCO Site d/		
Estuarine	<0.1	0.0
Subtotal	**<0.1**	**0.0**
Temporary Dredge Off-loading Area at APCO Site		
Estuarine c/	0.9	0.0
Subtotal	**0.9**	**0.0**
Temporary Dredge Transfer Line and Off-loading Area at Kentuck Site e/		
Estuarine b/, c/	2.2	0.0
Subtotal	**2.2**	**0.0**

TABLE 4.3.3.1-1 (continued)

Wetlands Impacts on the LNG Project Area

Wetland Type	Acres Affected By Construction a/	Acres Affected By Operation
Temporary Dredge Transfer Line and Loading Area at Eelgrass Mitigation Site f/		
Estuarine b/, c/	1.1	0.0
Subtotal	**1.1**	**0.0**
Ingram Yard g/	0.0	0.0
Port Laydown Site g/	0.0	0.0
Additional Offsite Park & Ride g/	0.0	0.0
Myrtlewood Offsite Park & Ride g/	0.0	0.0
Subtotal	**0.0**	**0.0**
Total Freshwater Wetland Impacts	3.9	3.4 g/
Total Estuarine Wetland Impacts	82.2 b/	18.9
Total All Wetland Impacts	**86.1**	**22.3**

Note that values may not sum correctly due to rounding. Acreages for wetlands are rounded to the nearest tenth of an acre; values below 0.1 acre are noted as <0.1.

a/ Acres affected by construction include acres affected by operation.

b/ Acreage of eelgrass and adjacent estuarine habitats subject to change based on field mapping conducted in late August 2018, which is currently under review.

c/ Impacts to deep subtidal habitat are not expected during operation, because natural recovery of benthic communities within this habitat is expected within a relatively short time frame following construction.; therefore, impacts are recorded as construction-phase only.

d/ APCO Site wetland and estuarine construction impacts are due to temporary bridge pilings.

e/ Wetlands associated with proposed mitigation areas (Panhandle, Lagoon, North Bank upland mitigation sites; Kentuck project site and Eelgrass Mitigation site) are not included in this table. Some correlated impacts to wetlands will occur at the Kentuck project site, but they will be offset by the overall mitigation project. A full accounting of correlated impacts will be included in the 404 permit application submitted to the COE.

f/ There are no wetlands within Ingram Yard, Port Laydown site, or Myrtlewood Offsite Park & Ride.

g/ Total freshwater wetland acreage includes 0.3 acre of operational forested wetland.

To satisfy COE and state permitting, Jordan Cove assessed the function and values of wetlands permanently affected by the Jordan Cove LNG Project to determine high value wetlands. The criteria used to assess wetlands were their water quality and quantity, the value of their fish and wildlife habitat, their native plant communities and species diversity, and their value for recreation and educational purposes. Four wetlands (wetlands 2013-6, 2012-2, Wetland C, and Wetland E), totaling less than two acres, are considered high value wetlands. The COE may also require additional compensatory mitigation for impacts on Aquatic Resources of Special Concern (ARSC), which are defined as "aquatic resources that are unique, difficult to replace, and/or have high ecological function" (COE 2018). ARSCs that may be affected by the Jordan Cove LNG Project may include estuarine wetlands, rocky substrate in tidal waters, and native eelgrass (*Zostera marina*) beds. As identified above, constructing and operating the Jordan Cove LNG Project would temporarily and permanently impact wetlands. In addition to the permanent loss of wetlands, temporary impacts on wetlands include loss of vegetation, and modification of wetland hydrology and soils characteristics. Disturbed wetlands are also susceptible to the introduction of exotic and invasive plant species. Based on assessments evaluating impacts on wetland habitats from dewatering activities, it is expected that groundwater movement and levels would return to pre-disturbance conditions following construction (DEA 2015, 2018a; GSI 2017). A monitoring program would be conducted prior to, during, and after construction to monitor potential impacts on ground and surface waters, as well as wetlands. In addition to impacts on wetlands listed in table 4.3.3.1-1, Henderson Marsh, which is located directly to the west of the terminal, may be affected due to a minor reduction in water entering the marsh due to the construction of the tsunami berm on the west side of the slip.

All impacts associated with mitigation sites are not part of the proposed action and are proposed only as necessary compensation for unavoidable impacts. Approximately 108.7 acres of wetlands (6.0 acres of estuarine wetlands and 102.7 acres of freshwater wetlands and open water) would be temporarily affected at the Kentuck project site in association with wetland restoration and mitigation activities. Potential impacts at the Kentuck project site include a temporary reduction in water quality due to an increase in sedimentation (e.g., resulting from import and grading of dredge material), temporary disturbances to adjacent wildlife, and a temporary impact on vegetation removed during restoration activities at the site. However, these impacts would be part of an overall long-term enhancement of the wetland habitat. Dredging for construction of the Eelgrass Mitigation site could result in approximately 10.3 acres of temporary short-term impacts; potential impacts include a temporary reduction in water quality due to an increase in sedimentation during dredging activities and a temporary loss of benthic organisms. Benthic organisms could re-establish within the area once eelgrass revegetation was complete (see section 4.5 of this EIS).

When unavoidable wetland impacts are proposed, the COE, EPA, and ODSL require that all practicable actions be taken to avoid, minimize, and then compensate for those impacts. The COE would determine the specific type and amount of compensatory mitigation that would be required to offset the loss of wetland acreage and functions that cannot be avoided or minimized as part of the CWA Section 404 permit process and by the ODSL as part of the state Removal-Fill permit process.[87]

Prior to COE authorization, the COE must ensure aquatic resource impact avoidance and minimization have been identified, outlined, and promulgated by an applicant. The COE uses a mitigation sequence to assess the need for aquatic resource impacts. This mitigation sequence contains a primary structure centered on avoidance of aquatic resource impacts, minimization of aquatic resource impacts, restoration of aquatic resource functions and services, and compensation for the loss of aquatic resource impacts that could not be avoided. If, after outlining project aquatic resource avoidance and minimization to the degree practicable, an applicant may mitigate for subsequent aquatic resource impacts. Mitigation for aquatic resource impacts is carried out via the development of a compensatory mitigation plan. A compensatory mitigation plan must be developed to meet the requirements of the 2008 Compensatory Mitigation Rule as outlined in the Final Rule on Compensatory Mitigation for Losses of Aquatic Resources (73 [70] FR 19594-19705 [April 10, 2008]) and in 33 CFR Part 232.4.

A compensatory mitigation plan must replace lost aquatic functions and values, and must contain the following required components:

- goals and objectives;
- site selection criteria;
- site protection instrument;
- baseline environmental information;

[87] The Oregon International Port of Coos Bay received a removal-fill permit from the ODSL to construct the slip and access channel for development of a new terminal (DSL permit 37712-RF). A new application will be submitted to ODSL for the remaining portions of the Jordan Cove Project area not covered by ODSL permit 37712-RF. A permit application that covers the entire Jordan Cove Project area will also be submitted to the COE.

- determination of credit methodology;
- mitigation work plan;
- maintenance plan;
- performance standards;
- monitoring requirements;
- long-term management plan;
- adaptive management plan; and
- financial assurances.

Jordan Cove developed a *Compensatory Wetland Mitigation Plan* to address unavoidable impacts on wetlands and other aquatic resource types.[88] Impacts on freshwater wetland resources would be mitigated via the Kentuck project site. Approximately 9.1 acres of the Kentuck project site would be enhanced and restored to mitigate for permanent impacts on freshwater wetlands (see Table 4 of Jordan Cove's *Compensatory Wetland Mitigation Plan*). Impacts on estuarine wetland and aquatic resources would be mitigated via the Eelgrass Mitigation site and Kentuck project site. Approximately 91.5 acres would be enhanced and restored at the Kentuck project site, and approximately 7.7 acres would be enhanced at the Eelgrass Mitigation site for a total of approximately 99.1 acres of mitigation for permanent impacts on estuarine wetlands and aquatic resources (see Table 4 of Jordan Cove's *Compensatory Wetland Mitigation Plan*). These mitigation plans are still being reviewed by the COE, ODSL, and applicable federal and state agencies. Approval of these mitigation plans by these agencies would be required prior to issuance of federal and state wetland permits. Restoration efforts at the Kentuck project and Eelgrass Mitigation sites would result in some short-term and permanent impacts; however, the *Compensatory Wetland Mitigation Plan* accounts for these impacts and provides mitigation to offset these impacts.

4.3.3.2 Pacific Connector Pipeline Project

Pacific Connector conducted wetland delineations of pipeline related workspaces. For areas where on-site delineation was not possible due to lack of landowner permission, Pacific Connector used USGS topographic maps, NRCS soil surveys, FWS NWI maps, and aerial photography to identify wetland type and boundaries. Wetland types identified along the proposed route included estuarine intertidal flats, estuarine subtidal channels, estuarine emergent, palustrine unconsolidated bottom, palustrine aquatic bed, palustrine emergent, palustrine scrub-shrub, palustrine forested, and riverine.

Along the proposed pipeline route, PEM wetlands, which are commonly disturbed by agricultural and grazing activities, are dominated by hydrophytic pasture grasses such as meadow foxtail (*Alopecurus pratensis*), rough bluegrass (*Poa trivialis*), and various bentgrasses (*Agrostis* spp.). Soft rush and white clover (*Trifolium repens*) are also commonly present in these disturbed wetlands. Within Douglas and Jackson Counties, pennyroyal (*Mentha pulegium*) is also a common dominant species in emergent wetlands. Emergent wetlands dominated by native species are uncommon, but when they occur (primarily within swales and irrigation canals) they generally contain cattail (*Typha latifolia*), small-fruited bulrush (*Scirpus microcarpus*), hardstem bulrush (*Schoenoplectus* [*Scirpus*] *acutus*), manna grass (*Glyceria striata* [*G. elata*]), American

[88] See *Jordan Cove Energy Project Compensatory Wetland Mitigation Plan* filed with the FERC in May 2018.

sloughgrass (*Beckmannia syzigachne*), and various sedges (*Carex* spp.). Vernal pool wetlands, which occur along the proposed pipeline route, are also defined as palustrine emergent wetlands.

Scrub-shrub wetland communities along the proposed pipeline route consist of two primary types: disturbed wetlands associated with grazing or development activities and relatively undisturbed wetlands. Common species within disturbed wetlands tend to support invasive species such as Himalayan blackberry (*Rubus laciniatus*) and sweetbriar rose (*Rosa rubiginosa* [*R. eglanteria*]). Common species in undisturbed wetlands include a mixture of Douglas' spirea, Pacific willow (*Salix lasiandra*), salmonberry (*Rubus spectabilis*), and Pacific ninebark (*Physocarpus capitatus*).

The majority of delineated forested wetlands along the proposed pipeline route contain Oregon ash (*Fraxinus latifolia*). Red alder (*Alnus rubra*) and black cottonwood (*Populus trichocarpa*) are more common along the western part of the pipeline route in Coos and Douglas Counties. Western red-cedar (*Thuja plicata*) and Sitka spruce are common in the coast range forested wetlands. Skunk cabbage (*Lysichiton americanum*) and salmonberry are common in the understory of coast range forested wetlands and lady fern (*Athyrium filix-femina*) and horsetails (*Equisetum* spp.) are often present in the understory in other parts of the pipeline route. Forested wetlands are uncommon along the southeastern portions of the pipeline route, but are generally in swales or depressions. They are dominated by Oregon ash with an understory of Himalayan blackberry, slough sedge, and spreading rush (*Juncus patens*).

Riverine wetlands are freshwater wetland habitats contained within a channel. The riverine wetlands along the proposed pipeline route include species similar to those found in the palustrine emergent, scrub-shrub, and forested wetlands.

Intertidal flats are the predominant estuarine wetland type crossed by the pipeline route. These wetlands are intertidal systems that are regularly flooded and have an unconsolidated shore (i.e., tidal mud/sand flats). Vegetation in estuarine tidal flats, with the exception of sea grass beds and algal mats, is generally restricted to small areas of accretion in the tidal marsh-mudflat boundary (Seliskar and Gallagher 1983). Estuarine subtidal channels occur below mean low tide and are adjacent to tidal mudflats. Subtidal channels provide important ecological functions including providing fish and invertebrate shelter during low tides, supporting sea grass communities and acting as nursery areas for some aquatic species (ODFW 2017a).

Estuarine emergent wetlands, also called estuarine marshes, occur along the outer edges of the tidal mudflats. Vegetation in these wetlands are typically erect, perennial species such as arrow grasses (*Triclochin* spp.), cordgrasses (*Spartina* spp.), bulrushes (*Scirpus* spp.), and alkali grasses (*Puccinellia* spp.).

Impacts and Mitigation

Constructing the pipeline would temporarily and permanently impact wetlands. Clearing wetland vegetation could alter several wetland functions including their ability to provide fish and wildlife habitats, sediment and nutrient trapping, and other water quality functions. Additionally, soil disturbance and removal of vegetation could temporarily affect a wetland's capacity to moderate flood flow, control sediment, or facilitate surface water flow. Removing vegetation could also increase water and soil temperatures and alter species composition within forested and shrub wetlands to a more shade intolerant composition. Digging a trench through an impervious layer of soil in a wetland would alter the hydrologic character of the wetland. Failure to segregate topsoil from the trench could result in altered biological and chemical functions in the wetland soil and could affect the re-establishment of vegetation, recruitment of native vegetation, or success of plantings. Improper operation of equipment or transport of pipe in wetlands could inadvertently rut or compact the soil and affect natural hydrologic patterns of the wetlands and may lead to inhibited seed germination or increase the potential for siltation. Improper sediment controls could lead to sediment deposition in wetlands (including those wetlands located downslope or outside of the right-of-way or construction disturbance footprint), which could lead to the release of chemical and nutrient pollutants from sediments.

The range and intensity of wetland impacts would vary depending on the type of wetland affected. In general, impacts on herbaceous wetlands would be short term, while impacts on scrub-shrub and forested wetlands would be long term. Impacts on herbaceous wetlands would be considered short term because herbaceous vegetation generally regenerates quickly. Scrub-shrub and forested wetlands may take several years to decades to reach functionality similar to pre-construction conditions, depending on the age and complexity of the system. Also, some wetlands would be permanently converted from one type to another (e.g., forested to scrub-shrub and/or herbaceous) as a result of pipeline maintenance activities.

As identified in table 4.3.3.2-1, constructing the pipeline would impact 112.2 acres of wetlands. Of this 112.2 acres, operation of the pipeline would permanently impact approximately 4.9 acres of wetlands. This includes 4.0 acres of long-term impacts on scrub-shrub and forested wetlands and 0.9 acres of wetlands that would be permanently converted to a different wetland type. Tables H-1a and H-1b in appendix H of this EIS list the wetlands crossed by the pipeline by wetland type, ecoregion, subbasin, and fifth-field watershed, and list the acres of impacts that would occur to each of these wetlands.

TABLE 4.3.3.2-1

Summary of Wetland Impacts along the Pacific Connector Pipeline

Wetland Type	Total Acres Affected by Construction	Total Acres Affected by Operation a/, b/
Palustrine unconsolidated bottom and aquatic beds	0.6	0.0
Palustrine emergent wetlands	106.7	0.0
Palustrine forested wetlands	2.6	2.6 (0.7)
Palustrine scrub-shrub wetlands	2.3	2.3 (0.2)
Total Wetland Impact	**112.2**	**4.9 (0.9)**

Note that values may not sum correctly due to rounding. Acreages for wetlands are rounded to the nearest tenth of an acre; values below 0.1 acre are noted as <0.1.

a/ Includes wetlands that would be allowed to restore to preconstruction conditions (i.e., they would not be filled, nor would they be located within the permanent 10-foot-wide operational corridor); however, it could take many decades for conditions within these wetlands to restore to preconstruction conditions.

b/ The numbers in parentheses represent the permanent conversion of forested wetlands within the 30-foot-wide maintenance corridor and scrub-shrub wetlands within the 10-foot-wide maintenance corridor.

The pipeline would cross 18 (fifth-field) watersheds; however, approximately 78 percent (87.3 acres) of the pipeline's total impact on wetlands would occur in two watersheds: the Lake Ewauna Upper Klamath River watershed and the Coos Bay Frontal watershed. The remaining 24.9 acres of wetland impacts would occur primarily in small palustrine emergent wetlands and intermittent drainages where impacts would be temporary and short term. As described previously, to satisfy COE and state permitting, Pacific Connecter assessed the function and values of wetlands to determine which affected wetlands were high value wetlands. Constructing the pipeline would impact approximately 7.1 acres of high value wetlands, with the majority of these impacts (about 4.1 acres) occurring to two palustrine emergent wetlands (Wetland ID EW-33 and EW-35) associated with the floodplain of Salt Creek in Jackson County. As stated above, the COE may also require additional compensatory mitigation for impacts on ARSCs (COE 2018). ARSCs that may be affected by the proposed pipeline include alkali wetlands, mature forested wetlands, vernal pools, and Willamette Valley wet prairie wetlands.

To minimize impacts on wetlands, Pacific Connector would implement the construction and restoration measures contained in its ECRP. Section VI.A.3 of the FERC's *Procedures* requires that the construction right-of-way width be limited to 75 feet across wetlands, while Section VI.B.1.a requires that TEWAs be located at least 50 feet away from wetland boundaries. However, Pacific Connector has submitted modifications for these requirements associated with where the applicant requested a 95-foot-wide construction right-of-way in a wetland or that TEWAs be located less than 50 feet away from a wetland (table E-1 in appendix E). Their justifications for the modifications at specific locations vary, but include reasons such as: 1) necking-down the right-of-way in emergent wetland would require use of TEWAs that would be located 50 feet back from the waterbody, which could result in these work areas being located within forested or shrub wetlands that can have a higher function and value than the disturbed emergent wetland, and 2) where the pipeline traverses disturbed emergent wetlands, such as in agricultural areas (cropland and hayfields), the typical 95-foot-wide construction footprint in uplands will be maintained because these wetlands are degraded systems that are expected to fully recover within one full growing season. Pacific Connector's proposed modifications to FERC's *Plan* and *Procedures* are provided in appendix E, also see discussion in section 2. Based on our *Procedures* and as described in its ECRP, Pacific Connector would implement the following measures in wetlands

- the top 1 foot of topsoil would be segregated from the subsoil in the area disturbed by trenching, except where standing water is present, or soils are saturated or frozen. Immediately after backfilling, the segregated soil would be restored to its original location;
- vegetation would be cut just above ground level to leave the existing root system in place. Tree stump removal and grading would occur directly over the trenchline. Stumps would not be removed from the rest of the right-of-way unless required for safety reasons;
- construction equipment operating would be limited to that needed to clear vegetation, dig trenches, install the pipe, backfill, and restore the right-of-way. Other equipment would use upland access roads to the maximum extent possible. Travel would be restricted across wetlands where topsoil was restored;
- low ground-weight equipment would be used in saturated wetlands or the normal equipment would be operated on prefabricated equipment mats;
- slope breakers and sediment controls would be installed and maintained on slopes greater than 5 percent that are less than 50 feet from a wetland;
- erosion control devices would be installed and maintained as necessary to prevent sedimentation and runoff from entering wetlands;
- trench breakers would be installed, or the bottom of the trench would be sealed as necessary, to maintain the original wetland hydrology;
- appropriate weed-free live seed mixtures would be used for revegetation. No fertilizers would be used in wetlands;

- appropriate native trees and shrubs would be replanted during restoration of wetlands within riparian areas;
- wetlands would be monitored after revegetation for three years after construction or until the revegetation is successful. Revegetation would be considered successful when 80 percent of the type, density, and distribution of species are similar to that of adjacent unaltered wetlands. If revegetation is not successful at the end of three years, Pacific Connector would develop and implement a remedial revegetation plan to actively revegetate the wetland and would continue revegetation efforts until wetland revegetation is successful; and
- vegetation maintenance would not be conducted over the full width of the operational right-of-way within wetlands, but limited to a 10-foot-wide corridor.[89]

The COE and ODSL may require additional mitigation (beyond what is required in this EIS) during their permitting process, which could include creating, restoring, or enhancing wetlands to replace the wetland functions and areas connectivity lost due to Project activities, or purchasing credits from a mitigation bank. ODSL administrative rules (OAR 141-085-0690) include minimum ratios for acres required for compensation that varies by type of mitigation proposed (e.g., restoration is 1 acre for each acre lost, creation is 1.5 for 1, and enhancement is 3 for 1). Pacific Connector has developed a *Compensatory Wetland Mitigation Plan* to mitigate for unavoidable impacts on wetlands affected by construction and operation of the pipeline (see section 4.3.3.1). The adequacy of wetland mitigation, including the scope and location of mitigation, would be determined by the COE.

4.3.3.3 Conclusion

In total the Project would impact a total of about 198 acres of wetlands, about 27 acres of which would be permanently lost. Based on our review of the Project and Jordan Cove and Pacific Connector's implementation of measure to reduce impacts on wetlands, we conclude that constructing and operating the Project would not significantly affect wetlands. Additionally, to mitigate wetlands impacts, Jordan Cove and Pacific Connector have prepared a Compensatory Wetland Mitigation Plan.

4.3.4 Environmental Consequences on Federal Lands

4.3.4.1 Groundwater

Shallow Groundwater

As indicated in section 4.3.1.2, the Pacific Connector Pipeline Project would cross areas where the groundwater is 0-6 feet bgs. The BLM and Forest Service may require that trench dewatering through a well point pumping system with a groundwater treatment plan be used, depending on if the groundwater is emanating from a pressurized or non-pressurized source point. On federal lands, dewatering activities would be coordinated with the BLM or Forest Service.

[89] Additionally, trees may be selectively removed if they are within 15 feet of the pipeline that could compromise the pipeline coating integrity.

Springs, Seeps, and Drains

Pacific Connector surveys have identified a number of springs and seeps, as noted in appendix H of this EIS. Pacific Connector has stated that it would further verify exact locations of springs and seeps during easement negotiations with land managers. Nearby springs and seeps supplied by deeper pressurized groundwater zones would generally not be affected by the trenching activities or trench plugs. Spring and seeps supplied by shallow groundwater, however, may be effected by the pipeline project, particularly if the pipeline is directly up-gradient of a spring or seep location.

The BLM has disclosed that French drains, similar in function to drain tiles, were installed to stabilize Elk Creek Road, which the proposed route would cross six times between MPs 34.02 and 37.15. These crossings are all within BLM lands. Pacific Connector would ensure that any French drains damaged by the pipeline would be repaired before backfilling. If either damage or repair causes a discharge to waterways under federal jurisdiction, a water quality permit would be required under Section 404 of the CWA. All French drains crossed by the Pacific Connector pipeline would be probed prior to right-of-way restoration to check for damage, and a qualified specialist would test for damage and conduct any necessary repairs. Pacific Connector would restore any damaged drains to the same condition that existed prior to construction. In order to identify, monitor, minimize, and mitigate for potential effects to groundwater, Pacific Connector has developed a *Groundwater Supply Monitoring and Mitigation Plan.* Land managers would be supplied with documentation that explains the pipeline construction Project and outlines the pre-construction field investigation for the identification and monitoring of groundwater supplies. Pre-construction surveys would be conducted to confirm the presence and locations of all groundwater supplies within and adjacent to the pipeline right-of-way.

Soil Compaction

Near-surface soil compaction caused by heavy construction vehicles could locally reduce the soil's ability to absorb water, which would increase surface runoff and the potential for ponding. To avoid long-term changes in water table elevation and subsurface hydrology, excavated topsoil and subsoils would be segregated (on non-federal lands) within wetlands, agricultural areas, and at the request of landowners, and returned as closely as practical to their original soil horizon and slope position. Following construction, restoration of compacted soils would include regrading, recontouring, scarifying (or ripping), and final cleanup activities. Decompacting soils would restore water infiltration, reduce surface water runoff, minimize erosion, and support revegetation efforts. The EI would be responsible for conducting soil compaction testing and determining corrective measures on non-federal lands, including localized deep scarification or ripping to an average depth of up to 8 inches where feasible, utilizing appropriate winged-tipped rippers. On federal lands, remediation and corrective measures to address compaction would be consistent with specific requirements of the BLM RMP Best Management Practices (e.g., R-91, TH-18) and Forest Service requirements (see NSR 2015a for details).

Accidental Spills of Hazardous Materials

Pipeline construction necessitates the use of heavy equipment and associated fuels, lubricants, and other potentially hazardous substances that, if spilled, could affect shallow groundwater and/or unconsolidated aquifers, throughout different aquifer layers. Accidental spills or leaks of hazardous materials associated with vehicle fueling, vehicle maintenance, and construction materials storage would present the greatest potential contamination threat to groundwater resources. Soil contamination resulting from these spills or leaks could continue to add pollutants to the groundwater long after a spill occurs. Implementation of proper storage, containment, and handling procedures would minimize the chance of such releases. Pacific Connector will follow the procedures outline in the *SPCC Plan* to minimize the potential of a spill, properly contain a spill in the event that one occurs, and to protect areas of environmental concern.

4.3.4.2 Surface Water

The Pacific Connector pipeline route would cross 19 fifth-field watersheds, and proposed access roads would cross an additional 5 watersheds. Of these, the Pacific Connector would cross NFS land in 6 fifth-field watersheds subject to ACS.

Riparian Reserves and the ACS

The 1994 NWFP set forth detailed requirements that describe how land managers should treat the forest lands within the range of the northern spotted owl (through implementation of the Standards and Guidelines – Attachment A to the 1994 NWFP ROD [Forest Service and BLM 1994a]). Some standards and guidelines apply to all lands and others to a specific land allocation. The 1994 NWFP ROD described the ACS, which was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands. The strategy would protect salmon and steelhead habitat on federal lands managed by the Forest Service within the range of the NSO. In August 2016, the BLM issued two RODs for two new RMPs (BLM 2016a and 2016b). These two plans supersede the NWFP on BLM lands. BLM retained a Riparian Reserve allocation but provided new management direction, thus eliminating the ACS requirements on BLM lands. The following discussion is specific to the Forest Service.

To achieve ACS objectives in the 1994 NWFP ROD, the ACS included areas defined as Riparian Reserves and Key Watersheds, specified analytical procedures for evaluating watersheds, and defined a program for watershed restoration. While the ACS focus was primarily on the conservation of anadromous salmon and steelhead, the nine objectives listed for the ACS include maintaining and restoring aquatic systems, floodplains, wetlands, upslope habitats, and riparian zones to support invertebrate and vertebrate species dependent on those habitats.

The existing conditions and range of variability within the fifth-field watersheds that would be crossed by the Pacific Connector pipeline are provided in the watershed analyses that were prepared by the Forest Service having jurisdiction over the NFS lands within the watersheds. Watershed assessments are a necessary component of a monitoring program in order to determine what degraded or impaired areas may exist in the watershed. Table 4.3.4.2-1 lists the fifth-field watersheds subject to ACS that would be crossed by the proposed route.

TABLE 4.3.4.2-1

Fifth-Field Watersheds Crossed by the Pacific Connector Pipeline on Forest Service Lands

Jurisdiction	Watershed (Name)	Approximate Miles Crossed	Watershed Analysis Completed
Forest Service – Umpqua National Forest (NF)	Days Creek-South Umpqua River a/	1.6	2001
	Elk Creek a/	2.7	1995 a/
	Upper Cow Creek a/	4.5	1995 a/
	Trail Creek a/	2.1	1995 a/
Forest Service – Rogue River NF	Little Butte Creek	13.7	1997
Forest Service –Winema NF	Spencer Creek	6.1	1995
	Total Watersheds Crossed on NFS Lands	**30.7**	

Note that mileages may not sum correctly due to rounding. Mileages are rounded to the nearest tenth of a unit; values below 0.1 are noted as <0.1.
Source: BLM 2006; Forest Service 2006a
a/ The Elk Creek Watershed Analysis (Forest Service 1996) and the Cow Creek Watershed Analysis (Forest Service 1995a) encompass the Umpqua National Forest lands crossed by the pipeline.

The following subsection discusses acres of impacts to Key Watersheds and the mitigation measures that would be implemented on NFS land to compensate for impacts. Key Watersheds are defined as either Tier 1 or Tier 2. Tier 1 (Aquatic Conservation Emphasis) Key Watersheds contribute directly to conservation of at-risk anadromous salmonids, bull trout, and resident fish species. They also have a high potential of being restored as part of a watershed restoration program. While Tier 2 (other) Key Watersheds may not contain at-risk fish stocks, they are important sources of high-quality water. Riparian Reserves are lands along streams, wetlands, ponds, lakes, reservoirs and unstable and potentially unstable areas where special standards and guidelines direct land use on NFS lands.

Four watersheds that encompass NFS lands that would be crossed by the Pacific Connector pipeline are designated as Key Watersheds: (1) Days Creek-South Umpqua River (Tier 1); (2) Elk Creek-South Umpqua River (Tier 1); (3) Little Butte Creek; and (4) Spencer Creek (Tier 1. Key Watersheds that would be crossed by the Pacific Connector pipeline are listed in table 4.3.4.2-2.

TABLE 4.3.4.2-2

Key Watersheds Crossed by the Proposed Pacific Connector Pipeline

Key Watershed	Jurisdiction	Approximate Miles Crossed	Approximate Construction Disturbance (acres) a/	Approximate Operational Easement (acres) b/
Days Creek-South Umpqua River (Tier 1), MP 82.71-102.59	Umpqua National Forest	1.56	53	10
Elk Creek-South Umpqua River (Tier 1), MP 101.8-109	Umpqua National Forest	2.67	30	16
Little Butte Creek (Tier 1), MP 135.04-168	Rogue River National Forest	13.75	277	83
Spence Creek (Tier 1), MP 168-183.02	Winema National Forest	6.05	92	37
	Total	**24**	**452**	**146**

Note that values may not sum correctly due to rounding. Mileages are rounded to the nearest tenth of a unit; values below 0.1 are noted as <0.1. Acreages are rounded to the nearest whole acre; values less than 1 are noted as <1.
a/ Includes uncleared storage areas.
b/ Assumes 50-foot-wide long-term easement.

The pipeline would not cross any roadless areas and would not require any new roads to be constructed within Tier 1 Watersheds. Although the pipeline would cause temporary disturbance within Tier 1 watersheds, all disturbed areas associated with the pipeline would be restored after construction. No adverse, long-term effects are anticipated to the water resources. The 30-foot operational maintenance corridor along the pipeline centerline would create a long-term vegetation type conversion impact within forested vegetation types, but the vegetation conversion is not expected to measurably alter hydrologic functions. Restoration of all areas disturbed by the Pacific Connector pipeline would include shaping to the approximate original contour to restore drainage patterns, scarification to relieve compaction, and revegetation for stabilization and to restore habitats and land use functions. The compensatory mitigation measures outlined for LSRs and Riparian Reserves on NFS lands would benefit Key Watersheds if the mitigation projects such as road decommissioning occur within these watersheds.

On NFS lands where Riparian Reserves would be affected, up to a 100-foot riparian strip or to the edge of the existing riparian vegetation would be planted to ensure that the "maintain and restore" objectives of the ACS are accomplished for native riparian vegetation.

Impacts on Streams on Federal Lands and Mitigation

Temporary Equipment Crossings

For any temporary equipment crossings on any stream channel (whether intermittent or perennial, wet or dry) on federal lands, equipment crossings must be accomplished using (1) a bridge, (2) a temporary culvert with temporary road fill to be removed after work is completed, or (3) a low water ford with a rock mat. Although the FERC's *Procedures* allow clearing equipment and equipment necessary for installation of the temporary bridges to cross waterbodies prior to bridge installation, Pacific Connector would not allow clearing equipment to cross waterbodies prior to bridge placement. Furthermore, where feasible, Pacific Connector's contractor would attempt to lift, span, and set the bridges from the streambanks. Where it is not feasible to install or safely set the temporary bridges from the streambanks, only the equipment necessary to install the bridge or temporary support pier would cross the waterbody. Any equipment required to enter a waterbody to set a bridge would be inspected to ensure it is clean and free of dirt or hydrocarbons.

No waterbodies or riparian reserves on federal lands would be affected by temporary or permanent access roads.

Water Use During Pipeline Construction

Water withdrawals and releases on federal lands for dust suppression or hydrostatic testing would require site-specific approval from the agency that manages the specific water resources (federal or state). Site-specific approval by the authorized Forest Service officer on NFS lands, and similar authorizations by BLM and Reclamation would be coordinated through the development of the POD to support the Right-of-Way Grant. Withdrawals and releases of hydrostatic test water would be done in accordance with Pacific Connector's *Hydrostatic Test Plan*, included with the POD.

Potential Encounters with Contaminated Sediments

On federal land, hazardous substances, including chemicals, oils, and fuels, would not be stored within 150 feet of a waterbody or wetland boundary. As noted in the ECRP, any variance on federal lands would require prior approval by an authorized agency representative. In instances where it is not possible to maintain the 150-foot distance, the EI would request a variance that would require approval from the authorized agency representative. To reduce impacts from potential encounters with contaminated sediments, Pacific Connector would implement the measures outlined in its *Contaminated Substances Discovery Plan,* which was included as part of its Spill Prevention, Containment, and Countermeasures Plan.

East Fork Cow Creek Crossing

The Forest Service expressed concerns about the potential for naturally occurring mercury to reach the aquatic environment during construction of the pipeline near the historic Thomason claim group (near MP 109). To address this concern, Pacific Connector conducted a mine hazard evaluation and mercury testing study for the proposed 2007 route on the Umpqua National Forest at the crossing of East Fork Cow Creek, which crossed the Thomason claim group (GeoEngineers 2007b).[90] Soil samples were collected along the proposed alignment in an area believed to be outside the zone of mineralization where mercury deposits occur, in the stream system in the vicinity of the East Fork of Cow Creek, and from mine workings in proximity to the Pacific Connector right-of-way in 2007. The samples did not contain concentrations of mercury that exceeded human health risk screening criteria.

Subsequently, Pacific Connector moved its proposed route to the east to avoid a NSO nest site. GeoEngineers (2009)[91] conducted an additional assessment of the relocated route, approximately 3,300 feet upstream and east of the original 2007 crossing to address the continued concerns of the Forest Service regarding the potential for naturally-occurring mercury within the East Fork Cow Creek drainage. That study concluded that the soils underlying the current proposed crossing of East Fork Cow Creek are unlikely to have concentrations of naturally occurring mercury exceeding those measured in samples obtained from the previous 2007 crossing location and most likely will have lower levels than those reported in GeoEngineers' (2007b) mine evaluation.

In addition to the GeoEngineers (2009) report, the Forest Service contracted with a geologist consultant (Broeker 2010)[92] to collect soil and stream sediment samples for analytical testing and reporting of mercury and other naturally occurring minerals along a 2,000-foot section of the proposed pipeline route between MP 109 and the East Fork Cow Creek. The Broeker study also concluded that construction activities along the revised pipeline route are not likely to encounter soils with elevated mercury concentrations.

In order to prevent this naturally occurring mercury from entering the aquatic environment during and after construction, additional erosion control measures and monitoring would be conducted along the pipeline route in the vicinity of the East Fork Cow Creek. If sediments containing high

[90] GeoEngineers, Inc., 23 August 2007, *Mine Hazards Evaluation and Mercury Testing at the Red Cloud, Mother Lode, Nivinson, and Elkhorn Mining Groups, Jackson and Douglas Counties, Oregon*, prepared by A. Bauer and T. Hoyles, filed as stand-alone report with Pacific Connector's June 2013 application to the FERC.
[91] GeoEngineers, Inc., 2 October 2009, *Addendum to Mine Hazards Evaluation and Mercury Testing at the Red Cloud, Mother Lode, Nivinson, and Elkhorn Mining Group*, prepared by A. Bauer and T. Hoyles, filed as stand-alone report with Pacific Connector's June 2013 application to the FERC.
[92] Broeker, L., 3 February 2010, *Potential for Natural-Occurring Mercury Mineralization to Enter the Aquatic Environment between MP 109 and East Fork Cow Creek Williams' Pacific Connector Pipeline Project*, filed as a stand-alone report with Pacific Connector's September 2017 application to the FERC.

levels of mercury are encountered in the East Fork Cow Creek drainage during Project construction, Pacific Connector would implement the measures outlined in its *Contaminated Substances Discovery Plan*.[93]

Hyporheic Exchange at South Fork Little Butte Creek

The Forest Service has expressed concern that the crossing of South Fork Little Butte Creek would go through basalt and andesite bedrock, and therefore a site-specific crossing would need to address the potential for groundwater interception and flow at and near the crossing. A site-specific drawing for Little Butte Creek located on NFS land was included in Appendix 2E of Resource Report 2 with Pacific Connector's September 2017 application to the FERC. The crossing would need to address the potential for groundwater interception and flow at and near the crossing since it is a critical coho stream which flows through andesite and basalt. The *Stream Crossing Hyporheic Analysis* (GeoEngineers 2013c; 2017g) determined that South Fork Little Butte Creek crossing had high hyporheic sensitivity. Therefore, BMPs would be implemented to mitigate for this possible effect.

Given the potential for disruption of hyporheic processes at crossings with a "high" sensitivity ranking, in addition to the pre-construction survey, a qualified geotechnical professional would be on-site to observe trenching/excavation associated with pipeline installation to document subsurface conditions, including the presence of fractured bedrock or the low probability of the presence of lava tubes. The geotechnical professional would make recommendations for backfill composition, including the use of trench plugs or other mitigation measures, to ensure that disruption to groundwater pathways are minimized. These recommendations would be pre-approved by an authorized Forest Service representative.

Stream Temperature Assessment

Project-specific temperature modeling was conducted on federal lands stream crossings. Temperature modeling, using Stream Segment Temperature Model (SSTEMP) (Bartholow 2002), was conducted at the perennial stream crossings on BLM lands at Middle Creek Deep Creek and Big Creek, and NFS lands at multiple crossing on the East Fork Cow Creek in 2009 and again in 2013 to reflect new pipeline alignment and lower flow conditions (NSR 2009, 2015b,c). During 2013, temperature data recorders were placed at selected locations relative to each crossing during the warmest low-flow summer period to help validate the model. Flows in 2013 represented drought conditions and were about 33 percent of those modeled in 2009 at MP 109.69 in the East Fork Cow Creek. When compared to measured existing conditions, the SSTEMP model overestimated the lower flowing stream's actual existing stream temperature slightly (about 0.2 to 0.4°F) (NSR 2015b,c), indicating the inherent uncertainty in modeling stream temperatures in very small stream channels, and the potential to overestimate temperature changes in small streams.

Model analysis of right-of-way clearing effects predicted slight temperature increases on the BLM channel crossings in Middle Creek and a small tributary to Big Creek (NSR 2014), with these limited temperature changes likely due to relatively higher flows (Middle Creek), cooler air temperatures and relative channel orientations (NSR 2015b). During the drought conditions of 2013, modeled 7-day maximum stream temperature just below in the multiple East Fork Cow

[93] Appendix E of the POD filed as a stand-alone report in Pacific Connector's September 2017 application to the FERC.

Creek crossings showed potential temperature increases of 1.2°F to 4.2°F under the rare drought flow conditions that occurred in 2013 (NSR 2015c). Measured stream volumes ranged from 0.045 cubic feet per second to 0.115 cubic feet per second with modeled total vegetation removal in the whole 75-foot right-of-way for post-construction shade levels ranging from 1.2 to 3.7 percent. Under the drought conditions of 2013 (high temperature and low flow), modeled results suggest temperatures may exceed the TMDL thresholds (0.1°C or 0.18°F at the point of maximum impact) or ODEQ Core Cold-Water Habitat temperature criteria of 16°C (61°F) in small perennial channels in the East Fork Cow Creek. This occurrence likely overestimates temperature changes that would most often occur, because of the drought conditions that occurred in 2013 and potential to overestimate of temperature in low-flow channels from the SSTEMP model as noted above. The 2014 analysis showed larger temperature increases than those reported in NSR (2009) primarily due to much lower flows during 2013.

Although exposure to solar radiation may cause temperature increases, temperatures downstream from limited stream-side forested clearings have often been found to cool rapidly once the stream re-enters forested regions (Zwieniecki and Newton 1999). Other studies have noted downstream cooling below timber harvest areas as well, but the extent of this cooling is not entirely clear and varies by stream (Moore et al. 2005; Poole 2001). Although there is some debate on the magnitude of cooling provided by riparian vegetation and the extent to which stream temperatures return to non-cleared temperature levels after exiting a cleared area, studies emphasize that riparian buffers assist in maintaining water temperatures (Correll 1997; Gomi et al. 2006). Generally, changes in temperature, especially in small streams, may recover quickly from cooler surrounding conditions downstream (e.g., streambed cooling, evaporation, hyporheic inflows, shade). This was validated by stream temperature data recorded on the Umpqua National Forest in 2013. The updated temperature assessment prepared for the Forest Service at this location (NSR 2014) incorporated field measurements of existing conditions on the Umpqua National Forest that showed decreasing stream temperatures of as much as -7.6°F per 100 feet with an overall average over 2,040 feet of the East Fork Cow Creek of -0.1°F per 100 feet (NSR 2015c). The presence of numerous small wetlands adjacent to the stream channel provide evidence of likely groundwater interactions. Most of this 2,040-foot reach also has substantial shade, suggesting the retention of shading structures, or at least partial shade, may greatly reduce increases in stream temperature. The 2014 assessment also supports the NSR (2009) finding that potential temperature increases are partially offset by cooling from groundwater interactions in the stream channel.

Observations of these streams suggest that LWD and low-growing willows, huckleberries, and other brush species can provide effective shade for small, narrow channels. Blann et al. (2002) noted that riparian grasses and forbs supply as much shade as wooded buffers for streams less than 8 feet (2.5 meters) wide. In many cases during pipeline crossing construction, low-growing brush outside of the immediate crossing construction area could be retained minimizing shade loss. In the mainstem of the East Fork Cow Creek, LWD provides significant shade that helps maintain cooler water temperatures. As described in the ECRP and waterbody crossing requirements for the project, all LWD and boulders removed from the crossing area would be replaced during site restoration and low-growing brush would be retained where possible (NSR 2015). Many of the channels crossed by the Pacific Connector pipeline on federal lands are very small, and could easily be shaded by the placement of LWD and willow plantings. Where site-specific modeling on NFS perennial stream crossings suggests temperature increases over natural pre-project levels, a plan would be prepared to reestablish pre-crossing shade conditions using items such as willows, boulders, and LWD.

With the retention of existing shading brush on small channels, the placement of LWD, and the replanting of willows and other brush species, downstream temperatures are expected to be comparable to the existing condition and to remain below ODEQ thresholds on the East Fork Cow Creek. Additionally, any temperature increases in small streams would likely be masked by the assimilative capacity of larger streams at the stream network scale (NSR 2009).

During the ODEQ CWA Section 401 process, Pacific Connector would develop a source-specific implementation plan in accordance with OAR 340-042-0080 for areas with existing TMDLs and Pacific Connector would be identified as a new nonpoint source. For perennial stream crossings on federal lands, this plan would incorporate the requirements of the site-specific restoration plans (NSR 2015b, c). The source-specific implementation plan would outline mitigation for predicted thermal impacts (GeoEngineers 2013i). This mitigation would have as its goal restoring shade along affected stream channels and nearby channels within the same fourth-field HUCs. Mitigation for construction-related impacts would occur to the extent allowed by landowners on the affected streambanks. This mitigation would incorporate riparian revegetation required by the Forest Service for impacts to riparian reserves on NFS lands. The length of channel banks planted by Pacific Connector would be determined prior to pipeline construction once a clear understanding of landowner wishes regarding streambank planting are known. Contiguous lengths of streambank planting would be preferred over planting on multiple small parcels, particularly for mitigation of permanent impacts. Mitigation ratios of 1:1 for construction-phase impacts or 2:1 for permanent impacts would be applied as outlined in ODEQ's September 2011 letter. Prior to construction, Pacific Connector would also provide the implementation plan to FERC.

Where TMDL thermal load allocations have not yet been established, ODEQ's 401 Water Quality Certification would require the development of a Water Protection Plan, consistent with the source specific implementation plan, and a mitigation plan to address project impacts on thermal loading.

On NFS lands, the Forest Service has requested that the riparian vegetation strip be extended up to 100 feet on either side of waterbodies in Riparian Reserves. Pacific Connector has agreed to implement this measure on both NFS lands and BLM lands. The riparian strip would generally be replanted with species such as willow cuttings and dogwood to provide a quick cover for shading and streambank stability. Quick cover plantings may be shorter in height than vegetation removed during constructions, thus providing less shade. Plantings/seeding would be done with native vegetation of a local source. The riparian strip would be maintained to allow an herbaceous cover 10 feet in width centered over the pipeline to facilitate corrosion and leak surveys. The remaining area of the construction right-of-way within the riparian strip would be replanted with trees that would provide greater height and stream shading over time.

<u>Restoration</u>

Near-surface soil compaction caused by heavy construction vehicles could locally reduce the soil's ability to absorb water, which would increase surface runoff and the potential for ponding. To avoid long-term changes in water table elevation and subsurface hydrology, excavated topsoil and subsoils would be segregated within wetlands, agricultural areas, and at the request of landowners, and returned as closely as practical to their original soil horizon and slope position. Following construction, restoration of compacted soils would include regrading, recontouring, scarifying (or ripping), and final clean-up activities. Decompacting soils would restore water infiltration, reduce surface water runoff, minimize erosion, and support revegetation efforts. Pacific Connector would test for soil compaction in agricultural (e.g., active croplands, hayfields, and pastures), residential areas, and on federal lands. The EI would be responsible for conducting soil compaction testing and determining corrective measures on non-federal lands, including localized deep scarification or ripping to an average depth of up to 8 inches where feasible, utilizing appropriate winged-tipped rippers. On federal lands, remediation and corrective measures to address compaction will be consistent with specific requirements of the BLM, Forest Service, and Reclamation (see NSR 2015a for details). In response to a Forest Service request, Pacific Connector would stabilize intermittent stream crossings (whether flowing or not) on NFS lands with temporary sediment barriers and reseed as described for other waterbodies. Streambanks and stream beds would be revegetated with native species and "armored" as needed with LWD and boulders to ensure stability. Channel breakers would be installed on each side of the trench to ensure that subsurface flows are not captured by the pipeline trench.

As discussed in section 4.3.2, Pacific Connector has requested a modification to the FERC's *Procedures* requirement that the upper 1 foot of the trench to be backfilled with clean gravel or native cobbles in all waterbodies that contain cold water fisheries. Pacific Connector has requested that for instances where the existing substrate is not gravel or cobbles, and site access is limited and would require unreasonable efforts to transport clean gravel to the waterbody, that only native materials removed from the stream be used for backfill.

For crossings of perennial streams on BLM and NFS lands, the site-specific restoration plans included as a supplement to appendix F.4 (NSR 2014)[94] will be used as directed by BLM and Forest Service monitors in conjunction with FERC's EIs. These restoration plans have been designed to ensure that restoration and revegetation of these crossings are consistent with ACS objectives as described in the relevant Forest Service land management plans.

All disturbed areas on federal lands would be monitored following construction to verify successful revegetation and to implement corrective action. Pacific Connector would also adhere to its mitigation plan (developed to mitigate for impacts to all riparian and upland habitats), which would be followed in areas with severe to soil erosion potential. Throughout operation of the pipeline, Pacific Connector would continue to monitor and maintain the right-of-way. The Forest Service, in consultation with Pacific Connector, has prepared a list of mitigation actions to address unavoidable impacts on NFS lands.

4.3.4.3 Wetlands

The Pacific Connector pipeline would cross approximately 0.2 mile of wetlands on federally managed land, affecting a total of approximately 2.2 acres (see table H-1a in appendix H). Permanent wetland vegetation conversion on federally managed lands would occur in approximately 0.2 acre of wetlands as a result of vegetation management on the operational right-of-way. This 0.2 acre of permanent conversion would occur to three wetlands: palustrine forested wetland CW010 located on lands managed by the BLM Coos Bay District, palustrine forested

[94] These site-specific restoration plans for BLM and Forest Service stream crossings are also incorporated into the Wetland and Waterbody Crossing Plan that is part of the POD.

wetland AW309 located on lands managed by the BLM Medford District, and palustrine scrub-shrub/emergent wetland GW-14/FS-HF-CWWW-111-001 (i.e., a tributary to East Fork Cow Creek) managed by the Forest Service (on the Umpqua National Forest).

There would be no permanent wetland loss or wetland impacts on federally managed land due to the construction of aboveground facilities. Impacts resulting from use of existing roads would be minimized through the implementation of Pacific Connector's ECRP and the mitigation measures described above for the pipeline on all lands.

In order to prevent or limit the spread of invasive species and noxious weeds into wetlands on federally managed lands, Pacific Connector would inspect all construction equipment prior to transporting equipment to the construction right-of-way to ensure that it is clean and free of potential weed seed. Because of the contiguous pattern of NFS lands crossed by the pipeline, equipment would be inspected and cleaned at cleaning stations located at the borders of each National Forest, prior to clearing and grading activities, in addition to being cleaned at cleaning stations associated with any mapped infestation of noxious weed of priority A and T and selected B listed weeds within each National Forest (see section 4.4 for more details regarding noxious weeds). Because the BLM lands crossed by the pipeline are not contiguous but are instead spread out in a checkerboard pattern, Pacific Connector feels that is not practical to set up inspection and cleaning stations at each entry point. Instead, Pacific Connector proposed that where BLM lands are contiguous to NFS lands, the cleaning stations would be located to include the adjacent BLM lands. The location of any additional cleaning stations required in areas where BLM- or Reclamation-managed lands are not contiguous with NFS lands would be coordinated with the agency of jurisdiction. Additional measures to prevent the spread of invasive weed and wildlife species into wetlands and waterbodies are addressed within sections 4.4 and 4.5 of this EIS.

Measures to avoid or minimize impacts on wetlands that would be implemented on federally managed lands, in addition to those described above for the entire pipeline, include the following:

- Where straw is to be used on federally managed lands during seeding operations, the authorized officer for the agency of jurisdiction may inspect and approve straw material to verify that the straw is weed-free. Any gravel or rock used on federal lands would be from weed-free sources as well, and approved by the authorized representative for the agency of jurisdiction.
- Hazardous materials, fuels, and oils would not be stored in a wetland/Riparian Reserve or within 150 feet of a wetland/Riparian Reserve. Storage of hazardous materials on NFS lands would not occur without prior authorization from the BLM, Forest Service or Reclamation.
- During revegetation efforts, specific mixtures specified by the agency with jurisdiction would be used on federally managed lands. No fertilizers would be used during the revegetation of wetlands.

Based on available information, with the implementation of appropriate plans, the use of additional BMPs, and mitigation, substantial effects to waterbodies on federal lands are not expected.

4.4 UPLAND VEGETATION

The vegetation affected by construction and operation of the Project represents arguably the largest and most permanent impact, particularly the forested vegetation. Forests in the Project area support multiple interacting layers of organisms that include plants, animals, fungi, and bacteria. Old-growth forests provide vital habitat for many native species of plants and wildlife, including many federally listed threatened or endangered species, as well as providing a variety of environmental services. Old-growth trees occupied about half of the forest area in Oregon when the first comprehensive forest surveys were made in the 1930s and 1940s. By 1992, only about 20.5 percent of the forest area was old growth (Bolsinger and Waddell 1993). These resources have particular value based on their contribution to other organisms and the fact that much of this habitat has been lost.

In the following sections, we describe the vegetation communities that may be affected by construction and operation of the proposed terminal and pipeline. We also discuss the ways in which construction and operation would affect these resources.

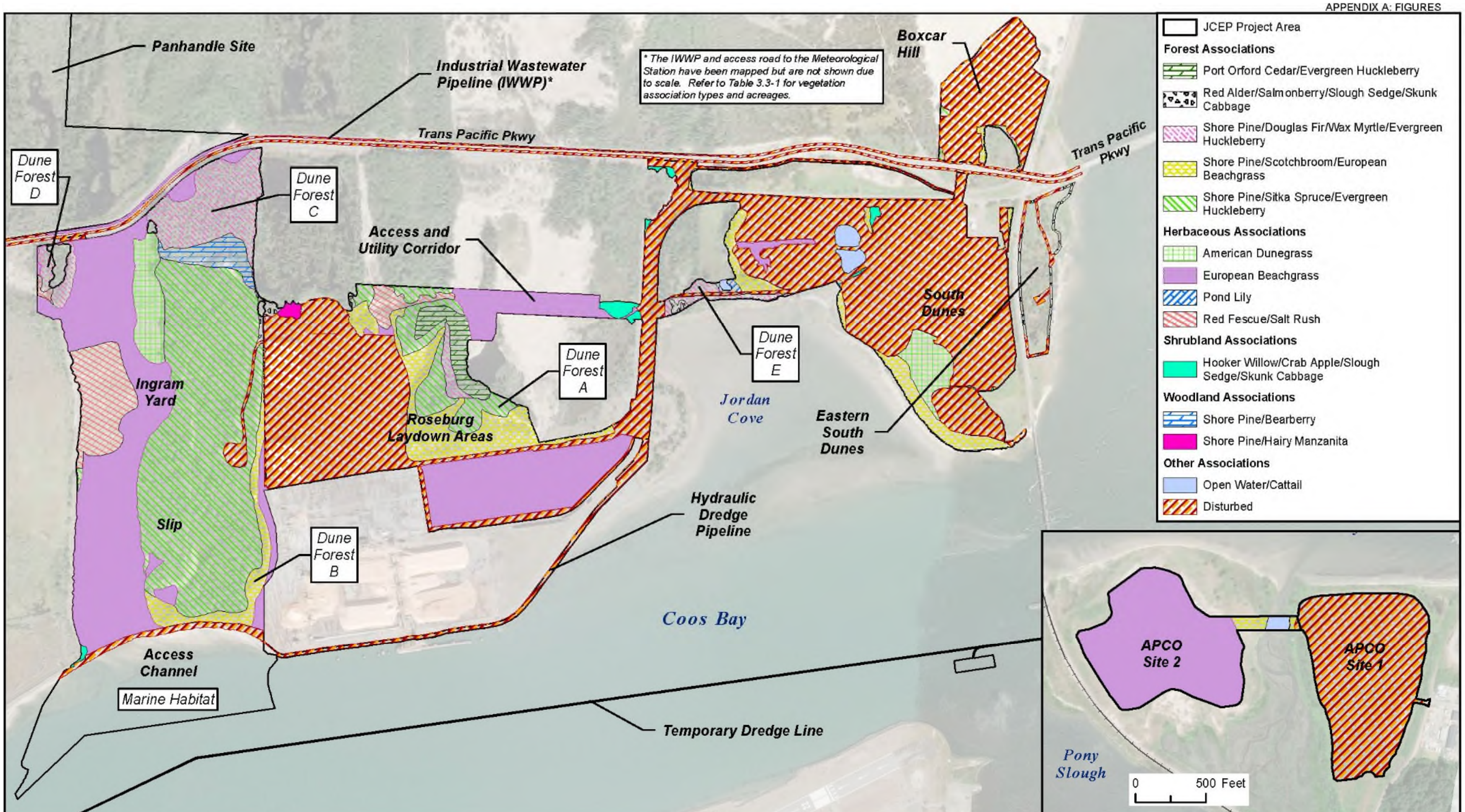
4.4.1 Jordan Cove LNG Project

As depicted in figures 4.4-1a and 4.4-1b, vegetation within the Jordan Cove LNG Project area includes forest, woodland, shrubland, and herbaceous vegetation types (as described in Christy et al. 1998). In addition, multiple areas consisting of disturbed vegetation are located within the area affected by the Project.

4.4.1.1 Forest Vegetation

Forested vegetation is defined as areas where tree species comprise at least 60 percent of the vegetation cover and canopy cover is generally 60 to 100 percent. Forested vegetation within the Jordan Cove LNG Project area varies in age and is dominated by coniferous species with scattered hardwoods. Five forested vegetation types occur within the Jordan Cove LNG Project area, as described below. Generally, the forested vegetation in this area is referred to as dune forest. Five different dune forests have been identified within the Jordan Cove LNG Project area (Dune Forest A through Dune Forest E, see figure 4.4-1a).

The Shore Pine–Douglas-Fir/Wax Myrtle-Evergreen Huckleberry vegetation type typically occurs near previously developed areas such as roads, fill sites, or industrial sites. It occurs most frequently on warm, dry ridges, and slopes on the dunes; primarily with south to west facing aspects (Christy et al. 1998). This vegetation type is characteristic of younger forest sites north of Jordan Cove and occurs in areas where dune stabilization has been achieved through recruitment of vegetation, most notably European beachgrass (*Ammophila arenaria*) and Scotch broom (*Cytisus scoparius*). This vegetation type has an open overstory dominated by shore pine (*Pinus contorta*) with scattered Douglas-fir (*Pseudotsuga menziesii*). The shrub layer is dominated by Scotch broom and coyote bush (*Baccharis pilularis*), with scattered hairy manzanita (*Arctostaphylos columbiana*), wax myrtle (*Morella* [*Myrica*] *californica*), and evergreen huckleberry (*Vaccinium ovatum*). Dominant herbaceous species include non-native species, including European beachgrass, silver hairgrass (*Aira caryophyllea*), little hairgrass (*A. praecox*), hairy cat's ear (*Hypochaeris radicata*), and sheep sorrel (*Rumex acetosella*), as well as native bracken fern (*Pteridium aquilinum*). This vegetation type can be found in portions of Dune Forests A, B, and C where adjacent landscapes have been altered by human or natural influences.



Associations used are based on the USDA Publication National Vegetation Classification System (NVCS).

Source: SHN Engineers, David Evans and Associates, Inc.

Figure 4.4-1a

Vegetation Associations

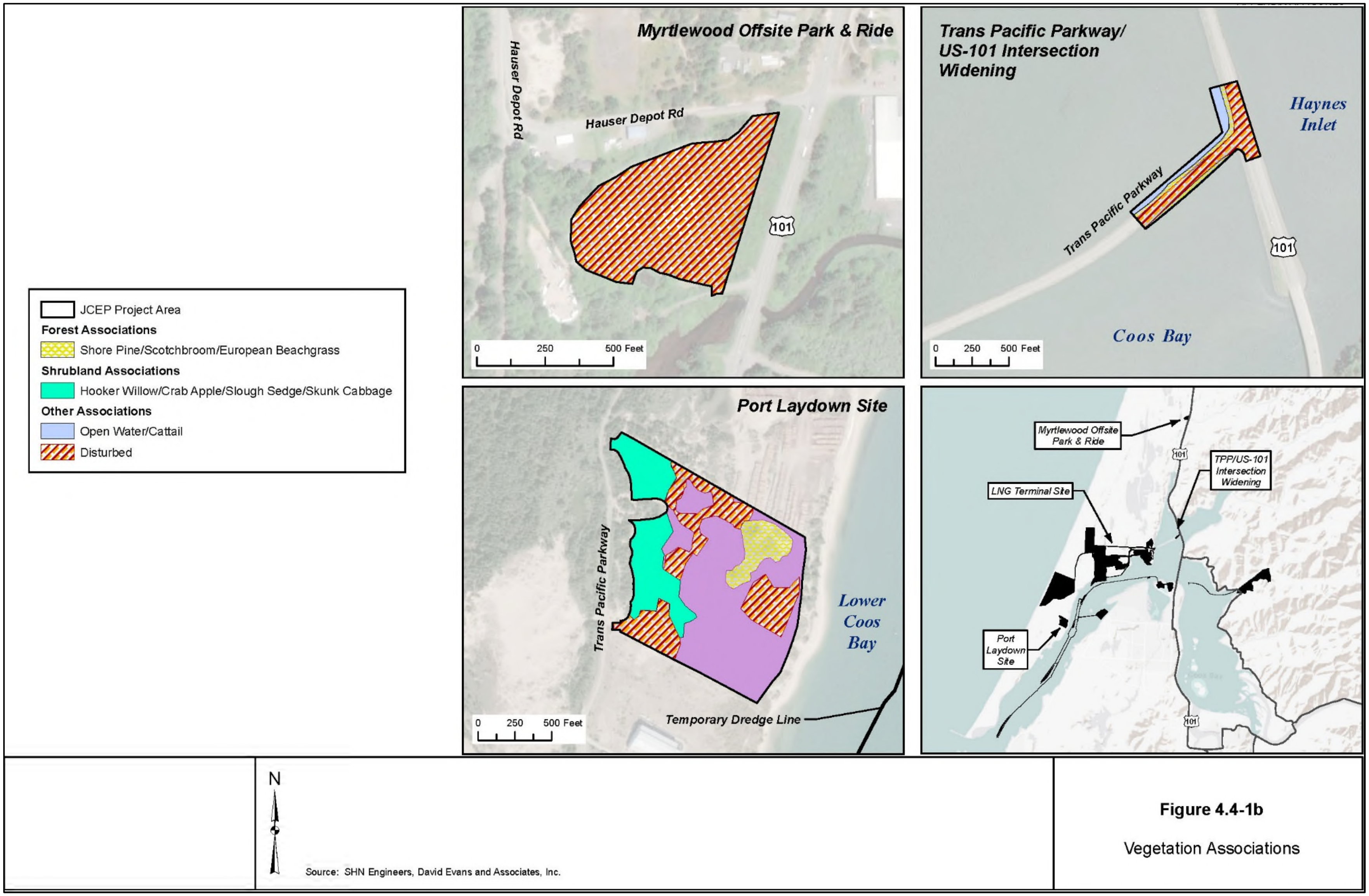


Figure 4.4-1b

Vegetation Associations

The Shore Pine-Sitka Spruce/Evergreen Huckleberry vegetation type is common in more successionally mature forests. Stands are generally dominated by shore pine and Douglas-fir, but also include Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), and scattered Port Orford cedar (*Chamaecyparis lawsoniana*). The dense shrub understory in this vegetation type is dominated by evergreen huckleberry, salal (*Gaultheria shallon*), and wax myrtle, with scattered Pacific rhododendron (*Rhododendron macrophyllum*) also present. The herbaceous layer varies from sparse to moderately covered with candy-stick (*Allotropa virgata*), rattlesnake plantain (*Goodyera oblongifolia*), and bracken fern along edges or gaps in the overstory. Dune Forest B occurs in this vegetation type.

The Port Orford Cedar/Evergreen-Huckleberry vegetation type is dominated by Port Orford cedar and is considered unique because it is being decimated throughout its limited range by the Port Orford cedar root rot disease which is caused by the fungal root rot *Phytopthora lateralis* (Christy et al. 1998). A small area of well-developed Port Orford cedar/evergreen huckleberry vegetation is located upslope from the southwestern shore of Jordan Lake. Port Orford cedar observed at this location includes two trees upslope from the existing access trail that travels from the Roseburg Forest Products facility to Jordan Lake. Additionally, 23 Port Orford cedars were observed at sites located adjacent to Jordan Lake, in areas that would be preserved as part of the Jordan Cove LNG Project. This vegetation type can be found in portions of Dune Forest A.

The Red Alder/Salmonberry/Slough Sedge-Skunk Cabbage vegetation type occurs in wetland vegetation adjacent to upland forested vegetation, and in low flat areas adjacent to inundated wetlands. In this vegetation type, the overstory consists entirely of red alder (*Alnus rubra*) around wet areas, but transitions to shore pine in adjacent areas. Canopy cover varies from moderate (i.e., more than 50 percent canopy cover) to closed. Scattered clusters of dense shrubs, including salmonberry (*Rubus spectabilis*) and Hooker’s willow (*Salix hookeriana*), are located in the understory. Herbaceous coverage is generally found in wet areas and consists almost entirely of slough sedge, with scattered skunk cabbage (*Lysichiton americanus*). This vegetation type occurs in Dune Forest E and adjacent to Dune Forest B.

Although the Shore Pine/Scotch Broom/European Beachgrass vegetation type contains shore pine, it is also described as a shrubland due to the high density of shrubby species, including Scotch broom. This vegetation type is relatively widespread throughout the Jordan Cove LNG Project site and is associated with roads and other disturbed areas. The overstory is generally open, averaging less than 50 percent cover of shore pine. Scotch broom cover varies from moderately to very dense in areas that lack a substantial canopy cover. Dominant herbaceous species include European beachgrass, red fescue (*Festuca rubra*), tall fescue (*Schedonorus arundinaceus* [*Festuca arundinacea*]), silver hairgrass, hairy cat’s ear, and sheep sorrel. This vegetation type occurs west of the South Dunes site, north of the Roseburg Forest Products property, along previous road cuts for the Trans-Pacific Parkway, and along the edges of the shore pine-Sitka spruce/evergreen huckleberry community at the Port Laydown, Boxcar Hill, and APCO sites.

4.4.1.2 Woodland Vegetation

Woodland vegetation includes areas of open tree stands with cover generally varying from 25 percent to 60 percent. They occur on all aspects of dry, well drained, partially stabilized dune ridges, slopes, and flats between the sand and the forest edge (Christy et al. 1998). Two woodland vegetation types occur within the Jordan Cove LNG Project site.

The overstory of the shore pine/bearberry (*Arctostaphylos uva-ursi*) woodland vegetation type consists entirely of shore pine. The shrub layer is dominated by the low growing shrub bearberry with hairy manzanita in scattered patches. The understory is comprised almost entirely of moss and lichen species except for scattered little hairgrass, hairy cat's ear, and shrub starts. This vegetation type is restricted to a thin band adjacent to the coastline and is easily damaged by human disturbances. Shore pine/bearberry vegetation is scattered throughout the LNG terminal site, with the most substantial occurrence between Dune Forests B and C.

The overstory of the shore pine/hairy manzanita woodland vegetation type is moderately open and is dominated by shore pine with scattered Douglas-fir trees. The shrub layer varies from moderate to dense in areas where the canopy is patchy. Hairy manzanita is the dominant shrub species with scattered evergreen huckleberry and bearberry along edges. A small area of this vegetation type can be found along the eastern boundary of Dune Forest B along the access and utility corridor.

4.4.1.3 Shrubland Vegetation

Shrubland vegetation types generally consist of greater than 25 percent cover of shrubs more than 0.5 meter tall and generally less than 25 percent tree cover. A single shrubland vegetation type was identified within the Jordan Cove LNG Project area.

The overstory within the Hooker Willow/Crabapple/Slough Sedge-Skunk Cabbage vegetation type is dominated by Hooker willow, Sitka willow (*Salix sitchensis*), and Douglas spiraea (*Spiraea douglasii*), with scattered twinberry (*Lonicera involucrata*). Evergreen trees are mostly absent but may include scattered shore pine and Sitka spruce. Slough sedge is the most abundant herbaceous species. Other herbaceous species include common rush (*Juncus effusus*), dagger-leaved rush (*Juncus ensifolius*), toad rush (*J. bufonius*), western bent-grass (*Agrostis exarata*), creeping bent-grass (*A. stolonifera*), reed canarygrass (*Phalaris arundinacea)*, northern willowherb (*Epilobium ciliatum*), tall mannagrass (*Glyceria striata* [*G. elata*]), and lowland cudweed (*Gnaphalium palustre*). This vegetation type occurs throughout the wetland areas west of Jordan Cove Road, in the access and utility corridor, and at the South Dunes site.

4.4.1.4 Herbaceous Vegetation

Herbaceous vegetation types are communities with less than 25 percent shrub cover and greater than 25 percent herbaceous cover. Five herbaceous vegetation types occur within the Jordan Cove LNG Project area.

Dominant species within the European beachgrass vegetation type include European beachgrass, red fescue, silver burweed (*Ambrosia chamissonis*), sand pea (*Lathyrus japonicus*), seashore lupine (*Lupinus littoralis*), beach silvertop (*Glehnia littoralis*), and beach evening primrose (*Camissonia cheiranthifolia*). This vegetation type occurs where the terminal marine slip would be located. It was also observed in patches north of Jordan Lake where the access/utility corridor is proposed and at the Port Laydown site and is the dominant vegetation type at the APCO Site 2.

The Red Fescue/Salt Rush vegetation type is generally found in grasslands on sand or fill material. Red fescue is the dominant species in this association. Scattered red fescue was observed on fill west of the South Dunes site and on sand north of the Roseburg Forest Products export facility. At the South Dunes site, in an area surrounded by scattered red fescue, a portion of a small dune was dominated by salt rush (*Juncus lesuerii*). Red fescue/salt rush was also observed at sites where sand burial by wind driven forces limits species diversity, including the western part of the LNG terminal site.

The American dunegrass vegetation type includes dune lands with the single dominant species American dunegrass (*Leymus mollis*). It can be found on beaches and in foredunes, and to a lesser extent on open deflation plains and in upper estuaries. Continual sand burial and inputs of salt spray seem necessary for American dunegrass to thrive. Scattered American dunegrass was observed west of Dune Forest B, in the LNG terminal grassland vegetation east of Henderson Marsh on previous fill deposits, and the western half of APCO Site 1.

Dominant species in the Pond Lily vegetation type include yellow pond lily (*Nuphar lutea* ssp. *polysepala),* floating water-pennywort *(Hydrocotyle ranunculoides)*, floating-leaved pondweed (*Potamogeton natans*), parrotfeather (*Myriophyllum aquaticum*), water shield (*Brasenia schreberi*), and common bladderwort (*Utricularia macrorhiza*). Pond lily vegetation has been observed in deep freshwater wetlands located at the LNG terminal site.

The Common Cattail/Open-Water vegetation type includes wetland fringe sites observed adjacent to open bodies of water. Open water and areas dominated by common cattails can be found surrounding the existing sludge ponds at the South Dunes site as well as around wetlands observed south of the Trans-Pacific Parkway in the eastern portion of the LNG terminal site.

Disturbed vegetation occurs in previously human-disturbed areas, where extensive grading and gravel and dredge spoils deposition has occurred. These areas often contain non-native upland shrubs with small patches of young coastal forest dominated by shore pine, and herbaceous communities dominated by European beachgrass. Disturbed vegetation within the Jordan Cove LNG Project site typically consists of ruderal shrub, such as Scotch broom, and herbaceous vegetation. Dominant herbaceous species include silver hairgrass, hairy cat's ear, bracken fern sheep sorrel, red fescue, and seashore lupine. Disturbed vegetation is common in many areas of the Jordan Cove LNG Project site including the South Dunes site, the Port Laydown site, and the APCO Site 1.

4.4.1.5 General Impacts on Vegetation

Table 4.4.1.5-1 identifies the amount of vegetation affected by construction and operation of the Jordan Cove LNG Project. Constructing the Jordan Cove Project would result in 499 acres of vegetation clearing, which includes the permanent clearing of 168 acres of vegetation. Construction of the Kentuck project and Eelgrass Mitigation sites would result in an additional 127 acres of vegetation clearing not included in table 4.4.1.5-1.

Approximately 73 acres of forested vegetation, 59 acres of which consists of the shore pine-Sitka spruce/evergreen huckleberry vegetation type, would be permanently affected. All of Dune Forests A and B, the majority of Dune Forest C, and portions of Dune Forest D and E would be permanently affected. The clearing of dune forest vegetation during construction would affect the vegetation at the newly exposed edge of the coniferous forest by changing the micro-climate factors (wind, light, salt spray, organisms that prefer edges). The vegetation found within the forest interior would be exposed to the environmental elements experienced by a forest edge, which could lead to a change in species composition.

TABLE 4.4.1.5-1

Impacts on Vegetation Type from the Jordan Cove LNG Project a/

Vegetation Type	Land Cleared during Construction (acres) b/, c/	Land Permanently Cleared due to Operations (acres) b/
Jordan Cove LNG Project Facilities		
Forested Vegetation	75	71
Woodland Vegetation	<1	<1
Shrubland Vegetation	1	<1
Herbaceous Vegetation	72	64
Disturbed Vegetation	24	21
Total Impacts from Project Facilities	***172***	***157***
Temporary Construction Areas d/		
Forested Vegetation	58	2
Woodland Vegetation	4	0
Shrubland Vegetation	8	<1
Herbaceous Vegetation	71	<1
Disturbed Vegetation	186	9
Total Impacts from Temporary Construction Areas	***327***	***11***
Grand Total for All Impacts		
Impact Grand Total	**499**	**168**

See table 2.3.1-1 in chapter 2 for the acreage of each individual Project component.

a/ Table does not include impacts on unvegetated upland areas or impacts on estuarine vegetation (impacts on estuarine vegetation is discussed in section 4.3).

b/ Values may not sum exactly due to rounding of significant digits. Acreages are rounded to the nearest whole acre; acreages less than 1 acre are reported as <1.

c/ Values include land permanently cleared due to operations.

d/ Temporary Construction Facilities include the Ingram Yard perimeter, North Ingram Yard, IWWP, Hydraulic Dredge Pipeline, Roseburg site laydown areas, APCO Sites, Boxcar Hill, Port Laydown site, South Dunes site, Workforce Housing Facility, parking, and Laydown area, the Trans-Pacific Parkway/U.S. Highway 101 Intersection Widening, the Additional Park & Ride site, and the Myrtlewood Off-site Park & Ride.

4.4.1.6 Noxious Weeds and Invasive Species

Noxious weeds and invasive plant species are non-native or introduced species that are able to exclude and out-compete desirable native species, and thereby decrease overall species diversity. Noxious weeds often invade and persist in areas after the vegetation and ground have been disturbed and can hinder restoration. Noxious weeds can adversely affect an area either when invasive plants become established or when an existing species' population size increases. Invasive or noxious plants can negatively affect native vegetation by competing for resources such as water and light, changing the community composition, eliminating or reducing native plants, or changing the vegetation structure. The changes in community composition or vegetation structure can reduce native plant populations and can also negatively affect wildlife habitat. Additionally, the movement of equipment to and from construction work areas can also increase the spread of noxious weeds and invasive species. In general, grasslands, riparian areas, and relatively dry or open forests, are more susceptible to invasion than are dense, moist forests, high montane areas, and serpentine areas that have relatively closed canopy cover or have extreme climate or soils that are tolerated by fewer invasive plant species.

Noxious weeds are classified by the Oregon State Weed Board (OSWB) as any plant that is injurious to public health, agriculture, recreation, wildlife, or any public or private property. The ODA Noxious Weed Control Program and the Oregon State Weed Board (OSWB) maintain the State Noxious Weed List. There are three categories of listed noxious weeds under the ODA Noxious

Weed Control Classification System (i.e., A Listed, B Listed, and List T weeds[95]). Species listed in the Noxious Weed Policy and Classification System that have been documented or could occur within the LNG terminal area are summarized in table 4.4.1.6-1.

TABLE 4.4.1.6-1

Noxious Weeds and Invasive Aquatic Species Documented or with Potential to Occur in the Jordan Cove LNG Project Area

Common Name	Scientific Name	LNG Terminal a/	Boxcar Hill	APCO Sites	Kentuck Project Site	Port Laydown
"A" List Weeds						
cordgrass (T)	*Spartina angelica, S. alterniflora, S. densiflora, S. patens*	D				
"B" List Weeds						
bull thistle	*Cirsium vulgare*	L			L	
butterfly bush	*Buddleja davidii*	L		L	L	D
Canada thistle	*Cirsium arvense*	D	D	L	D	D
English ivy	*Hedera helix*	D	D	L	L	
field bindweed (T) (morning glory)	*Convolvulus arvensis*	L		L		
French broom	*Cytisus monspessulana*	L		L		
gorse (T)	*Ulex europaeus*	D				
Himalayan blackberry	*Rubus armeniacus (R. discolor, R. procerus, R. fruticosa)*	D	D	D	D	
Jubata grass (Pampas grass)	*Cortaderia jubata*	D			L	
meadow knapweed	*Centaurea moncktonii*				L	
parrot feather	*Myriophyllum aquaticum*	D				
poison hemlock	*Conium maculatum*	D			D	
Scotch broom	*Cytisus scoparius*	D	D	D	D	D

"D" – indicates species has been documented at the Project site.
"L" – indicates species is likely to occur at the Project site.
"(T)" – indicates target species designated for removal and control in Oregon
a/ Includes LNG terminal, access and utility corridor, South Dunes site, and Roseburg Laydown area.

To avoid introducing or spreading invasive species, Jordan Cove would follow the recommendations outlined in the Oregon Invasive Species Council (OISC) Action Plan for 2017-2019, BLM's multi-state EIS Northwest Area Noxious Weed Control Program (BLM 1985) and its supplements, the BLM's *Final Vegetation Treatments on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Report* (2007), and the BLM's *Final North Spit Plan* (2005). These documents focus on detection, containment, and/or reduction of invasive plant infestations with an integrated pest management approach (e.g., chemical, mechanical, manual, and/or biological) as well as implementation of measures to avoid the introduction and spread of noxious weeds.

[95] A Listed – Weeds of known economic importance which occur in small enough infestations to make eradication or containment possible; or are not known to occur in Oregon but are present in neighboring states making future occurrence in Oregon seem imminent.
B Listed – Weeds of economic importance which are regionally abundant, but which may have limited distribution in some counties in Oregon.
T List – Priority noxious weeds designated as target species that will be the focus of prevention and control by the Noxious Weed Control Program and for which the ODA will develop and implement statewide management plans. Species selected from either the "A" or "B" list.

Jordan Cove would conduct a pre-construction survey of the Project area to identify noxious species listed by the ODA that persist despite recent and previous control efforts. Following the survey, Jordan Cove would employ standard removal practices (BLM 1985) for the weed species identified on the Project area. Methods for removal that would not aid in the dispersal of these species would be used and would include the use of integrated BMPs such as fire, mechanical or manual removal, and herbicide application, as appropriate. Treated areas would be restored by spreading native seeds and planting native plants.

Jordan Cove would also use herbaceous and native dune seed mixes to limit germination of noxious weeds during the stabilization and restoration of the site during and following construction. Once the site is stabilized and in operation, Jordan Cove would check the site for noxious weed infestations and control measures would be implemented that are consistent with ODA, OISC, and BLM noxious weed control plans and policies, as applicable.

4.4.1.7 Vegetative Pathogens

Port Orford cedar root rot disease is caused by the fungus *Phytophthora lateralis*. The disease was first discovered in Port Orford cedar's natural range in 1952 and since has spread throughout its range. Port Orford cedar root rot disease affects both seedlings and mature trees. The spores live in the soil and are spread through contact with contaminated soil or via free water. The disease is primarily spread through soil disturbance and moving water. Spread of the disease over long distances occurs from contaminated equipment and livestock.

Jordan Cove would take precautions during construction to minimize the introduction or spread of Port Orford cedar root rot disease from contaminated earth moving equipment. To ensure adequate conservation measures to address Port Orford cedar root rot disease are in place and implemented, Jordan Cove would follow the measures and recommendations found in the Forest Service and BLM's Final Supplemental EIS regarding the management of Port Orford cedar in southwest Oregon (Forest Service and BLM 2004).

4.4.2 Pacific Connector Pipeline Project

Vegetation types that would be crossed by the pipeline include forests and woodlands, shrublands, grasslands, wetland, and agricultural (see table 4.4.2-1). Wetland vegetation types found along the pipeline route are discussed in section 4.3.

TABLE 4.4.2-1

Vegetation Types Crossed by the Pacific Connector Pipeline Project a/

General Vegetation Type	**Mapped Vegetation Category**	**Late Successional or Old-Growth Forest Crossed (miles)**	**Mid-Seral Forest Crossed (miles)**	**Clearcut/ Regenerating Forest Crossed (miles)**	**Total Miles b/**	**Percent of Total Vegetation**
Forest-Woodland	Douglas-fir-W. Hemlock-W. Red-Cedar Forest	2.2	4.3	10.8	17.2	8.2
	Douglas-Fir-Mixed Deciduous Forest	5.4	14.5	7.5	27.4	13.1
	Alder-Cottonwood	0.0	<0.1	0.0	<0.1	<0.1
	Mixed Conifer/Mixed Deciduous Forest	1.8	4.0	9.5	15.4	7.4
	Shasta Red Fir – Mountain Hemlock Forest	1.4	0.9	4.0	6.3	3.0
	Douglas-fir-White Fir/Tanoak-Madrone Mixed Forest	0.7	0.9	0.3	1.8	0.9
	Douglas-fir Dominant-Mixed Conifer Forest	20.8	8.4	18.2	47.5	22.7
	Ponderosa Pine/White Oak Forest and Woodland	3.4	1.5	2.5	7.4	3.5
	Ponderosa Pine Forest and Woodland	1.1	2.7	3.0	6.7	3.2
	Oregon White Oak Forest	2.2	2.1	0.0	4.4	2.1
	Western Juniper Woodland	0.2	2.9	0.0	3.1	1.5
	Ponderosa Pine/Western Juniper Woodland	0.0	1.4	3.7	5.0	2.4
	Forest-Woodland Subtotal	**39.3**	**43.6**	**59.4**	**142.2**	**68.1**
Shrubland	Sagebrush Steppe	n/a	n/a	n/a	7.1	3.4
	Shrublands	n/a	n/a	n/a	10.7	5.1
	Shrubland Subtotal	n/a	n/a	n/a	**17.8**	**8.5**
Grassland	Grasslands (West of Cascades)	n/a	n/a	n/a	11.8	5.7
	Grasslands (East of Cascades)	n/a	n/a	n/a	4.5	2.2
	Grassland Subtotal	**n/a**	**n/a**	**n/a**	**16.3**	**7.8**
Wetland	Wetland	0.0	0.1	0.1	5.9	2.8
	Wetland Subtotal	**0.0**	**0.1**	**0.1**	**5.9**	**2.8**
Agriculture	Agriculture	0.0	0.0	0.0	26.6	12.7
	Agriculture Subtotal	**0.0**	**0.0**	**0.0**	**26.6**	**12.7**
	Project Total	**39.3**	**43.7**	**59.5**	**208.8**	**100.0**
	Percent of Project Total	**18.8**	**20.9**	**28.5**		

General: Mileages may not sum correctly due to rounding. Mileages are rounded to nearest tenth of a mile; values less than 0.1 are shown as "<0.1".)

a/ Table does not include impacts on unvegetated areas (e.g., urban, industrial, beaches, roads, open water).

b/ Total miles crossed include the 0.9 mile of pipeline that would not disturb vegetation because of the HDD method and direct pipe method used to install pipeline below six waterbodies: Coos Estuary (2 crossings), Coos River, South Umpqua River, Rogue River, and Klamath River.

4.4.2.1 Forest and Woodland Vegetation

Forests vegetation found along the Pacific Connector pipeline route were assigned an age class using available GIS data (BLM 2016c; Moeur et al. 2005, 2006, and 2011; Davis et al. 2015).[97] Age classes were categorized within various age ranges: clearcut (0-5 years), regenerating (5-40 years), mid-seral (40-80 years), as well as LSOG (80+ years).

- Clearcut/Regenerating forest:
  - Clearcut forest includes areas that were harvested within the past five years but presently are non-stocked. This age class generally has a canopy cover of less than 10 percent (Moeur et al. 2005).
  - Regenerating forest generally includes areas with canopy cover greater than 10 percent and tree size less than 10 inches diameter at breast height (dbh; Moeur et al. 2005). This category was further refined to identify early regenerating forest (harvested within the last 10 to 15 years) and regenerating forest for interior forest analyses described later in this section.
- Mid-seral forest includes stands within the current harvest rotation and generally includes small single- and multi-storied trees with canopy cover greater than 10 percent and tree size between 10 and 20 inches dbh (Moeur et al. 2005).
- LSOG:
  - Late successional forest includes forest stands greater than 80 years old. This age range is consistent with definitions used in the NWFP and as described in Moeur et al. (2005) and Davis et al. (2015). This age class generally includes medium and large single- or multi-storied trees with canopy cover greater than 10 percent and average tree size between 20 and 30 inches dbh.
  - Old-growth forest includes forest stands greater than 175 years and dominated by coniferous forest. This correlates well with Moeur et al. (2005), Franklin et al. (1981, 1986), and Franklin and Spies (1991) descriptions that consider primary size and canopy structure characteristics of old-growth Douglas-fir to develop between 175 and 250. This age class generally includes large, multi-storied stands with canopy cover greater than 10 percent and average tree dbh greater than 30 inches (Moeur et al. 2005). Mature deciduous-dominated forests were also included in this forest age classification.

The following text describes dominant vegetation communities in the Project area, lists the common species, and discusses the general distribution:

The Douglas-fir–Western Hemlock–Western Redcedar Forest type occurs at low to middle elevations and has a multi-storied canopy dominated by Douglas-fir, with western hemlock, western redcedar (*Thuja plicata*), and grand fir (*Abies grandis*) as co-dominants. In addition, Pacific yew (*Taxus brevifolia*) may be present in the subcanopy (Kagan et al. 1999). Port Orford cedar can also be a dominant tree species within Douglas-fir–Western hemlock–Western redcedar forest types within the pipeline Project area (Johnson and O'Neil 2001). Within riparian areas, and non-conifer dominated stands, bigleaf maple (*Acer macrophyllum*) and red alder are common. Large stature shrubs, such as vine maple (*Acer circinatum*), Pacific rhododendron, and evergreen

[97] Age class was also reviewed by BLM and Forest Service biologists on their respective lands between 2007 and 2008, with specific focus on verifying/classifying late seral forest stands, as well as by Siskiyou BioSurvey LLC.

and red huckleberry (*Vaccinium ovatum* and *V. parvifolium*), are frequently present. Ferns dominate the rich and diverse herbaceous layer. It is located within Coos and Douglas Counties.

The Douglas-Fir–Mixed Deciduous Forest type is a low to mid-elevation conifer and mixed deciduous forest found primarily in southwestern Oregon. The upper tree layer always contains Douglas-fir, with the sub-canopy consisting of a mix of shade tolerant conifers and deciduous trees including: tanoak (*Notholithocarpus densiflorus*), Pacific madrone (*Arbutus menziesii*), golden chinquapin (*Chrysolepis chrysophylla*), and Pacific dogwood (*Cornus nuttallii*). Indicative shrubs of this cover type include dwarf Oregon-grape (*Mahonia nervosa*), pacific blackberry (*Rubus ursinus*), oceanspray (*Holodiscus discolor*), California hazelnut (*Corylus cornuta*), and others (Kagan et al. 1999). This forest type is found within Douglas, Jackson, and Klamath Counties.

The Alder–Cottonwood Forest type is found along the margin of flowing streams in the foothills and mountains throughout much of Oregon. It is prevalent along high gradient stream systems that flood frequently and deposit bed-load sand and gravel. Black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) is always present in the overstory of this forest type. West of the Cascade crest, other dominant species in the overstory include red alder and big leaf maple, and conifers could include Douglas-fir, western hemlock, western redcedar, and Port Orford cedar. East of the Cascade crest, the other dominant species is typically white alder (*Alnus rhombifolia*), with other deciduous trees present including mountain alder (*Alnus incana* ssp. *tenuifolia*), Pacific willow (*Salix lucida* ssp. *lasiandra*), non-native black locust (*Robinia pseudoacacia*), and quaking aspen (*Populus tremuloides*). Associated conifers east of the Cascades include ponderosa pine (*Pinus ponderosa*), Douglas-fir, Engelmann spruce (*Picea engelmannii*), and lodgepole pine (Kagan et al. 1999). It is found within Coos, Douglas, Jackson, and Klamath Counties.

The Mixed Conifer/Mixed Deciduous Forest type is generally composed of co-dominant conifer (e.g., Douglas-fir) and deciduous (e.g., red alder and/or bigleaf maple) trees in a single-layered canopy forest (Kagan et al. 1999). Port Orford cedar may also be the dominant tree species within this forest type (Johnson and O’Neil 2001). This forest type is found in low- to mid-elevations (Kagan et al. 1999) within Coos County.

The Shasta Red Fir–Mountain Hemlock Forest type is a mid-to-upper elevation conifer forest mostly found above 4,000 feet. Overstory species generally include Shasta red fir (*Abies magnifica* var. *shastensis*), mountain hemlock (*Tsuga mertenxiana*), white fir (*Abies concolor*), and lodgepole pine. It often is a closed, multi-story canopy with dense understory of shrubs, forbs, and ferns, including dwarf bramble (*Rubus lasiococcus*), Oregon boxwood (*Paxistima myrsinites*), pinemat manzanita (*Arctostaphylos nevadensis*), and Sadler’s oak (*Quercus sadleriana;* Kagan et al. 1999). It is found within Jackson and Klamath Counties.

The Douglas-fir–White Fir/Tanoak–Madrone Mixed Forest type is a multi-layered forest of mixed conifer and mixed deciduous species. It always contains Douglas-fir, with other co-dominants (e.g., white fir, incense cedar (*Calocedrus* [*Libocedrus*] *decurrens*), sugar pine [*Pinus lambertiana*] and western white pine [*Pinus monticola*]). Subcanopy layers contain shade-tolerant trees, including tanoak, Pacific madrone, golden chinquapin, Pacific dogwood, and California laurel (*Umbellularia californica*). Shrub and herb layers are generally well represented. This forest type is found at low to mid elevations (Kagan et al. 1999) within Jackson County.

The Douglas-fir Dominant-Mixed Conifer Forest type typically consists of a single-layer forest canopy, although stand structure can be diverse in undisturbed late seral stands. There is a wide range of canopy closure based on management practice, disturbance history, and microsite. Douglas-fir is dominant, with a variety of coniferous trees including, white fir, incense cedar, western white pine, ponderosa pine, and sugar pine. Understory vegetation is usually diverse and rich in species. This forest type is found at mid elevations (Kagan et al. 1999) within Coos, Douglas, Jackson, and Klamath Counties.

Ponderosa pine and white oak (*Quercus garryana*) are the dominant overstory species within the Ponderosa Pine/White Oak Forest and Woodland type. Shrub cover is typically sparse, but herbaceous and grass species tend to be abundant. This forest type is found at low elevations (Kagan et al. 1999) within Jackson and Klamath Counties.

Ponderosa pine is exclusively the overstory tree at low elevations within the Ponderosa Pine Forest and Woodland type. White fir, grand fir, western larch, incense cedar, Douglas-fir, subalpine fir, and Engelmann spruce are common at higher elevations. Understory and regeneration layers reflect similar composition as overstory. Lower elevations have fewer shrubs, with shrubs increasing in diversity and abundance with elevation and improved soil moisture conditions. This forest type is found at low to middle elevations (Kagan et al. 1999) within Jackson and Klamath Counties.

The Oregon White Oak Forest type contains deciduous woodland/forest dominated by Oregon white oak. Other canopy trees can be Douglas-fir and ponderosa pine in upland settings, and Oregon ash (*Fraxinus latifolia*), black cottonwood, and bigleaf maple on valley floors. The subcanopy often consists of California black oak (*Quercus kelloggii*). Understory typically contains tall deciduous shrubs and smaller stature deciduous trees. This forest type is a highly desirable wildlife habitat that has been decreasing as a result of fire suppression. It is found at low elevations (Kagan et al. 1999). This forest type can require more than 100 years to reach full productivity and function as wildlife habitat, and these types of wildlife habitats are limited within the region (see section 4.5). It is found within Douglas and Jackson \Counties.

The Grass-shrub-sapling or Regenerating Young Forest type is characteristic of successional conditions following timber harvest, which can include ground scarification and slash/large woody debris, a variety of shrubs and forbs typical of the area, and then conifer saplings which form a continuous canopy above the shrub layer (Kagan et al. 1999). It is found within Coos, Douglas, Jackson, and Klamath Counties.

The Western Juniper Woodland type is dominated by western juniper (*Juniperus occidentalis*) and has an open canopy (less than 30 percent crown closure) and single story, short stature (6 to 20 feet tall) trees. Understory vegetation is dominated by sagebrush species, such as big sagebrush (*Artemisia tridentata*), rigid sagebrush (*Artemisia rigida*), and low sagebrush (*Artemisia arbuscula*), as well as mountain mahogany (*Cercocarpus ledifolius*), bitterbrush (*Purshia tridentata*), and rabbitbrush (*Ericameria* ssp; *Chrysothamnus* spp.). Grasses characterize the herbaceous layer. This woodland type is found at a wide range of elevations (Kagan et al. 1999) within Klamath County.

The Ponderosa Pine/Western Juniper and Woodland type is typically found in the foothill margins bordering upland conifer types and sagebrush dominant lowlands. This forest type has a two-story canopy with widely spaced overstory ponderosa pine and a subcanopy of western juniper. Canopy cover is generally between 10 and 50 percent. The understory is dominated by a shrub layer, including big sagebrush, low sagebrush, rabbitbrush, mountain mahogany, and bitterbrush, and is interspersed with non-native grasses (typically in areas that are overgrazed) and native bunchgrasses (Kagan et al. 1999). It is found within Klamath County.

Late Successional and Old-growth Forest

Many of the forested and woodland vegetation types discussed above include areas that contain late-successional and mature old-growth vegetation (i.e., old-growth forests). Historic logging practices within the Pacific Northwest have dramatically reduced the size and health of old-growth forests. There is no single definition of old growth and multiple definitions have been used, depending on the forest type (deciduous or evergreen) being considered and the agency/organization managing the land. The NWFP defines old growth as "(a) forest stand usually at least 180 to 220 years old with moderate to high canopy closure; a multilayered, multi species canopy dominated by large overstory trees; high incidence of large trees, some with broken tops and other indications of old and decaying wood (decadence); numerous large snags; and heavy accumulations of wood, including large logs on the ground" (FEMAT 1993). In addition, old-growth forests typically contain moderate-to-high accumulations of nonvascular vegetation such as fungi, lichens, and bryophytes (Forest Service and BLM 1994b).

LSOG forests west of the Cascade Range typically consist of old large overstory trees, such as Douglas-fir and western hemlock, multiple tree canopy levels, shade-tolerant tree species in the understory, large course woody debris and snags, a lush understory shrub layer, and infrequent stand replacement fire events (BLM 2008a, ODFW 2016a). The drier LSOG forests of eastern and southwest Oregon generally contain widely spaced or small groups of large overstory trees, such as ponderosa pine, with a more open grassy understory maintained by frequent low-intensity fire (BLM 2008a).

LSOG forests provide vital habitat for many native plant and animal species, including many federally-listed threatened or endangered species (Forest Service and BLM 1994b). Bird species that are obligates of old-growth forests include the federally threatened northern spotted owl and marbled murrelet (see section 4.6). LSOG forests have been greatly reduced in size and connectivity, which impacts plant and wildlife species adapted to LSOG conditions and/or wildlife species with limited ability to travel over long distances to find new suitable areas (ODFW 2016a). Additionally, many of the species supported by LSOG forests require large patches of older or mature forests to survive and may be sensitive to changes in the seral stage of the forest (ODFW 2016a). LSOG forests also provide a variety of other environmental services, including clean water, carbon sequestration, and a variety of recreational opportunities (BLM 2008a). Additionally, the complexity of LSOG forests increases the resiliency of these forest to disturbance (BLM 2008a). The loss of LSOG forests since 1850 in the Coast Range, West Cascades, and Klamath Mountains ecoregions of Oregon is estimated to be almost 90 percent (ODFW 2016a).

4.4.2.2 Shrubland Vegetation

The Sagebrush Steppe vegetation type is a mosaic of grasses (mostly introduced) and shrubs that include sagebrush subspecies, such as Wyoming (*Artemisia tridentata* ssp. *wyomingensis*), basin (*A. tridentata* ssp. *tridentata*), and mountain (*A. tridentata* ssp. *vaseyana*). Other shrubs include low, silver, and three-tip sagebrush, and rabbitbrush. A variety of bunchgrasses are scattered with the shrubs, although overgrazing has limited their presence (Kagan et al. 1999). Sagebrush steppe vegetation is a valuable natural resource and many species of wildlife (including ungulates, birds, reptiles, and invertebrates) rely on sagebrush steppe vegetation (Monsen and Shaw 2000; FWS 2014a). Vast areas of sagebrush steppe vegetation have been altered or lost through grazing, agriculture or other development, conversion to non-native annual or perennial grasslands through artificial seeding or invasion of annual grasses, and wildfire; and sagebrush steppe is now considered one of the most imperiled ecosystems in the United States (Monsen and Shaw 2000; FWS 2014a). Sagebrush steppe is found within Klamath County.

The Shrublands vegetation type consists of a mosaic of grasses and shrubs. It may include sagebrush but is not dominated by this species and species composition can vary greatly based on location along the pipeline. Common shrubs may include rabbitbrush (*Ericameria nauseosa* and *Chrysothamnus viscidiflorus*), bitterbrush, and manazanita (*Arctostaphylos* spp.) east of the Cascades. West of the Cascades native shrubs may include salmonberry (*Rubus spectabilis*), thimbleberry (*Rubus parviflorus*), as well as non-native shrubs including Scotch broom. It typically occurs within revegetated utility corridors and transitional areas, such as reclaimed industrial sites. It is located within Coos, Douglas, Jackson, and Klamath counties.

4.4.2.3 Herbaceous Vegetation

Grasslands (west of Cascades) are found at lower elevations and contain less than 30 percent tree or shrub cover and is generally used for livestock grazing. Native-dominated sites consist primarily of bunchgrasses, with mosses, lichens, and native forbs occurring throughout. Native westside grasslands (i.e., native prairie) have largely been disturbed through grazing activities and are typically vegetated with a mix of native and non-native perennial and annual grasses and forbs. Patches of native remnant prairie still occur, but their distribution is limited. It is found within Coos, Douglas, and Jackson Counties.

Grasslands (east of Cascades) contain a mosaic of various bunchgrasses, typically dominated by Idaho fescue (*Festuca idahoensis*). Other co-dominant grass species include bluebunch wheatgrass (*Pseudoroegneria spicata*), junegrass (*Koeleria* spp.), Sandberg bluegrass (*Poa secunda*), and western needlegrass (*Achnatherum occidentale*). In heavily grazed stands, cheatgrass (*Bromus tectorum*) and bottlebrush squirreltail (*Elymus elymoides* ssp. *elymoides*) can be dominant. This vegetation type is found at low to middle elevations (Kagan et al. 1999) within Klamath County.

Agricultural vegetation includes crop land, orchards, hay fields, and managed pastures. These areas consist of lands that have been cleared of native vegetation and modified for growing crops.

4.4.2.4 General Impacts on Vegetation

Constructing the pipeline would temporarily and permanently impact approximately 4,186 acres of vegetation (table 4.4.2.4-1). Operating the pipeline would permanently impact approximately 782 acres of vegetation (table 4.4.2.4-2). Permanent impacts would occur in association with aboveground facilities, new permanent access roads, and areas of road improvements. In these locations, vegetation would be removed during construction and the areas would not be revegetated during restoration. Permanent impacts would also occur within the 30-foot-wide operational right-of-way maintenance corridor. While this corridor would be revegetated following construction, it would be maintained in an herbaceous and/or low-growing shrub state during the life of the pipeline. Finally, the clearing of mature forested vegetation is also a permanent impact because restoration to preconstruction conditions would not happen during the life of the Project.

As indicated in tables 4.4.2.4-1 and 4.4.2.4-2, constructing and operating the pipeline would require the temporary and permanent clearing of vegetation, including clearing of unique or sensitive vegetation (i.e., LSOG forest, native prairie grasslands, and sagebrush steppe). Removal of vegetation would increase the potential for soil erosion, edge effects, and introduction and spread of noxious weeds and invasive species, and would reduce the amount of available wildlife habitat. The degree of impact depends on the type and amount of vegetation affected, the rate of vegetation regeneration following construction, and the frequency of vegetation maintenance conducted within the 30-foot-wide maintenance corridor within the operational pipeline easement. Additionally, site-specific conditions, such as grazing, precipitation, soil type, and presence of noxious weeds and invasive plants, would influence the length of time required to achieve successful revegetation. Clearing of agricultural and grassland areas would be considered a short-term impact because revegetation of these areas would typically occur within three growing seasons. Clearing of forested and shrubland areas would be considered a long-term impact because affected areas would not resemble adjacent undisturbed areas for many years to many decades; and, as stated above, clearing of mature forests (e.g., LSOG forest) would be considered a permanent impact.

Additional long-term impacts would include the cutting of danger trees or hazard trees, which are defined as trees located outside approved construction areas that are at risk of falling on workers or vehicles and thus would need to be removed. The removal of these trees would result in an additional long-term impact to adjacent vegetation. The extent or existence of danger trees would be identified, to the extent possible, following creation of the construction right-of-way, TEWAs, new access roads, and on roads that have not triggered land-managing agency danger tree removal due to limited road use. Pacific Connector would compensate the respective land manager/owner for any merchantable danger trees that are felled. Danger trees are discussed further in section 4.7.2.5 of this EIS.

TABLE 4.4.2.4-1

Construction Impacts on Vegetation by the Pacific Connector Pipeline Project (acres)

General Vegetation Type	Mapped Vegetation Type	Forest Stand by Age a/	Pipeline Facilities: Construction Right-of-Way	Pipeline Facilities: Temporary Extra Work Areas	Pipeline Facilities: Uncleared Storage Areas	Pipeline Facilities: Rock Source/ Disposal	Pipeline Facilities: Access Roads (TARs/PARs/ Improvements) b/	Pipeline Facilities: Pipe Yards	Pipeline Facilities: Aboveground Facilities - Klamath Compressor Station c/	Subtotals: Subtotal Late Successional – Old Growth	Subtotals: Subtotal Mid-Seral	Subtotals: Subtotal Clearcut or Regenerating	Subtotals: Subtotal by Vegetation Type	Subtotals: *Percent of Total Vegetation Impacted*
Forest-Woodland	Douglas-fir-W. Hemlock-W. Redcedar Forest	L-O	25	1	5	0	0	0	0					
		M-S	52	14	9	1	0	0	0	31	76	210	318	*7.6*
		C-R	124	60	21	5	0	0	0					
	Douglas-fir – Mixed Deciduous Forest	L-O	67	19	75	0	0	0	0					
		M-S	165	40	104	0	<1	<1	0	162	309	231	701	*16.7*
		C-R	87	35	108	0	<1	0	0					
	Alder-Cottonwood	L-O	0	0	0	0	0	0	0					
		M-S	<1	<1	0	0	<1	0	0	0	<1	0	<1	*<0.1*
		C-R	0	0	0	0	0	0	0					
	Mixed Conifer/Mixed Deciduous Forest	L-O	22	5	9	0	0	0	0					
		M-S	47	13	10	0	0	0	0	36	71	171	277	*6.6*
		C-R	112	34	25	0	<1	0	0					
	Shasta Red Fir – Mountain Hemlock Forest	L-O	16	<1	6	0	0	0	0					
		M-S	9	<1	4	0	0	0	0	22	14	78	114	*2.7*
		C-R	45	17	16	0	0	0	0					
	Douglas-fir-White Fir/Tanoak-Madrone Mixed Forest	L-O	7	2	5	0	0	0	0					
		M-S	12	3	6	0	0	0	0	14	20	5	39	*0.9*
		C-R	4	<1	1	0	0	0	0					
	Douglas-fir Dominant-Mixed Conifer Forest	L-O	245	40	107	1	<1	0	0					
		M-S	97	34	28	<1	<1	0	0	393	159	349	900	*21.5*
		C-R	207	61	81	0	<1	0	0					
	Ponderosa Pine/White Oak Forest and Woodland	L-O	39	14	6	0	0	0	0					
		M-S	19	7	<1	0	0	0	0	59	26	42	126	*3.0*
		C-R	28	7	7	0	0	0	0					
	Ponderosa Pine Forest and Woodland	L-O	12	2	0	0	0	0	0					
		M-S	32	2	0	<1	0	0	0	14	35	45	94	*2.2*
		C-R	35	9	<1	1	0	0	0					
	Oregon White Oak Forest	L-O	27	9	4	0	0	0	0					
		M-S	25	7	2	0	<1	0	0	40	34	0	74	*1.8*
		C-R	0	0	0	0	0	0	0					
	Western Juniper Woodland	L-O	2	<1	0	0	0	0	0					
		M-S	33	6	0	0	<1	0	0	3	39	0	42	*1.0*
		C-R	0	0	0	0	0	0	0					

TABLE 4.4.2.4-1 (continued)

Summary of Construction-Related Disturbance to Vegetation by the Pacific Connector Pipeline Project (acres)

General Vegetation Type	Mapped Vegetation Type	Forest Stand by Age a/	Pipeline Facilities: Construction Right-of-Way	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/ Disposal	Access Roads (TARs/PARs/ Improvements) b/	Pipe Yards	Aboveground Facilities - Klamath Compressor Station c/	Subtotals: Subtotal Late Successional – Old Growth	Subtotal Mid-Seral	Subtotal Clearcut or Regenerating	Subtotal by Vegetation Type	*Percent of Total Vegetation Impacted*
Forest - Woodland	Ponderosa Pine/Western Juniper Woodland	L-O	0	0	0	0	0	0	0	0	17	46	63	*1.5*
		M-S	16	2	0	0	0	0	0					
		C-R	42	3	0	0	0	0	0					
Subtotal Forest-Woodland by Age Class		***L-O***	***461***	***93***	***218***	***1***	***<1***	***0***	***0***	***773***	***800***	***1,177***	***2,750***	***65.7***
		M-S	***507***	***128***	***163***	***1***	***<1***	***<1***	***0***					
		C-R	***684***	***227***	***260***	***6***	***<1***	***0***	***0***					
Subtotal Forest-Woodland			**1,652**	**448**	**641**	**8**	**1**	**<1**	**0**	**773** [d]	**800**	**1,177**	**2,750**	
Percent of All Forest-Woodland			***59.9***	***16.3***	***23.4***	***0.3***	***<0.1***	***<0.1***	***0.0***	***28.1***	***29.1***	***42.8***	***100.0***	
Shrubland	Sagebrush Steppe	n/a	78	33	0	0	<1	0	21	n/a	n/a	n/a	133	*3.2*
	Shrublands	n/a	122	41	11	0	<1	0	0	n/a	n/a	n/a	174	*4.1*
Subtotal Shrubland		n/a	**200**	**74**	**11**	**0**	**1**	**0**	**21**	**n/a**	**n/a**	**n/a**	**307**	***7.3***
Grassland	Grasslands (West of Cascades)	n/a	132	87	6	<1	2	148	0	n/a	n/a	n/a	376	*9.0*
	Grasslands (East of Cascades)	n/a	51	9	0	1	0	122	0	n/a	n/a	n/a	183	*4.4*
Subtotal Grasslands			**183**	**96**	**6**	**2**	**2**	**270**	**0**	n/a	n/a	n/a	**559**	**13.4**
Wetland	Wetland	n/a	64	47	<1	0	<1	<1	0	n/a	n/a	n/a	112	*2.7*
Subtotal Wetland			**64**	**47**	**<1**	**0**	**<1**	**<1**	**0**	**0**	**<1**	**<1**	**112**	***2.7***
Agriculture	Agriculture	n/a	306	132	<1	3	2	14	0	n/a	n/a	n/a	458	*10.9*
Subtotal Agriculture			**306**	**132**	**<1**	**3**	**2**	**14**	**0**	n/a	n/a	n/a	**458**	***10.9***
Subtotal Non-Forest			**752**	**349**	**18**	**5**	**5**	**284**	**21**	**0**	**<1**	**<1**	**1,436**	***34.4***
Percent of All Non-Forest			***52.4***	***24.3***	***1.3***	***0.3***	***0.3***	***19.8***	***1.5***	***0.0***	***<0.1***	***<0.1***	***100.0***	
Project Total		n/a	**2,404**	**797**	**659**	**13**	**6**	**284**	**21**	**773** [d]	**801**	**1,177**	**4,186**	
Percent of Pipeline Facilities		n/a	***57.4***	***19.0***	***15.7***	***0.3***	***0.1***	***6.8***	***0.5***	***15.6***	***18.5***	***28.1***		

General: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

a/ "L-O" = Late Successional and Old-Growth; M-S = Mid-Seral; "C-R" = Clearcut or Regenerating

b/ Road improvements will affect approximately 22.52 acres along the margins of existing access roads; all acres of disturbance have been included in vegetation type "roads."

c/ Construction disturbance associated with aboveground facilities (mainline block valves and meter stations) is included in construction right-of-way and/or TEWA acres of disturbance. Approximately 1.61 acres associated with communication towers is not included in this table (previously disturbed sites).

d/ Approximately 658 acres of construction-related disturbance to LSOG forests would occur on lands managed by the BLM and Forest Service.

TABLE 4.4.2.4-2

Operation Impacts on Vegetation by the Pacific Connector Pipeline Project

			Pipeline Facilities (acres a/)							
General Vegetation Type	**Mapped Vegetation Type**	**Forest Stand by Age b/**	***30-foot-wide Maintenance Corridor***	**Permanent Access Roads**	**Subtotal LSOG**	**Subtotal Mid-Seral Forest**	**Subtotal Clearcut / Regenerating Forest**	**Permanent Easement (50-foot) c/**	**Aboveground Facilities d/ (acres a/)**	**Total Operation Impacts by Vegetation Type e/**
Forest-Woodland	Douglas-fir-W. Hemlock-W. Redcedar Forest	L-O	8	0	8	16	39	14	0	**63**
		M-S	16	0				27		
		C-R	39	0				65		
	Douglas-fir – Mixed Deciduous Forest	L-O	20	0	20	52	27	34	<1	**99**
		M-S	52	<1				87		
		C-R	27	<1				46		
	Alder-Cottonwood	L-O	0	0	0	<1	0	*0*	0	**<1**
		M-S	<1	0				<1		
		C-R	0	0				*0*		
	Mixed Conifer/Mixed Deciduous Forest	L-O	7	0	7	15	35	11	0	**56**
		M-S	15	0				24		
		C-R	35	<1				59		
	Shasta Red Fir – Mountain Hemlock Forest	L-O	5	0	5	3	14	9	<1	**23**
		M-S	3	0				5		
		C-R	14	0				24		
	Douglas-fir-White Fir/Tanoak-Madrone Mixed Forest	L-O	3	0	3	3	1	4	0	**7**
		M-S	3	0				6		
		C-R	1	0				2		
	Douglas-fir Dominant-Mixed Conifer Forest	L-O	75	0	76	31	67	126	<1	**173**
		M-S	31	0				51		
		C-R	67	<1				112		
	Ponderosa Pine/White Oak Forest and Woodland	L-O	12	0	12	6	9	21	0	**27**
		M-S	6	0				9		
		C-R	9	0				15		
	Ponderosa Pine Forest and Woodland	L-O	4	0	4	10	11	6	0	**25**
		M-S	10	0				17		
		C-R	11	0				18		
	Oregon White Oak Forest	L-O	8	0	8	8	0	14	0	**16**
		M-S	8	0				13		
		C-R	0	0				0		
	Western Juniper Woodland	L-O	<1	0	<1	10	0	1	0	**11**
		M-S	10	0				16		
		C-R	0	0				0		
	Ponderosa Pine/Western Juniper Woodland	L-O	0	0	0	5	13	0	<1	**19**
		M-S	5	0				8		
		C-R	13	0				22		
Subtotal Forest-Woodland by Age Class		***L-O***	**143**	**0**	**143**	**158**	**216**	**239**	***<1***	***143***
		M-S	**158**	**<1**				**264**	***<1***	***158***
		C-R	**216**	**<1**				**363**	***<1***	***217***
Subtotal Forest-Woodland			**517**	**<1**	**143**	**158**	**216**	***866***	**<1**	**517**

TABLE 4.4.2.4-2 (continued)

Operation Impacts on Vegetation by the Pacific Connector Pipeline Project

General Vegetation Type	**Mapped Vegetation Type**	**Forest Stand by Age b/**	**Pipeline Facilities (acres a/)** *30-foot-wide Maintenance Corridor*	**Permanent Access Roads**	**Subtotal LSOG**	**Subtotal Mid-Seral Forest**	**Subtotal Clearcut / Regenerating Forest**	**Permanent Easement (50-foot) c/**	**Aboveground Facilities d/ (acres a/)**	**Total Operation Impacts by Vegetation Type e/**
Shrubland	Sagebrush Steppe	n/a	26	<1	n/a	n/a	n/a	44	21	**48**
	Shrublands	n/a	39	<1	n/a	n/a	n/a	65	<1	**39**
	Subtotal Shrubland		**65**	**<1**	n/a	n/a	n/a	***109***	**21**	**86**
Grassland	Grasslands (West of the Cascades)	n/a	42	1	n/a	n/a	n/a	71	1	**45**
	Grasslands (East of the Cascades)	n/a	16	0	n/a	n/a	n/a	27	0	**16**
	Subtotal Grassland		**58**	**1**	n/a	n/a	n/a	***98***	**1**	**61**
Wetland	Wetland	n/a	21	<1	0	<1	<1	<1	0	**20**
	Subtotal Wetland/Riparian		**21**	**<1**	0	<1	<1	***35***	**<1**	**21**
Agriculture	Agriculture	n/a	97	<1	n/a	n/a	n/a	161	<1	**97**
	Subtotal Agriculture		**97**	**<1**	n/a	n/a	n/a	***161***	**<1**	**97**
	Subtotal Non-Forest		**241**	**2**	**n/a**	**n/a**	**n/a**	**403**	**23**	**266**
	Project Total		**758**	**1**	**143**	**158**	**216**	**1,269**	**23**	**782**

General: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
a/ Acres disturbed were evaluated using GIS; footprints for each component (aboveground facilities, 50-foot-wide permanent easement, and 30-foot-wide maintenance corridor) were overlaid on the digitized vegetation coverage.
b/ "L-O" = Late Successional and Old-Growth; "M-S" = Mid-Seral; "C-R" = Clearcut or Regenerating Young Forest.
c/ Shaded cells identify acres of vegetation type within the defined area but are not included in the overall Project total because: 1) only the 30-foot-wide Maintenance Corridor included within the 50-foot-wide Permanent Easement is expected to be affected during operations and maintenance activities, and 2) no additional maintenance would occur on access roads improved for construction of the Project.
d/ Aboveground facilities include block valve assemblies (BVAs), the Jordan Cove, Clarks Branch, and Klamath meter stations, and the Klamath Compressor Station.
e/ Total by Vegetation Type includes the 30-foot-wide maintenance corridor and permanent access roads, and only aboveground facilities with a meter station or compression station (mainline block valves are located within the 30-foot-wide maintenance corridor).

Acres of impacts only include impacts on vegetated areas; therefore, impacts in this table may not reflect impact values reported in other sections of this EIS. Shaded cells identify acres of vegetation type within the defined area but are not included in the overall Project total because: 1) only the 30-foot-wide Maintenance Corridor included within the 50-foot-wide Permanent Easement is expected to be affected during operations and maintenance activities, and 2) no additional maintenance would occur on access roads improved for construction of the Project.

The Pacific Connector Pipeline Project would impact approximately 133 acres of sagebrush steppe habitat. Impacts on sagebrush steppe would be long term because big sagebrush only regenerates from seed and may take 20 years or more to become reestablished (West 1988). Constructing and operating the pipeline would also impact approximately 773 acres of LSOG forests, 800 acres of mid-seral forest, and 1,177 acres of clearcut/regenerating forests.

Throughout our environmental review of this Project, we have received comments not only from the public, but from the tribes, and federal and state resource agencies expressing concern about impacts on forests, specifically "old-growth" forests. Since implementation of the Northwest Forest Plan (NWFP) in 1994, periodic monitoring of the amount, distribution, and spatial arrangement of LSOG forest within the range of the NWFP has been conducted. Based on monitoring conducted in 2012, there was approximately 6,460,900 acres of LSOG forests within the NWFP boundary in the four physiographic provinces in Oregon (Coast Range, Western Cascades, Eastern Cascades and Klamath) crossed by the pipeline (Davis et al. 2015). The impacts to 773 acres of LSOG forests from construction and operation of the Project would represents a loss of only 0.01 percent of the remaining LSOG forest in the four physiographic provinces crossed by the pipeline. As stated above, LSOG forests provide vital habitat for many native species of plants and wildlife, including many federally-listed threatened or endangered species, as well as providing a variety of environmental services (Forest Service and BLM 1994b; BLM 2008a). The loss of this forest vegetation would reduce the amount of habitat available to species dependent on LSOG vegetation and would potentially alter existing vegetation composition and soil and hydrologic characteristics and the ecosystem services provided by LSOG forests.

Additionally, constructing the pipeline would result in forest fragmentation and edge effects. The pipeline would fragment or "break-up" large tracts of contiguous forest and further the fragmentation of tracts broken up previously due to other forest practices (timber harvest, access roads), and other development (urban growth, agricultural development, utility corridors). Fragmentation reduces forest size and can reduce the size and increase the spatial isolation of local plant populations, including rare or endangered species (Jules et al. 1999). Fragmented forests also affect wildlife movement and its ability to successfully function as wildlife habitat (see section 4.5).

Fragmentation also results in new forest "edges" which play a crucial role in ecosystem interactions and landscape function, including the distribution of plants and animals, fire spread, vegetation structure, and wildlife habitat. New forest edges would affect microclimate factors such as wind, humidity, and light, and can lead to a change in species composition within the adjacent forest or increase invasion by invasive species. Compared to the forest interior, vegetation edges receive more direct solar radiation during the day, lose more light and heat at night, and experience less humidity. Increased solar radiation (e.g., light and heat) and wind can desiccate vegetation by increasing evapotranspiration, which can affect which species survive along the edge (typically favoring shade intolerant species) and can impact soil characteristics. The orientation of a fragment's edge can affect the extent and magnitude of edge effects because the amount of solar radiation that falls on the newly created edge would depend on the direction it faces, its latitude, time of year and time of day, and height of trees in the area that would cast shadows on the new edge (Chen et al. 1995). Because these values constantly change temporally and spatially, the edge effects would also constantly change along the pipeline, as tree shadows would extend different distances across the right-of-way depending on the time of year or aspect of the edge. This would result as some areas would be in shade at one point in the year (reducing edge effects) and in sunlight during another portion of the year (increasing edge effects).[98]

Harper et al. (2005) reported that the mean distance of edge influence could occur up to 300 feet (approximately 100 meters); however, the study also found that the development of a sidewall of dense vegetation along the new edge can affect the overall mean distance of edge effects.. This may reduce the depth of penetration of energy and matter into the forest, shortening the length of the gradient (distance) while the magnitude of edge influence remains strong (Harper et al. 2005). In general, the greater distances were not found in the North American sites, where the influence associated with maintained clearings was less than 150 feet; however, these studies were done in boreal forests (Harper et al. 2015) which may not be directly applicable to the temperate old-growth forests in the Pacific Northwest. A study on edge influence in old-growth Douglas-fir forests in the Pacific Northwest found that the edge influence on microclimatic variables (air temperature, soil temperature, relative humidity, short-wave radiation, and wind speed) extended between 98 feet (30 meters) to more than 785 feet (240 meters) depending on the microclimatic variable (Chen et al. 1995). Additionally, Jules et al. (1999) found that the depth of edge influence on forest understory species in the Klamath ecoregion ranged from 0 feet to more than 197 feet (60 meters) depending on the species. In younger coniferous forests or mixed forests with deciduous species, edge effects compared to interior forests have been much less pronounced (Heithecker and Halpern 2007; Harper and Macdonald 2002).

Although any vegetation type can be fragmented, of the vegetation types crossed by the pipeline, forested and woodland vegetation and their associated species are likely the most sensitive to fragmentation. Existing patch size, patch isolation, and edge characteristic (i.e., the contrast or the relative difference among adjacent patches) of coniferous and/or mixed forest patches of different age classes were evaluated along the pipeline's centerline to determine the acreage of interior forests that would be fragmented and experience new edge effects. Based on this assessment, approximately 430 acres of interior forest would be affected by construction of the pipeline, while between 1,752 and 3,504 acres would be indirectly affected (i.e., would be within 50 to 100 meters of newly created edges). This includes effects on approximately 185 acres of LSOG forests, 126 acres of mid-seral forests, and 119 acres of regenerating forests, and indirect effects on approximately 1,449 acres of LSOG forest, 1,010 acres of mid-seral forests, and 1,046 acres of regenerating forests.

To minimize forest fragmentation and edge effects, Douglas-fir or western hemlock would be planted during restoration of temporary work areas, including TEWAs, in the pipeline right-of-way (except in the 30-foot-wide maintenance corridor centered on the pipe), where conifers would be removed during construction activities. By revegetating the area, the edge along the fragment would be reduced, thereby reducing the effects of fragmentation and edge effects. If 12-inch- tall Douglas-firs and western hemlocks are planted during restoration and they are not harvested later,

[98] For example, assume the 95-foot-wide pipeline construction corridor is oriented northwest to southeast at 135 degrees from north. At a location in the vicinity of the pipeline (longitude=123.0 degrees West, latitude=42.5 degrees North) on June 21, the sun would be shining from the east (azimuth ≈91.5 degrees) at 0815 (Pacific Standard Time [PST]) with solar altitude of ≈ 37.6 degrees. A tree 100 feet tall on the southwest-facing edge of the right-of-way would cast a shadow 130 feet which, given the angle and width of the right-of-way, would fall short of reaching the opposite side (northeast-facing edge) by about 5 feet. On May 21, however, the sun in the same position would have cast a shadow of about 170 feet at 0745 (PST) and on July 21 at 0800 (PST) the shadow would extend about 160 feet. In both instances, the edge opposite the eastern sun would be in shadow.

trees of both species could, depending on site conditions, range between about 20 and 120 feet tall in 50 years at the end of the Project's operational life. Douglas-fir and western hemlock planted adjacent to edges of clearcut and/or early regenerating stands (assuming conifers from 1 to 10 feet tall at the time of construction) would modify edges of the seral stands from hard, to soft, to no edge as they grow. As the replanted trees grow, edge contrasts would decrease, as would effects on forest interiors, because taller trees would reduce direct solar radiation and increase soil moisture and humidity along the edges of stand interiors (Chen et al. 1993; Heithecker and Halpern 2007).

The Project's proposed vegetation clearing in forested vegetation has the potential to exacerbate the rate of windthrow in adjacent forest stands. Long-term forest stand degradation due to windthrow could potentially occur in local areas along the proposed right-of-way where the route is exposed to strong winds, especially where it runs perpendicular to the direction of the prevailing wind.

UCSAs would not be cleared of vegetation during construction but would be located in areas of woodlands and dense, mature forest. Within UCSAs located in forests and woodlands, some damage to understory vegetation and minor damage to trees would occur. Trees that are damaged at the time of construction could die over time (e.g., from severed roots, damage to lateral or anchoring roots, broken tops, or damage to more than 50 percent of the circumference of the tree). In these cases, the impact would be long term, i.e., the death of a tree would be considered a long-term or permanent impact. Vegetation disturbance would generally depend on the site-specific vegetation characteristics, with younger regenerating forests being potentially more susceptible to damage such as limb breakage. To protect trees within UCSAs, Pacific Connector would implement the measures outlined in its *Leave Tree Protection Plan*.[99] After construction, Pacific Connector would assess potential tree damage within the UCSAs and would appropriately compensate the landowner for damage.

Pacific Connector would implement numerous measures to minimize impacts on vegetation and ensure successful revegetation of disturbed areas. These measures include those found in the ECRP, *Leave Tree Protection Plan*, *Integrated Pest Management Plan*, *Fire Prevention and Suppression Plan*, and the *SPCC Plan* (see the POD, appendix F.10). These measures would be applied to all lands crossed by the pipeline route. However, as part of their ROW grant, the Forest Service and BLM would require additional measures to minimize and mitigate impacts on vegetation, including LSOG forests, on federal lands. Measures specific to federally managed lands are addressed below in section 4.4.3.3, as well as in the *BLM and Forest Service Compensatory Mitigation Plan and Amendment* (appendix F.2) and *Late Successional Reserves Crossed by the PGCP Project* (appendix F.3).

4.4.2.5 Noxious Weeds and Invasive Species

Section 4.4.1.6 describes and defines what noxious weeds and other invasive plant species are, as well as the general effects that they can have to a system. List "T" (i.e., target species) noxious weeds that have the potential of occurring in the area of the pipeline are listed in table 4.4.2.5-1.

[99] This plan was included as Appendix P to Pacific Connector's POD.

TABLE 4.4.2.5-1

Oregon Target Weeds (List T) Suspected within or Near the Proposed Pacific Connector Pipeline Work Area a/

Noxious Weed Common and Scientific Name	Known or Suspected Occurrences: County b/	Known or Suspected Occurrences: Forest Service Region 6 c/	Known or Suspected Occurrences: BLM Districts c/	ODA Noxious Weed Class d/
Garlic mustard *Alliaria petiolata*	Jackson (L)		MD - D	B
Plumeless thistle *Carduus acanthoides*	Douglas e/ Klamath (L)		LV – D, RO – D	A
Woolly distaff thistle *Carthamus lanatus*	Douglas (L) Jackson e/		MD – D, RO - D	A
Spotted knapweed *Centaurea stoebe* (*C. maculosa*)	Coos (L) Douglas (L) Jackson (L) Klamath (W)	UMP - D	LV – D MD - D	B
Squarrose knapweed *Centaurea virgata*	Klamath e/		LV MD - D	A
Rush skeletonweed *Chondrilla juncea*	Douglas (W) Jackson (W) Klamath (L)	FW – D RRS – D UMP - D	LV MD - D RO - D	B
Field bindweed *Convolvulus arvensis*	Coos (W) Douglas (W) Jackson (W) Klamath (W)	FW – D	CB – D, MD – D, LV – D, RO - D	B
Portuguese broom *Cytisus striatus*	Douglas (L)	UMP – D	MD – D, RO - D	B
Paterson's curse *Echium plantagineum*	Douglas (L)			A
Leafy spurge *Euphorbia esula*	Coos e/ Jackson (L) Klamath (L)	FW - D	CB – D, LV – D, MD - D	B
Orange hawkweed *Hieracium aurantiacum*	Coos (L) Klamath (L)			A
Perennial pepperweed *Lepidium latifolium*	Jackson (L) Klamath (W)	FW – D	LV - D	B
Dalmatian Toadflax *Linaria dalmatica* (*L. genista*)	Coos (L) Douglas (L) Jackson (L) Klamath (W)	FW – D UMP – D	LV – D MD - D	B
Waterprimrose *Ludwigia grandiflora* ssp. *hexapetala; L. peploides*	Jackson (L)		MD - D	B
Matgrass *Nardus stricta*	Klamath (L)		CB	A
Yellow floating heart (*Nymphoides peltata*)	Douglas (L) Jackson (L)	RRS – D UMP - D		A
Taurian thistle *Onopordum tauricum*	Klamath (L)			A
Tansy ragwort *Senecio jacobaea*	Coos (W) Douglas (W) Jackson (L) Klamath (H)	FW – D	CB – D, LV – D, MD - D, RO - D	B
Smooth cordgrass *Spartina alterniflora*	Coos (H)			A
Dense-flowered cordgrass *Spartina densiflora*	Coos (L)			A
Saltcedar *Tamarix ramosissima*	Jackson (L) Klamath (L)		LV - D	B
Gorse *Ulex europaeus*	Coos (W) Douglas (L)	RRS – D UMP – D	CB – D, MD – D, RO - D	B

a/ Source: ODA 2018a; Forest Service 2005b and 2017b; BLM 2017

b/ Letter in parenthesis indicates distribution within the county, if provided (ODA 2018a). L = Limited, W = Widespread, and H = Historic. No letter indicates county not listed on the ODA (2018a) species fact sheet

c/ Forest Service and BLM District Codes: UPM–Umpqua NF, RRS – Rogue River Siskiyou NF, FW – Fremont-Winema NF, CB–Coos Bay BLM, LV – Lakeview BLM, MD–Medford BLM, RO - Roseburg BLM. "D" indicates that it is documented in National Forest Service or BLM District but not necessarily within county crossed by the Pacific Connector pipeline.

d/ Oregon Noxious Weed List: List "A" weeds occur in small enough infestations to make eradication or containment possible or is not known to occur in Oregon but is present in neighboring states making occurrence in Oregon seem imminent. List "B" weeds are regionally abundant but may have limited distribution in some counties. List "T" weeds are selected from the "A" or "B" lists and are designated as a target species

e/ BLM District indicated that this species is found in the listed county (BLM 2017a).

In addition to the List T weeds, other weed species (e.g., non-List T species) that are also of concern could occur along the pipeline route.[100]

All Oregon State-listed noxious weeds (List A, B, and T species) documented along the pipeline route are listed in table 4.4.2.5-2. Five List T weeds, spotted knapweed, rush skeletonweed, Dalmatian toadflax, tansy ragwort, and gorse, were documented.

TABLE 4.4.2.5-2

Summary of Noxious Weeds found within the Vicinity of the Pacific Connector Pipeline Route during Surveys a/

Common Name *Scientific Name*	ODA Noxious Weed Class	ODA Target "T" Weed
Velvetleaf *Abutilon theophrasti*	B	No
Biddy-biddy *Acaena novae-zelandiae*	B	No
False brome *Brachypodium sylvaticum*	B	No
Butterfly bush *Buddleja davidii*	B	No
Musk thistle *Carduus nutans*	B	No
Meadow knapweed *Centaurea moncktonii*	B	No
Yellow starthistle *Centaurea solstitialis*	B	No
Spotted knapweed *Centaurea stoebe* (*C. maculosa*)	B	Yes
Rush skeletonweed *Chondrilla juncea*	B	Yes
Canada thistle *Cirsium arvense*	B	No
Bull thistle *Cirsium vulgare*	B	No
Houndstongue *Cynoglossum officinale*	B	No
Scotch broom *Cytisus scoparius*	B	No
Cutleaf teasel *Dipsacus laciniatus*	B	No
French broom *Genista monspessulana*	B	No
English ivy *Hedera helix*	B	No
St. Johnswort *Hypericum perforatum*	B	No
Perennial peavine *Lathyrus latifolius*	B	No
Dalmation toadflax *Linaria dalmatica (L. genista)*	B	Yes
Purple loosestrife *Lythrum salicaria*	B	No
Scotch thistle *Onopordum acanthium*	B	No
Japanese knotweed *Polygonum cuspidatum* (*Fallopia japonica*)	B	No
Sulphur cinquefoil *Potentilla recta*	B	No
Himalayan blackberry *Rubus armeniacus (R. discolor, R. procerus, R. fruticosa)*	B	No
Tansy ragwort *Senecio jacobaea*	B	Yes
Medusahead rye *Tainiatherum caput-medusae*	B	No
Gorse *Ulex europaeus*	B	Yes

a/ Documented within 100 feet of the pipeline project route.

Pacific Connector's ECRP includes measures to control noxious weeds, soil pests, and forest pathogens. In addition, Pacific Connector developed an *Integrated Pest Management Plan,*[101] in consultation with the ODA (Butler 2017), BLM, and the Forest Service, to minimize the potential spread and infestation of weeds. This plan, applicable to all land ownerships, includes requirements for surveys to be conducted prior to construction to determine the presence of noxious weeds; determining where management or pretreatment may be necessary prior to construction to prevent the spread of noxious weeds; cleaning of construction equipment prior to moving it onto the construction right-of-way; and cleaning of vegetation clearing and grading

[100] All Oregon State noxious weeds that could potentially occur along the pipeline project (including List A and B species) are included in Table C.3-4 of Appendix C.3 in Resource Report 3 in Pacific Connector's September 2017 application to the FERC.
[101] See Appendix N to the POD submitted to the FERC January 23, 2018.

equipment if it passes through areas where weeds have been identified. Additionally, disturbed areas would be replanted with appropriate seed mixes to prevent noxious weed germination. After construction, the right-of-way would be monitored and any noxious weed infestations would be controlled. Pacific Connector would also investigate noxious weed issues raised by landowners during operation of the pipeline.

To minimize the spread of noxious weeds, construction equipment would be power washed, if necessary, as determined by the EI. In addition, initial inspections of all company and construction contractor vehicles would be performed prior to being allowed on the construction right-of-way. The EI or Pacific Connector's authorized representative would be responsible for performing inspections and registering or tagging the equipment prior to being transported or moved to the right-of-way. Any equipment used within areas where noxious weeds are present (specifically those that are classified as priority A and T as well as selected B listed weeds) would be cleaned by hand, blown down with air, or pressure washed prior to leaving the site. Equipment cleaning on the right-of-way would occur in a cleaning station approved by the EI. Infested areas and cleaning stations would be mapped to ensure that these areas are monitored during construction and to ensure that weeds at these areas are controlled and not spread.

After construction, Pacific Connector would monitor the right-of-way for infestations of noxious weeds, in compliance with its *Integrated Pest Management Plan*. Targeted weed monitoring would occur in the areas where noxious weeds were identified prior to construction and were previously mapped to ensure that potential infestations do not reestablish and/or spread. Monitoring would also occur in areas along the right-of-way where equipment cleaning stations, hydrostatic dewatering sites, and other temporary project disturbances were located to ensure that infestation at these locations do not occur. If infestations occur along the right-of-way, Pacific Connector would make an assessment of the source of the infestation, the potential for the infestation to spread, and develop a treatment plan to control the infestation. Where infestations occur on federal lands, this assessment and treatment plan would be developed cooperatively with these agencies. The treatment plan would be developed using integrated weed management principles, and if herbicides are used, all applicable approvals would be obtained prior to their use including landowner approvals. Only herbicides that are approved for use on the affected lands (private, state, or federal) would be used. Herbicide treatments would not be conducted during precipitation events or when precipitation is expected within 24 hours to minimize the risk of these chemicals moving beyond the treated areas or into waterbodies. If weeds targeted for herbicide treatments are in the vicinity of sensitive sites, proper buffers would be used in order to prevent the spread of herbicides to these areas. Pacific Connector would consult with the ODA Noxious Weed Control Program or local County Weed Programs for additional support regarding noxious weed control issues that may occur during the pipeline operations. Pacific Connector would conduct follow-up inspections of all disturbed areas until revegetation is successful. If additional infestations or other invasive/noxious weed species are found, then these would be controlled and monitored as well.

4.4.2.6 Vegetation Pathogens

In Oregon, the Forest Service and ODF conduct annual aerial surveys of all forested land to determine insect and disease activity status. These surveys indicated the following insect and/or disease activity within 0.5 mile of the pipeline route: Douglas-fir beetle, fir engraver, flatheaded borer, mountain pine beetle (ponderosa and sugar pine), western pine beetle, needle cast (lodgepole pine, ponderosa pine, and Swiss), and Port Orford cedar root disease.[102] Within the pipeline Project area, the flatheaded borer, western pine beetle, and fir engraver are most prevalent. Other diseases that may occur or have potential to occur are annosus root and butt rot, laminated root rot, dwarf mistletoe, sudden oak death, and the black stain root disease. As indicated in table 4.4.2.6-1, multiple infestations of insect parasites and tree pathogens already exist along the pipeline route.

TABLE 4.4.2.6-1

Summary of Known Infestations of Insect Parasites and Tree Diseases Along the Pacific Connector Pipeline Route a/

Tree Insect or Disease	Land Ownership	Number of Incidences Along Pipeline Route	Approximate Mileposts (MP) of Right-of-Way Affected
Douglas-fir Beetle	BLM/Private/Forest Service	7	MP 32.1-32.2; MP 48.0; MP 98.4 – 102.2
Fir Engraver	BLM/Private/Forest Service	18	MP 48.3; MP 82.0 – 84.5; MP 103.9 – 113.7; MP 152.3-177.7
Flatheaded Borer	BLM/Private/Forest Service	27	MP 30.5 – 40.9; MP 50.8 – 51.1; MP 104.4 – 158.1
Laminated Root Rot	Forest Service	1	MP 154.2 – 154.5
Mountain Pine Beetle	BLM/Private/Forest Service	9	MP 112.3; MP 159.5 – 173.8; MP 224.2 – 224.9
Needle Cast	BLM/Private/Forest Service	7	MP 6.7R – 22.0; MP 161.5 – 168.7
Pine Engraver	Private	1	126.8
Port Orford Cedar Root Disease	Private	4	MP 23.1; MP 30.4 – 30.9; MP 39.65
Western Pine Beetle	BLM/Private/Forest Service	13	MP 96.9 – 97.0; MP 116.6 – 127.1; MP 139.9 – 154.0

Mileages rounded to nearest tenth of a mile.
a/ Summarized from Table 1-2 in the *Integrated Pest Management Plan* (Appendix N to the POD).
Source Data: ODF 2004 through 2017 aerial GIS data.

The introduction and/or spread of insects and diseases from construction equipment, activities, and personnel can adversely affect vegetation. Impacts include loss, reduced species fitness and diversity, and changes to habitat characteristics and subsequent wildlife use. To minimize the introduction and spread of insects and disease, Pacific Connector would implement measures described in its *Integrated Pest Management Plan*. Pacific Connector would identify/verify areas infested with forest pathogens during timber cruises prior to construction and implement minimization measures, including but not limited to cleaning equipment and vehicles upon entering/departing infested areas, applying sporax/borax on freshly cut stumps and wounds to reduce spread of root rot, and utilizing standard logging practices that minimize or prevent damage to standing trees adjacent to the pipeline.

4.4.2.7 Fire Regimes

Fires play a substantial role in shaping the composition and structure of vegetative communities. The pipeline would pass through numerous fire regimes. Table 4.4.2.7-1 lists the mean fire return interval (i.e., mean fire frequency in the area) as well as the total acres that have burned between 2000 and 2015 (based on existing fire data) for the fifth field watersheds crossed by the pipeline. The most notable recent fire event in the region is the Stouts Creek fire, which burned 26,452 acres in and around the pipeline project area in 2015 in the Days Creek-South Umpqua River and Elk

[102] Table C.3-3 in Appendix C.3 of Pacific Connector's Resource Report 3 lists the location (by MP when known) of each identified pathogen near the pipeline route.

Creek watersheds (Northwest Interagency Coordination Center 2015). Approximately 10.7 miles (227 acres) of the pipeline crosses the area burned by the Stouts Creek fire, generally between MP 95.5 through MP 108.8.

TABLE 4.4.2.7-1

Historic Average Fire Frequency and Extent of Acreage Burned in Watersheds Crossed by the Proposed Pacific Connector Pipeline

Ecoregion	HUC – Fifth-Field Watershed	Mean Fire Return Interval a/	Total Acres Burned (2000–2015) b/
Coast Range	Coos Bay-Frontal Pacific Ocean	126-150 Years	0
	Coquille River	81-90 Years	0
	North Fork Coquille River	151-200 Years	0
	East Fork Coquille River	126-150 Years	0
	Middle Fork Coquille River	61-70 Years	827
Klamath Mountains	Olalla Creek-Lookingglass Creek	21-25 Years	0
	Clark Branch-South Umpqua River	26-30 Years	56
	Myrtle Creek	61-70 Years	0
	Days Creek-South Umpqua River	46-50 Years	17,753
	Lower Cow Creek	41-45 Years	11,551
	Upper Cow Creek	41-45 Years	897
	Elk Creek	36-40 Years	13,504
	Trail Creek	26-30 Years	835
	Shady Cove-Rogue River	21-25 Years	48,677
	Bear Creek	21-25 Years	2,379
	Gold Hill-Rogue River	21-25 Years	1,870
	Big Butte Creek	26-30 Years	986
	Little Butte Creek	26-30 Years	3,644
Eastern Cascades Slopes and Foothills	Spencer Creek	31-35 Years	0
	John C Boyle Reservoir-Klamath River	26-30 Years	5,529
	Lake Ewauna-Klamath River	61-70 Years	26
	Mills Creek-Lost River	91-100 Years	13

a/ Data from LANDFIRE (2017).
b/ Data from BLM_Fire_History shapefile (BLM 2017b). Acres rounded to nearest whole acre.

The use of heavy equipment to construct the pipeline would increase the potential for a wildfire. Specifically, prescribed burning of slash, mowing, welding, refueling with flammable liquids, and parking vehicles with hot mufflers or tailpipes on tall dry grass would increase the risk of wildfires. A wildfire would result in additional loss of vegetation.

Certain activities associated with construction and operation of the Pacific Connector project (such as prescribed burning of slash, mowing, welding, refueling with flammable liquids, and parking vehicles with hot mufflers or tailpipes on tall dry grass) could increase the risk of wildland fires, especially if these activities occur within the fire season. Even small fires, created during these activities, could have far-reaching consequences on vegetative communities. For example, large forest fires could occur if small, low-intensity surface fires, ignited within the herbaceous or low-shrub cover maintained along the permanent right-of-way, spread to ladder fuels near forest edges, allowing access to the forest's canopy. This could trigger a high intensity crown fire that could spread to adjacent areas, away from the pipeline's route. If fire frequencies were to increase due to Project activities, vegetative communities could shift over time to a species composition more adapted to higher fire frequencies. It is also possible that the cleared right-of-way could serve as a fire break for large crown fires, thereby reducing the extent of a fire's spread; however, as discussed above, the presence of the cleared right-of-way could also increase the risk of crown fires occurring in the first place.

4.4.3 Environmental Consequences on Federal Lands

The Pacific Connector pipeline route would cross lands managed by federal agencies including the Forest Service, BLM, and Reclamation. The pipeline would pass through portions of federal land designations that are intended to protect vegetation or habitats: such as Riparian Reserves and LSRs. These federal land designations, as well as the effects that the pipeline would have on these areas, are addressed in section 4.7.

4.4.3.1 BLM – Forest Operations Inventory

The BLM tracks vegetation, land management treatments, and disturbance within each district during operations inventories. These data and/or attributes are then transferred to a GIS coverage called the Forest Operations Inventory (FOI). The FOI describes and classifies forest cover (vegetation), site class, denudation cause, dominant species, understory species, treatments, age class, and stand condition (BLM 2016c).

Table I-6 in appendix I lists the acres of impact that would occur to FOIs from both construction and operation of the pipeline. As shown in table I-6, there would be approximately 893 acres of impact during construction of the pipeline to FOIs, which includes about 285 acres on the Coos Bay District (approximately 238 acres of conifer forest, 7 acres of hardwood forest, 31 acres of mixed conifer and hardwood forest, and 9 acres of non-forest/other), 316 acres on the Roseburg District (approximately 273 acres of conifer forest, 37 acres of mixed conifer and hardwood forest, and 7 acres of non-forest/other), 274 acres on the Medford District (approximately 107 acres of conifer forest, 34 acres of hardwood forest, 83 acres of mixed conifer and hardwood forest, and 50 acres of non-forest/other), and 18 acres on the Lakeview District (all conifer forest).

4.4.3.2 Forest Service – Plant Series and Plant Association Groups

The Forest Service classifies potential vegetation based on plant series, and plant association groups (PAGs). Plant series are based on the climax dominant trees of a stand (e.g., the Douglas-fir series). Plant series can be subdivided into PAGs, which are described primarily by the presence or absence of plant species, as well as the abundance of a species based on environmental variables, including soil, aspect, slope, slope position, and moisture. Not all of the three National Forests crossed by the Pacific Connector pipeline route have identified PAGs or plant series, and these unidentified areas are noted as “not in series” (Forest Service 1996a). Table I-7 lists the acres of impact that would occur on PAGs and plant series from both construction and operation of the pipeline. As shown in table I-7, there would be approximately 585 acres of impacts during construction of the pipeline on PAGs and plant series, which includes about 211 acres on the Umpqua National Forest, 276 acres on the Rogue River-Siskiyou National Forest, and 98 acres on the Fremont-Winema National Forest. White fir and Douglas-fir series would be the most heavily affected PAGs.

The following describes the seven plant series that would be crossed by the pipeline, based on GIS coverage.

Douglas-Fir Series

Douglas-fir occurs in all PAG series within elevations ranging from sea level to 5,600 feet. Usually overstory presence of Douglas-fir indicates recent ground disturbance while presence and dominance in the understory can indicate hot, dry conditions, which is characteristic of the Douglas-fir Series. Many other tree species may be present that are also tolerant of drought-like conditions, such as ponderosa pine, incense cedar, and canyon live oak (*Quercus chrysolepis*). Within Umpqua National Forest, the following shrubs/plant associations may occur within the Douglas-fir Series: poison oak (*Toxicodendron diversilobum*), canyon live oak, chinquapin, salal, and species associated with ultramafic parent materials. Potentially canyon live oak and Douglas-fir may occur on the Rogue River-Siskiyou National Forest.

Mountain Hemlock Series

In Southwest Oregon, mountain hemlock occurs at high elevations, ranging from approximately 3,950 feet to 6,690 feet in the Cascades, with cold temperatures and moderate precipitation. Associated parent material is highly variable, although pumice, andesite, and basalt are the most common. Mountain hemlock and Shasta red fir are dominant tree species in the overstory, with western white pine and Douglas-fir occasionally occurring. Within the Rogue River-Siskiyou National Forest, the Mountain Hemlock Series may be associated with grouse huckleberry (*Vacccinium scoparium*) in deep soils at higher elevations, Pacific rhododendron at lower elevations and warmer conditions, and/or with the wildflower sidebells pyrola (*Pyrola secunda*). Mountain Hemlock Series has also been documented in the Fremont-Winema National Forest.

Shasta Red Fir Series

The Shasta Red Fir Series is representative of a variety of California red fir found in southwest Oregon and northern California generally at higher elevations (4,000 to 6,900 feet) where the climate is cool and moist. Shasta red fir is typically the dominant tree in the overstory, although on warmer sites, white fir is present and, on cooler sites, mountain hemlock is present. Within the Rogue River-Siskiyou National Forest, the mountain sweet-root (*Osmorhiza berteroi*)/Shasta Red Fir Series association, which is typically located at sites with lower precipitation, may potentially be found. In the Winema National Forest, the Shasta Red Fir series is found within the Cascade Province of Southwest Oregon.

White Fir Series

This species is most abundant in southwest Oregon and will occur on a variety of sites and therefore is not specific to slope, aspect, soil type, or elevation. White Fir Series generally occurs on cool sites, with an average rainfall varying between 45 inches in drier areas of the Cascades to 102 inches near the coast. As a result of frequent disturbances, other early seral species become the dominant overstory tree in the White Fir Series, such as Douglas-fir and Shasta red fir, which are present within the Rogue River-Siskiyou National Forest. Also, dwarf Oregon-grape is common and widespread within the Series and may occur within the area crossed by the pipeline. Based on GIS coverage, white fir-Shasta red fir is crossed on the Winema National Forest.

Grand Fir Series

No specific description has been created for this series. However, based on GIS coverage, grand fir trees may be dominant within stands located in the Umpqua National Forest, with a canyon live oak association.

Jeffrey Pine Series

This species is scattered throughout Jackson and Douglas Counties and usually occurs on dry, ultramafic parent material, mainly serpentine and peridotite with high exposed gravel, surface rock, and bedrock components. As a result of the serpentine/periodotite parent material, this series is associated with many unique and rare species. This series is found within a wide elevational range, from 1,200 feet to 6,000 feet; however, most occurrences are concentrated near 2,000 feet. It can occur on all aspects and slope positions although it is most common on the southerly aspect and mid-slope position. Often Douglas-fir and incense cedar are associated with the Jeffrey Pine Series, which has an open canopy characteristic. Within the Umpqua National Forest, Jeffrey pine has the potential to occur with high grass understory coverage.

Western Hemlock Series

This plant series is known to occur in drier conditions on Umpqua National Forest, and the associations crossed by the pipeline are salal, Oregon-grape, and rhododendron. The series is associated with low to moderate elevations. Because of the frequent disturbances in southwest Oregon, the overstory of this series is generally dominated by Douglas-fir with the understory predominately western hemlock; however, within the western hemlock/salal-dwarf Oregon-grape association, both western hemlock and Douglas-fir are present in the overstory.

Lodgepole Pine Series

This plant series is widely distributed throughout forested areas of eastern Oregon, where distribution is apparently tied directly to ash and pumice deposits, mostly from Mt. Mazama. Within the area crossed by the pipeline, this series occurs within the Fremont-Winema National Forest and is associated with huckleberry (*Vaccinium* spp.) and forbs within elevations between 5,000 and 5,700 feet on lower slopes and bottoms, and shrub (cool-xeric zone) at upper elevations in well-drained soils. This series tends to dominate sites that are too wet or too dry for its competitors (ponderosa pine, white fir-grand fir, Shasta red fir, or mountain hemlock).

4.4.3.3 Measures Implemented on Federally Managed Lands

Listed below are the avoidance and minimization measures that would be implemented on federally managed lands, in addition to those described above:

- Disturbed areas would be replanted to prevent noxious weed germination, and disturbed areas would be revegetated with seed mixes described in the ECRP.
- The authorized officer for the BLM or Forest Service may inspect and approve straw material used on federal lands to verify that it is certified noxious weed free. Gravel/rock used on federal lands would be from weed-free sources as well, and approved by the agencies' authorized representative.
- Pacific Connector has agreed to plant the easement with native trees/shrubs described in the ECRP. Affected riparian areas would be replanted extending 100 feet from the streambanks on federal lands. All plantings proposed for federally administered lands must be approved by each agency's authorized representative.
- The Forest Service and Pacific Connector are currently working together to develop projects that could be implemented in order to provide compensatory mitigation for environmental impacts on Forest Service lands, as well as ensure that the Pacific Connector pipeline is consistent with the objectives of LMPs.

4.4.3.4 Noxious Weeds

Pacific Connector developed an *Integrated Pest Management Plan,* in consultation with the ODA (Butler 2017), BLM, and Forest Service, to minimize the potential spread and infestation of weeds. This plan, applicable to both public and private lands, includes requirements for surveys to be conducted prior to construction to determine the presence of noxious weeds; determining where management or pretreatment may be necessary prior to construction to prevent the spread of noxious weeds; cleaning of construction equipment prior to moving it onto the construction right-of-way; and cleaning of vegetation clearing and grading equipment if it passes through areas where weeds have been identified.

The BLM objective for weeds is Early Detection Rapid Response (EDRR) in order to avoid introduction or spread of noxious weeds, and to contain and/or reduce noxious weed infestations using an integrated pest management approach (e.g., chemical, mechanical, manual, and/or biological), as outlined in the BLM's multi-state Northwest Area Noxious Weed Control Program EIS (BLM 1985) and its supplements, as well as the BLM’s (2010a) *Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in Oregon*. The BLM is concerned with the impacts of weeds on special areas, including LSRs (see section 4.7), and seeks to eliminate or control weeds that adversely affect those areas. The BLM surveys for noxious weed infestations, reports them to the ODA, and coordinates with them to reduce infestations while using methods that do not conflict with the objectives of each BLM District’s RMP.

The Forest Service’s objective for invasive plants and noxious weeds is similar to BLM’s objectives (described above). Control of noxious weeds by the Forest Service is coordinated with state, county, and private organizations through weed control districts or coordinated resource management agreements. On NFS lands, preventive management is critical to an effective control program. The agency utilizes management direction provided in the *Pacific Northwest Region Invasive Plant Program: Preventing and Managing Invasive Plants Final Environmental Impact Statement* (Forest Service 2005b). Noxious weeds classified as target species that occur on federally managed lands are listed in table 4.4.1.6-1.

In order to prevent or limit the spread of invasive species and noxious weeds, all construction equipment would be inspected to ensure that it is clean and free of potential weed seed or propagules, prior to transporting equipment to the construction right-of-way. In addition, equipment used in areas of priority A and T listed weeds, as well as selected B listed weeds, would be cleaned by hand, blown down with air, or pressure washed prior to leaving the site, as determined necessary by the EI based on the specific weed infestation, level of infestation, and stage of growth of the weed. Because of the contiguous pattern of NFS lands crossed by the pipeline, equipment that could serve as a vector for invasive species would be inspected and cleaned at cleaning stations located at the borders of each National Forest, prior to clearing and grading activities. Because the BLM lands crossed by the Project are not contiguous and are spread out in a checkerboard pattern, it is not practical to set up inspection and cleaning stations at each entry point. However, where BLM lands are contiguous to NFS lands, cleaning stations would be located to include the adjacent BLM lands. Additionally, equipment would be inspected and cleaned at cleaning stations located adjacent to mapped noxious weed infestation areas that were identified during preconstruction surveys on federal lands and where a treatment plan has been developed in consultation with the agency authorized representative.

Additionally, equipment would be inspected and cleaned at stations located adjacent to mapped noxious weed infestation areas that were identified during pre-construction surveys on federally-managed lands. The cleaning stations would be located and approved by the EIs and authorized agency representative; these locations would also be mapped for future monitoring efforts to determine if potential infestations occur at these sites and, if they do, to ensure that appropriate control treatments are applied. The BLM has indicated that cleaning of equipment should occur when leaving noxious weed sites prior to entering BLM-managed lands regardless of land continuity. Also, monitoring efforts for weed species would be similar to those described above (for all lands), except that Pacific Connector has proposed to conduct monitoring on federally managed lands annually for a period of at least three to five years. However, the BLM and Forest Service have indicated that they would require that monitoring on federally managed lands be conducted every three to five years for the life of the Project, and that this would be a condition of the Right-of-Way Grant. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file a revised *Integrated Pest Management Plan* with the Secretary, for review and written approval by the Director of the OEP, that specifies that construction equipment would be cleaned after leaving areas of noxious weed infestations and prior to entering BLM-managed lands regardless of contiguous land owner. The revised plan should also address BLM and Forest Service requirements related to monitoring of invasive plant species on federally managed lands, and documentation that the revised plan was found acceptable by the BLM and Forest Service.**

4.4.3.5 Vegetative Pathogens

The existing conditions related to known occurrences of insects or pathogens are identical to the discussion presented in section 4.4.2. Insects or pathogens that have the potential to occur within the area that would be affected by the Project include Douglas-fir beetle, fir engraver, flatheaded borer, mountain pine beetle (ponderosa and sugar pine), western pine beetle, needle cast (lodgepole pine, ponderosa pine, and Swiss), Port Orford cedar root disease, annosus root and butt rot, laminated root rot, dwarf mistletoe, sudden oak death, and the black stain root disease (see section 4.4.2). The effects that could occur as well as the measures that would be implemented for the prevention of infestation by insects or pathogens on federally managed lands would be similar to those discussed in section 4.4.2, with the addition of the following:

- *Douglas-fir beetle*—No Douglas-fir down wood, 12 inches or larger in diameter, would be left in areas on NFS lands where there are known infestations of Douglas-fir beetle.
- *Port Orford cedar root disease*—All equipment entering NFS lands would comply with all Forest Service *P. lateralis* mitigation requirements. The Forest Service (Region 6) and BLM prepared management objectives for affected federally managed lands in 2004 to help control the spread of the fungus. The objectives focus on maintaining disease-free watersheds, preventing spread through sanitation, seasonal restrictions for activities, and reestablishing Port Orford cedar using resistant and non-resistant seedlings.
- *All pathogens*—Directional tree falling would be required on all NFS lands, including areas with no known insect/disease occurrence, to prevent residual tree damage/injury and disease infection.

4.4.3.6 Wild-Harvesting of Non-Timber Forest Products

Wild-harvesting is the act of gathering food, decorative, or medicinal botanical products that grow naturally on lands not normally associated with agriculture. The non-timber forest products harvested near the pipeline route are of three categories: floral greens, edibles, and medicinals. Some of the more common of these are salal, evergreen huckleberry, swordfern (*Polystichum munitum*), and pinemat manzanita (Forest Service 2017b). This harvesting of non-timber forest products is widespread on public lands in the Pacific Northwest and can occur year-round (OPB 2006).

The Forest Service and BLM grant permits to wild-harvest for both recreational and commercial uses. Some recreational and commercial harvesters could be temporarily displaced during pipeline construction. Additionally, some of the forest products typically harvested would be removed during vegetation clearing for the Pacific Connector pipeline. However, the pipeline right-of-way and roads would also create new access into forested areas. As a result, it is possible that wild harvesting could increase as a result of the operation of the pipeline project.

4.4.4 Conclusion

Constructing the Jordan Cove LNG Project would result in about 499 acres of impacts on vegetation, including 168 acres of permanent vegetation loss. Constructing the Pacific Connector Pipeline Project would impact approximately 4,186 acres of vegetation; this amount includes a total of approximately 133 acres of sagebrush steppe and 2,750 acres of forested lands, including 773 acres of LSOG forests.

Most of the vegetation types affected by the Project are common and widespread in the vicinity of the Project. Although constructing and operating the Project would result in the loss of 773 acres of LSOG forests, this represents only a small percentage of remaining LSOG forests in Oregon. Additionally, measures listed in section 4.4.3.3, as well as in the *BLM and Forest Service Compensatory Mitigation Plan and Amendment* (appendix F.2) and *Late Successional Reserves Crossed by the PGCP Project* (appendix F.3) would minimize or mitigate impacts to LSOG forests. Therefore, based on the types and amounts of vegetation that would be affected by the Project, the measures that would be implemented to avoid, minimize, and mitigate the resulting impacts, and the presence of similar vegetation in the affected watersheds, we conclude that constructing and operating the Project would not significantly affect vegetation.

4.5 WILDLIFE AND AQUATIC RESOURCES

4.5.1 Terrestrial Wildlife

The Project would affect suitable habitat for a number of wildlife species associated with the coastal, mid-coastal, interior foothills, and mountain terrains in southern Oregon. The types of wildlife habitat affected by the Project and the wildlife species potentially located in those habitats are described below. Endangered and threatened species and other special status species are addressed in section 4.6.

4.5.1.1 Jordan Cove LNG Project

Wildlife Habitats

Characterizations of wildlife habitats potentially affected by construction of the Project are based on resource agency consultations, on-the-ground surveys, and published reports. In accordance with its Fish and Wildlife Habitat Mitigation Policy, the ODFW has established the following six classifications for habitats, based on dominant plant, soil, and water associations of value to the support and use of fish and wildlife:

- Category 1 – irreplaceable[103], essential habitat[104] that is limited;[105]
- Category 2 – essential habitat that is limited;
- Category 3 – essential habitat, or important[106] habitat that is limited;
- Category 4 – important habitat;
- Category 5 – habitat having a high potential to become essential or important habitat; and
- Category 6 – habitat that has a low potential to become essential or important habitat.

Below we discuss the habitats found in the Jordan Cove terminal tract, their vegetation cover, associated wildlife, and ODFW habitat categories.

<u>Upland Habitats</u>

Uplands on the North Spit contain coastal dune forest, riparian forest, shrubs, grasslands (herbaceous), and unvegetated sand dunes (see section 4.4 for more details and descriptions). Dominant overstory for coastal dune forest include Douglas-fir, western hemlock, shore pine, Sitka spruce, and Port Orford cedar, with an understory including evergreen huckleberry, salal, bearberry, rhododendron, California wax myrtle, and manzanita. Shore pine and Sitka spruce forests constitute the habitat with the greatest structural complexity on the North Spit and support the greatest diversity of wildlife species. The trees, snags, and downed logs in coastal dune forests

[103] "Irreplaceable" means that successful in-kind habitat mitigation to replace lost habitat quantity and/or quality is not feasible within an acceptable period of time or location, or involves an unacceptable level of risk or uncertainty, depending on the habitat under consideration and the fish and wildlife species or populations that are affected. "Acceptable", for the purpose of this definition, means in a reasonable time frame to benefit the affected fish and wildlife species (OAR 635-415-0025).
[104] "Essential Habitat" means any habitat condition or set of habitat conditions that, if diminished in quality or quantity, would result in depletion of a fish or wildlife species (OAR 635-415-0025).
[105] "Limited habitat" means an amount insufficient or barely sufficient to sustain fish and wildlife populations over time (OAR 635-415-0025).
[106] "Important Habitat" means any habitat recognized as a contributor to sustaining fish and wildlife populations on a physiographic province basis over time (OAR 635-415-0025).

provide important breeding, foraging, and cover habitat for a variety of wildlife species: upland amphibians seek cover in downed logs, and many bird species, including raptors, woodpeckers, and songbirds, nest and forage in these habitats.

Coastal dune forest and riparian forest habitats are classified as Category 3 because they are "essential to wildlife" but are "not limited" (as defined by Oregon under OAR 635-415-0025). Species that depend on these habitat types include the Pacific marten (*Martes caurina*) (or coastal marten, addressed in section 4.6), bats, and some songbirds.

Herbaceous, herbaceous shrub, and shrub upland habitat types are all classified as Category 4 because they are not essential or limited, but they are still important to wildlife. The vast majority of these habitats lie on dredge spoils covered by weedy herbaceous and shrub species. Shrub species present within these habitats include young shore pine and invasive species such as Scotch broom and Himalayan blackberry. Herbaceous vegetation in these habitat types includes native species such as seashore lupine, small-head clover, and beach strawberry, together with invasive species such as European beachgrass, colonial bentgrass, and sweet vernal grass. These habitats have been extensively degraded historically, and only provide habitat for generalist species such as deer, small mammals, and a limited suite of songbirds (DEA 2014).

Open Water/ Wetland Habitats

Open water and wetland habitats on the LNG terminal site are composed of several freshwater lakes, ponds, forested and shrub wetlands, and emergent wetlands and marshes, together with the Coos Bay estuary and its associated shoreline, including mudflats. Habitats found in this environment support a rich terrestrial wildlife community, including mammals, birds, reptiles, and invertebrates; aquatic species found in these habitats are discussed below in section 4.5.2. Terrestrial wildlife species that use open water and wetland habitats (inland, estuarine, or marine) on the North Spit are generally specialized or are strongly associated with one habitat type. However, there are dozens of species that may occur in the area affected by the Project that are very well adapted to utilizing one, two, or all three of these open water and wetland habitats, as seasonal conditions warrant. Resident and migrant shorebirds congregate on the tidally inundated mudflats along the shore of Coos Bay, to forage on the invertebrates in the shallow waters and exposed mudflats, especially during low tides. Raptors known to use open water and shoreline habitats include the bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), northern harrier (*Circus cyaneus*), and peregrine falcon (*Falco peregrinus*). Mammals that also forage in wetlands and near shore environments include, but are not limited to, raccoon (*Procyon lotor*), mink (*Neovison vison*), and striped skunk (*Mephitis mephitis).*

Forested, scrub-shrub, and emergent wetlands are classified as Category 2, because they are essential for wildlife, and limited, but not irreplaceable. The access channel contains open water habitat in Coos Bay (see figure 4.5-2 in section 4.5.2). This area consists of salt marsh, eelgrass, intertidal, and subtidal habitats. Open water habitat contains both Category 2 and Category 3 habitat classifications.

Developed Habitat

Developed areas include portions of the LNG terminal site that have been substantially disturbed by previous development and industrial use, including land use activities such as demolished mill foundations/concrete pads, unvegetated cut slopes, rocked yards, paved roads, parking lots, gravel roads, concrete laydown areas, log deck storage areas, and sandy roadside areas. Developed lands have limited potential to become important or essential wildlife habitat, and therefore are classified as Category 6.

Terrestrial Animals in the Project Area

Terrestrial wildlife that may occupy the area affected by the Jordan Cove LNG Project includes mammals, birds, amphibians, reptiles, and invertebrates. Approximately 178 species of amphibians, reptiles, birds, and mammals were recorded in uplands on or adjacent to the Jordan Cove Project site (i.e., the LNG terminal facility) during surveys conducted from 2005 to 2017 in support of the Project.

Mammals

Fifty-eight mammal species are known to occur on the North Spit (BLM 2005). This includes large mammals, such as mountain lion (*Puma concolor*), Roosevelt elk (*Cervus elaphus roosevelti*), American black bear (*Ursus americanus*), and black-tailed deer (*Odocoileus hemionus*). Wildlife surveys conducted for Jordan Cove in 2005, 2006, and 2012 documented 11 mammal species in the terminal tract (LBJ 2006; SHN 2013b): American beaver (*Castor canadensis*), Roosevelt elk, Virginia opossum (*Didelphis virginiana*), North American porcupine (*Erethizon dorsatum*), mountain lion, Townsend's chipmunk (*Neotamias townsendi*), black-tailed deer, harbor seal (*Phoca vitulina*), raccoon, Douglas' squirrel (*Tamiasciurus douglasii*), and American black bear. Nine species of bats are known to occur on the North Spit (BLM 2005). While bat-specific surveys were not completed by Jordan Cove, the mosaic of habitat types in the area suggests bat presence is potentially high. Unidentified bats were observed in one of the buildings on the Roseburg Forest Products property on July 21, 2005.

Birds

Migratory birds, which include all native birds in the U.S., with the exception of upland game birds, are protected under the MBTA, as described in section 1.5.1.10. Additionally, EO 13186 was enacted, in part, to ensure that the environmental analysis of a federal action evaluates the effects of that action on migratory birds, and the federal agency and its project proponents avoid, minimize effects, conserve species, and restore and enhance migratory bird habitat. EO 13186 states that emphasis should be placed on species of concern, priority habitat, and key risk factors. In March 2011, FERC and FWS finalized an MOU to implement EO 13186. Conservation of migratory bird habitats, avoiding or minimizing take of migratory birds, and developing effective mitigation measures to restore or enhance habitats on lands affected by energy projects are included as obligatory elements in the MOU. The MOU also places emphasis on, but is not exclusive to, birds of conservation concern (BCC; FWS 2008).

The Jordan Cove LNG Project is located in the Pacific Flyway path for migratory birds and is in Bird Conservation Region (BCR) 5 as defined by FWS (2008) (note that the Pacific Connector Pipeline Project is also in BCR 9 as well, as discussed in section 4.5.1.2). Birds that are known or that likely occur along the waterway and in the LNG terminal site include seabirds, shorebirds, waterfowl, passerines (songbirds), wading birds, and raptors. The number of bird species documented on or near the North Spit of Coos Bay is 277: the BLM has documented 275 avian species in this area (BLM 2005), while LBJ Enterprises (2006) documented 151 avian species during surveys of the LNG terminal tract, including two additional species not documented by the BLM. BCC that potentially occur in the area affected by the Project are listed in table 4.5.1.1-1.

Federally- or state-listed species that are also BCC are not included below, as they are discussed in more detail in sections 4.6.1 and 4.6.2.

TABLE 4.5.1.1-1

Birds of Conservation Concern in the Project Area, Timing of Potential Occurrence, and Expected Habitat

Common Name	Scientific Name	Timing of Potential Occurrence	Expected Habitat
Allen's hummingbird	*Selasphorus sasin*	Summer	Chaparral, thickets, brushy hillsides, open coniferous woodlands, and gardens near coast
Bald eagle	*Haliaeetus leucocephalus*	year-round	Near large bodies of water
Black oystercatcher	*Haematopus bachmani*	year round	Coastal beaches, bays, and estuaries
Black swift	*Cypseloides niger*	Migration	Forages over forests and open areas
Caspian tern	*Sterna caspia*	Migration	Coastal areas
Hudsonian godwit	*Limosa haemastica*	Rare	Marshes, beaches, flooded fields, and tidal mudflats
Lesser yellowlegs	*Tringa flavipes*	Migration	Marshes, ponds, wet meadows, lakes and mudflats
Long-billed curlew	*Numenius americanus*	Winter	Fields, dry prairies, mudflats
Little willow flycatcher	*Empidonax traillii brewsteri*	Summer	Low brushy vegetation in wet areas
Marbled godwit	*Limosa fedoa* (ssp. *beringiae* only)	Winter	Beaches, mudflats, shallow pools
Olive-sided flycatcher	*Contopus cooperi*	Summer	Coniferous forests
Oregon vesper sparrow	*Pooecetes gramineus* (ssp. *affinis* only)	Very unlikely to occur in vicinity of Project	Open fields and pastures
Peregrine falcon	*Falco peregrinus*	winter/year-round	Open habitats, nests on cliffs
Purple finch	*Carpodacus purpureus*	Year-round	Wooded areas
Red knot	*Calidris canutus*	Migration	Beaches and mudflats
Rufous hummingbird	*Selasphorus rufus*	summer/migration	Coniferous forests
Short-billed dowitcher	*Limnodromus griseus*	Winter	Beaches, mudflats, shallow ponds
Western grebe	*Aechmophorus occidentalis*	Winter	Marshes, lakes, and bays
Whimbrel	*Numenius phaeopus*	Migration	Coastal marshes, beaches, rocky shores

Sources: FWS (2008); Sibley (2000); NatureServe (2009, 2013)

Seabirds

Thirteen seabird species breed along Oregon's coast, with offshore rocks and islands providing critical nesting habitat and important rest-over locations. Seabirds depend on relatively undisturbed coastal nesting habitats and on the rich coastal waters for food (Oregon Ocean Resources Management Task Force 1991). Foraging habitat can differ by species; some species such as the sooty shearwater (*Puffinus griseus*) and the northern fulmar (*Fulmarus glacialis*) are found primarily along the mid and outer shelf, while California gull (*Larus californicus*) and western gull (*Larus occidentalis*) occur only in the nearshore (Oregon Ocean Resources Management Task Force 1991). Foraging sea birds can be encountered along the LNG carrier transit route, at the terminal site, and in adjacent Coos Bay water.

Shorebirds

Coos Bay is an important area for shorebirds between San Francisco Bay and British Columbia. Key areas for migrating shorebirds include Coos Bay and the beaches and deflation plains in the Oregon Dunes National Recreation Area (ODNRA). Coos Bay's extensive eelgrass beds, productive sloughs, intertidal algal flats, and substantial tidal marshes provide valuable habitat for thousands of shorebirds. Foraging habitat for shorebirds includes inter-tidal mudflats, rocky inter-tidal areas, estuaries, salt marshes, and beaches; salt marshes are used for resting and preening. The vast majority of shorebirds are migratory and non-breeders in Coos Bay. An important exception is the western snowy plover (*Charadrius alexandrinus nivosus*), which nests on the North Spit (this species is discussed in more detail in section 4.6). Shorebirds are most likely to be encountered along the beaches of the North Spit, and in the bay along tidal mudflats, salt marshes, and other exposed estuarine habitat.

Waterfowl

Waterfowl habitat varies from ocean surf to fields and open meadows to upland streams (FWS 2007a). The southern Oregon coast provides wintering and migratory habitat for waterfowl of the Pacific Flyway. Coos Bay is recognized as an important migration and wintering waterfowl location. Waterfowl are most likely to be encountered in Coos Bay and the immediate near shore habitat.

Passerines (Songbirds)

Breeding and foraging habitat for migratory passerines is associated with terrestrial and wetland habitat in Coos Bay. Important habitat includes coastal scrub-shrub, coastal dune forest and palustrine wetlands. In the case of swallows, human-made structures can be important structures for nesting colonies. Passerines are likely to occur in all habitats at the terminal site.

Neotropical migrants (birds that breed in North America and overwinter in the tropics) were observed during surveys of the waterway and LNG terminal. These are largely forest-nesting species. Examples of neotropical migrants detected at the LNG terminal site include olive-sided flycatcher (*Contopus cooperi*), Wilson's warbler (*Wilsonia pusilla*), orange-crowned warbler (*Vermivora celata*), and Swainson's thrush (*Catharus ustulatus*).

Wading Birds

Several wading bird species are resident in the Coos Bay area and the North Spit. Wading birds are typically colonial when nesting and therefore are sensitive to anthropogenic disturbance at breeding sites. Wading birds hunt in a variety of habitat types from fields and meadows to palustrine and estuarine wetlands. Wading birds are likely to occur in the shoreline habitats at the terminal site.

At least two historic great blue heron (*Ardea herodias*) rookeries occur close to the Jordan Cove LNG terminal site area. One rookery is located about 2,000 feet to the east of the LNG terminal site and about 300 feet from Jordan Cove Road (on both sides of Trans-Pacific Parkway) (LBJ 2006). The other historical rookery is located adjacent to the LNG terminal site on the south side of Henderson Marsh (BLM 2006a). No evidence of great blue heron breeding in the area was observed during the 2005, 2006, 2012, or 2013 surveys.

Raptors

Raptors are abundant year-round residents in Coos Bay. Fourteen species of raptor are known to occur on the North Spit (BLM 2005), and surveys conducted by LBJ (2006) detected both peregrine falcons and bald eagles near the Jordan Cove site. Coos Bay and the North Spit provide a mosaic of terrestrial, coastal, and nearshore habitat types with abundant prey for raptors. White-tailed kites (*Elanus leucurus*) were observed during 2005 surveys near Henderson Marsh. Osprey, falcons, and eagles may occur in the nearshore habitats along the waterway for LNG carrier transit and at the terminal site. Ospreys are relatively common near river estuaries and bays and nest on human-made structures including the Roseburg Forest Products facility lights. Falcons are likely to be associated with salt marsh and tidal mudflats where shorebirds are abundant.

Amphibians and Reptiles

Eleven species of amphibians (8 salamanders, 3 frogs) are known to occur on the North Spit (BLM 2005). Despite the presence of invasive non-native bullfrogs (*Lithobates catesbeianus*), two native amphibian species were observed in suitable habitat during the wildlife surveys conducted in 2005, 2006, and 2012 for the LNG terminal (LBJ 2006; SHN 2013b). The northern red-legged frog (*Rana aurora*) and northwestern salamander (*Ambystoma gracile*) are present in some wetlands within the terminal tract.

Ten species of reptiles are known to occur on the North Spit (BLM 2005), including the western pond turtle (*Actinemys marmorata*). However, the western pond turtle was not observed during wildlife surveys of the Jordan Cove LNG terminal area (LBJ 2006; SHN 2013b). Reptiles observed during Project surveys in 2005, 2006 and 2012 included the northern alligator lizard (*Elgaria coerulea*) and northwestern garter snake (*Thamnophis ordinoides*) (LBJ 2006; SHN 2013b).

Invertebrates

Inland sand dunes at the North Spit are used extensively by certain species of terrestrial insects, primarily beetles, centipedes, and millipedes. Flying insects are also common throughout the site and are fed upon heavily by barn swallows (*Hirundo rustica*) (BLM 2005).

Effects on Wildlife Habitat and Terrestrial Wildlife Species from Construction and Operation of the Jordan Cove LNG Project

Effects on Habitats

The area affected by the construction of the LNG terminal and associated facilities (including the Workforce Housing Facility, Ingram Yard, laydown areas, etc.) is presented by temporary and permanent acres of disturbance by habitat type in table 4.5.1.1-2. Temporary disturbances to upland habitat would be restored in consultation with landowners and to the extent possible using non-invasive native plant species. Permanent disturbance to habitat results in these areas being converted to a developed habitat type that would be occupied by Project facilities during operations.

TABLE 4.5.1.1-2

Acres of Wildlife Habitat Types Affected by Construction and Operation of the Jordan Cove LNG Project

Area	Acres of Disturbance		Grand Total
	Temporary	Permanent	
Access and Utility Corridor a/	**5.8**	**20.9**	**26.7**
Coastal Dune Forest (Category 3)	2.7	6.9	9.6
Developed (Category 6)	0.1	4.0	4.1
Herbaceous (Category 4)	0.1	0.2	0.3
Herbaceous Shrub (Category 4)	1.0	2.9	4.0
Riparian Forest (Category 3)	<0.1	0.1	0.1
Unvegetated Sand Upland (Category 3)	1.6	6.2	7.7
Emergent Wetland (Category 2)	0.2	0.6	0.8
Scrub-Shrub Wetland (Category 2)	<0.1	<0.1	0.1
Access Channel/Pile Dike Rock Apron/Slip/MOF	**21.4**	**57.8**	**79.2**
Algae/Mud/Sand (Category 2)	0.2	5.9	6.1
Deep Subtidal (Category 3)	17.9	--	17.9
Eelgrass (Category 2)	0.1	2.1	2.2
Intertidal Unvegetated Sand (Category 2)	0.5	6.1	6.6
Salt Marsh (Category 2)	--	0.1	0.1
Shallow Subtidal (Category 3)	0.29	4.1	4.4
Coastal Dune Forest (Category 3)	--	16.8	16.8
Developed (Category 6)	0.1	2.2	2.4
Herbaceous (Category 4)	1.8	19.9	21.7
Shrub (Category 4)	0.4	0.6	1.0
APCO Sites 1 and 2 b/	**40.7**	**0.0**	**40.7**
Algae/Mud/Sand (Category 2)	0.2	--	0.2
Deep Subtidal (Category 3)	0.9	--	0.9
Eelgrass (Category 2)	<0.1	--	<0.1
Salt Marsh (Category 2)	0.1	--	0.1
Shallow Subtidal (Category 3)	<0.1	--	<0.1
Developed (Category 6)	12.2	--	12.2
Herbaceous (Category 4)	14.9	--	14.9
Herbaceous Shrub (Category 4)	9.0	--	9.0
Shrub (Category 4)	3.3	--	3.3
Ingram Yard c/	**35.3**	**82.8**	**118.1**
Coastal Dune Forest (Category 3)	27.0	45.9	72.9
Developed (Category 6)	1.5	2.8	4.4
Herbaceous (Category 4)	6.7	34.0	40.7
Shrub (Category 4)	0.1	--	0.1
IWWP/Water Utility Easements	**15.2**	**0.0**	**15.2**
Coastal Dune Forest (Category 3)	0.2	--	0.2
Developed (Category 6)	8.3	--	8.3
Herbaceous (Category 4)	6.1	--	6.1
Herbaceous Shrub (Category 4)	0.3	--	0.3
Shrub (Category 4)	0.2	--	0.2
Scrub-Shrub Wetland (Category 2)	0.1	--	0.1
Meteorological Station d/	**1.5**	**0.0**	**1.5**
Developed (Category 6)	0.6	<0.1	0.6
Herbaceous (Category 4)	0.1	<0.1	0.1
Herbaceous Shrub (Category 4)	0.7	--	0.7
Marine Waterway Modification Areas and Temporary Dredge Pipeline	39.7	0.0	39.7
Algae/Mud/Sand (Category 2)	<0.1	--	<0.1
Deep Subtidal (Category 3)	39.5	--	39.5
Eelgrass (Category 2)	<0.1	--	<0.1
Shallow Subtidal (Category 3)	<0.1	--	<0.1
Herbaceous (Category 4)	<0.1	--	<0.1

TABLE 4.5.1.1-2 (continued)

Acres of Wildlife Habitat Types Affected by Construction and Operation of the Jordan Cove LNG Project

Area	Acres of Disturbance: Temporary	Acres of Disturbance: Permanent	Grand Total
South Dunes Site e/	**68.6**	**24.2**	**92.9**
Algae/Mud/Sand (Category 2)	0.1	--	0.1
Salt Marsh (Category 2)	<0.1	--	<0.1
Coastal Dune Forest (Category 3)	2.2	0.8	3.0
Developed (Category 6)	21.2	13.8	35.0
Herbaceous (Category 4)	5.2	3.8	9.0
Herbaceous Shrub (Category 4)	35.7	3.4	39.1
Riparian Forest (Category 3)	0.9	1.4	2.4
Shrub (Category 4)	1.1	<0.1	1.3
Emergent Wetland (Category 2)	1.4	0.4	1.8
Forested Wetland (Category 2)	0.1	0.2	0.3
Scrub-Shrub Wetland (Category 2)	<0.1	--	<0.1
Open Water (Category 2)	0.7	0.2	0.9
Temporary Construction Areas f/	**157.8**	**0.0**	**157.8**
Algae/Mud/Sand (Category 2)	<0.1	--	<0.1
Intertidal Unvegetated Sand (Category 2)	<0.1	--	<0.1
Shallow Subtidal (Category 3)	<0.1	--	<0.1
Coastal Dune Forest (Category 3)	24.3	--	24.3
Developed (Category 6)	59.4	--	59.4
Herbaceous (Category 4)	46.3	--	46.3
Herbaceous Shrub (Category 4)	11.8	--	11.8
Riparian Forest (Category 3)	0.1	--	0.1
Shrub (Category 4)	3.8	--	3.8
Unvegetated Sand Upland (Category 3)	11.4	--	11.4
Emergent Wetland (Category 2)	0.5	--	0.5
Scrub-Shrub Wetland (Category 2)	0.2	--	0.2
Trans Pacific Pkwy/US 101 Intersection Widening	**5.1**	**0.0**	**5.1**
Algae/Mud/Sand (Category 2)	1.4	--	1.4
Developed (Category 6)	3.7	--	3.7
GRAND TOTAL g/	**391.1**	**185.7**	**576.9**

a/ Access and Utility Corridor includes all temporary construction and permanent access roads and facilities and utilities, as well as the Fire Department (non-jurisdictional).

b/ APCO Sites 1 and 2 includes off-loading transfer platform and temporary dredge pipeline option.

c/ Ingram Yard Site includes all permanent LNG Terminal facilities. e.g., LNG tanks and liquefaction equipment, compressors, etc., and any other temporary construction facilities located on Ingram Yard.

d/ Meteorological Station includes access road.

e/ South Dunes Site includes Workforce Housing Facility, metering station, administrative building, and SORSC (non-jurisdictional), and temporary areas around the border.

f/ Temporary Construction Sites includes construction laydown/staging and off-site park & rides, i.e. Roseburg laydown site, Port laydown site, Boxcar Hill, Mill Casino, and Myrtlewood and Hydraulic Dredge Pipeline/Access Road from Jordan Cove Road to MOF.

g/ The acres disturbed as listed in this table includes vegetated and unvegetated upland and wetland habitats (excluding mitigation sites) and thus may differ from the total acreage disturbed as listed in other sections of this EIS, such as the vegetation section.

The primary effect on wildlife from construction and operation of the LNG terminal would be habitat modification or habitat loss. The natural habitats most important to wildlife that would be affected include forested dunes and open water/wetlands. Jordan Cove has indicated that upland habitat values lost to the construction of the LNG terminal and related facilities would be mitigated through the Panhandle, Lagoon, and North Bank mitigation sites. More details on these upland mitigation sites will be provided in a *Wildlife Habitat Mitigation Plan* that will be provided by the applicant as an appendix to their *Comprehensive Mitigation Plan*. Jordan Cove has indicated that estuarine habitat values lost to the construction of the LNG terminal and related facilities would be replaced in-kind at the eelgrass and Kentuck mitigation sites. Standard measures to avoid or minimize effects on wildlife, such as those presented in the ECRP and *Integrated Pest Management*

Plan, would also apply to actions taken at mitigation sites. These upland and estuarine mitigation sites include:

- The Panhandle site is approximately 133 acres and is located north of Trans-Pacific Parkway. The Panhandle site is part of a larger natural area that extends north into the ODNRA. It contains coastal dune forest, herbaceous, shrub, unvegetated sand, wetlands, and open water habitat types. The Panhandle site is home to a known population of northern red-legged frog and unique wetland types. Scotch broom would be removed at this site to promote ecological uplift.
- More than 100 acres of the 320-acre Lagoon site is proposed as mitigation. The Lagoon site is located adjacent to the meteorological station and contains shrub, herbaceous shrub, herbaceous, emergent wetland, and scrub-shrub wetland habitat types. Existing overhead power lines would be buried at the site.
- The North Bank site is approximately 156 acres and is located on the north bank of the Coquille River adjacent to the Bandon Marsh National Wildlife Refuge (NWR). It contains conifer forest, stabilized sand dunes, and scrub-shrub wetland habitat types. Forestry activities and weed control are proposed at the site that promote progress towards a mature forest setting.
- Eelgrass (Habitat Category 2) would be replaced by constructing an eelgrass mitigation site across the bay from the LNG terminal site, south of the runway for the Southwest Oregon Regional Airport;
- Estuarine resources (Habitat Category 2), including intertidal sand/mudflats, salt marsh, and shallow subtidal, would be mitigated by the construction of mudflat estuarine wetlands in the Kentuck project site; and
- Additional freshwater wetland resources (Habitat Category 2) disturbed by the construction of the LNG terminal would be mitigated out-of-kind at the Kentuck project site and in accordance with ODSL wetland mitigation requirements (OAR Chapter 141, Division 85 and Division 90) on neighboring North Spit property owned by Jordan Cove.

Effects on Terrestrial Wildlife Species

General Effects Applicable to All Terrestrial Wildlife

Constructing the project would temporarily and permanently affect wildlife. Impacts would include mortality if less mobile individuals are unable to avoid equipment or vehicles or cannot flee away from an oil or fuel spill. More mobile species would likely be displaced from the terminal area during active construction to adjacent similar habitats. Wildlife near the LNG terminal would also be disturbed by construction activities and noise and may move farther away.

An increased human presence and the resulting trash/waste could attract predators. However, the Project site would be kept clear of construction debris and food wastes. Covered, animal-proof receptacles would be provided in eating and break areas, parking lots, and at appropriate locations around the construction site. During construction, the site would be cleaned on a daily basis to remove any food or other debris left by construction workers. During operations, the Project site would be regularly inspected to ensure that no garbage is allowed to accumulate.

Noise associated with construction of the Project could also affect wildlife. Construction-related noise could affect animal behavior, foraging, or breeding patterns, and cause wildlife species to move away from the noise or relocate in order to avoid the disturbance. Noise from construction of the LNG terminal should be similar to typical commercial construction programs, which have noise levels averaging between 47 to 57 A-weighted decibels (dBA) when measured 2,000 feet away (H&K 1994). Noise from construction of the terminal is discussed in detail in section 4.12.2.4. Construction of the terminal would occur over a period of about five years. Noise associated with construction would be intermittent and may be operated on two 10-hour shifts, 6 days per week, with the potential to increase to a 24/7 schedule if required. Given the high level of current activity on the North Spit, including existing industrial operations and vehicle and rail traffic,[107] and the temporary nature of Jordan Cove's construction activities, Project-related construction noise is not expected to adversely affect wildlife in the region.

Operating the Project would also affect wildlife. For example, an LNG carrier in transit in the waterway could strike seabirds or shorebirds, an oil or fuel leak from a ship could affect both aquatic wildlife and terrestrial wildlife near the surface of the water and along the shorelines of the navigation channel, or vessel traffic may cause shoreline erosion. Jordan Cove would encourage LNG carrier operators to implement measures that would reduce the potential for oil or fuel spills. LNG carriers have a double hull that would keep fuel and oil onboard, thereby reducing the potential for a spill. Furthermore, each LNG carrier would maintain a shipboard oil pollution emergency plan. Further details on the potential effects of a spill are discussed in section 4.5.2.1. Studies conducted by Jordan Cove have shown that LNG carriers transiting at slow speeds in the Coos Bay navigation channel suggests that waves created by the vessels would be within the normal magnitude of waves that naturally occur in the bay and that any increase in shoreline erosion would be minor (section 4.5.2.1).[108]

Light being emitted from the LNG terminal facility could cause wildlife to alter their behavior to either avoid areas of artificial light or be attracted to those areas. Lighting at the LNG terminal would likely include a mixture of low-power fluorescent lighting and higher intensity security lighting that would primarily be located on shore, in and adjacent to the slip. When an LNG carrier is not in the berth, the lighting would be reduced to that required for security. Other industrial facilities on the North Spit (Roseburg, Southport, DB Western) already have night lighting. Jordan Cove has proposed including hooded or cut-off fixtures in its lighting plan to reduce glare and reduce light pollution to night skies. Because Jordan Cove has not prepared and filed a lighting plan, **we recommend that:**

- **Prior to construction, Jordan Cove should file with the Secretary, for review and written approval by the Director of OEP, its lighting plan. The plan should include measures that will reduce lighting to the minimal levels necessary to ensure safe operation of the LNG facilities and any other measures that will be implemented to minimize lighting impacts on fish and wildlife. Along with its lighting plan, Jordan Cove should file documentation that the plan was developed in consultation with the**

[107] Current ambient noise levels measured at the BLM boat ramp parking lot on the North Spit about 2 miles south of the Jordan Cove terminal site ranged from 40.8 to 47.6 dBA. See section 4.12.2.4 of this EIS.
[108] See *Technical Report – Draft, Volume 2 – Jordan Cove Energy Project and Pacific Connector Gas Pipeline, Coastal Engineering Modeling and Analysis*, filed by Jordan Cove as Appendix I.2 in Resource Report 2 included with its September 2017 application to the FERC.

FWS, NMFS, and ODFW. This lighting plan should also be in compliance with the lighting recommendations found in section 4.13.

Operational noise from the Jordan Cove Project could have long-term effects on wildlife on the North Spit. We predict that operational noise from the LNG terminal would have an equivalent sound level (L_{eq}) of 49 dBA and day-night sound level (L_{dn}) of 55 dBA when measured about 0.7 miles away, at the nearby ODNRA. This compares to current ambient L_{dn} noise levels of about 55 dBA at this location (see section 4.12.2.4 of this EIS). During operation, the ODNRA would experience a noise level of 58 dBA L_{dn} (a 3 dB increase). A small portion of the ODNRA would be subjected to day-night sound levels as high as 65 dBA. The Jordan Cove Project would result in a 3 decibel (dB) or greater increase over ambient at this recreation area. We conclude that operational noise from the terminal may affect some wildlife depending on their proximity to the terminal and each species' tolerance for increased noise.

Special status species that could be affected by the Jordan Cove Project, and relevant mitigation of those effects, are discussed in section 4.6.

Effects on Mammals

The construction and operation of the LNG terminal would reduce the amount of habitat available for big game species, and vehicle traffic related to the Project would increase the potential for collisions. However, due to the amount of previous disturbance at the site, and existing industrial activities in the area, we conclude that the Project would not significantly affect mammal species that currently occupy the North Spit.

Breeding and roosting sites for bats at the LNG terminal tract are limited due to the absence of typical bat habitat such as cliffs, rock outcrops, bridges, caves, and mines. Dune forest habitat is available on the LNG terminal site for those bat species that roost under bark. Removal of dune forest habitat would remove bat roosting habitat and likely displace individuals into nearby dune forest habitat (such as the ODNRA immediately north of the LNG terminal site). A meteorological station on the North Spit would pose a collision risk for bats, especially if guy-lines are required for operation. As with other mammals, we conclude that the Project would not significantly affect bat species.

Effects on Birds

Migratory bird species would likely experience disturbance due to the construction and operation of the Jordan Cove Project. Effects on birds would most likely be related to modification of habitat. However, areas affected by the Jordan Cove Project are relatively small in comparison to the total habitat available in Coos Bay, and in the larger BCR 5. Effects on migratory birds from both jurisdictional and non-jurisdictional facilities are included in this analysis.

Nesting habitat for migratory birds occurs in areas that would be cleared for the LNG terminal and related facilities. The Project would alter and disturb breeding and non-breeding habitat and could affect prey populations. The removal of coastal dune forest, grasslands (herbaceous), and shrublands (herbaceous shrubs and shrubs) could affect nesting and foraging opportunities for songbirds and raptors that occupy upland habitats. The effect of the construction of the slip and access channel, pile dike rock apron, and MOF on wetlands would be the permanent loss of intertidal, shallow subtidal, and eelgrass. These are all habitats utilized by seabirds, waterfowl, wading birds, and shorebirds. The loss of wetland habitat would be offset by the creation of in-kind mitigation areas proposed by Jordan Cove at the Kentuck project and eelgrass mitigation site. Table 4.5.1.1-2 presents the acreage of upland and wetland habitat disturbed during construction.

The great blue heron rookery located 300 feet from the Jordan Cove Road would be subject to potential disturbance from noise from construction traffic using Jordan Cove Road. The rookery is currently subject to noise from truck traffic delivering chips to the Roseburg wood chip export facility. Similarly, the historic rookery on the south side of Henderson Marsh could be affected by construction noise if the rookery was active during site construction. Jordan Cove would conduct spring status assessments annually of both great blue heron rookeries, as reuse by this species could occur. If biologists from other agencies (such as ODFW and BLM) conduct rookery surveys on the North Spit, Jordan Cove may use the results of these agency surveys. If either rookery becomes active, Jordan Cove, in consultation with ODFW, would develop an appropriate mitigation plan.

During operation of the Project, birds would be at risk of colliding with terminal facilities, including the LNG storage tanks and meteorological station. This risk is expected to be low given the visibility of most facilities, but could increase during storms, dense fog, at night, or at other times with reduced visibility. The meteorological station would be less visible than the terminal facilities and storage tanks and would likely pose a greater collision risk for birds that utilize beach and dunes habitat than the other facilities. If guy-lines would be required for operation of the meteorological station, they would be outfitted with bird deterrent measures to reduce the likelihood of bird strikes.

The facilities would be well lit at night, which could attract birds. There is some evidence that high intensity continuous anti-collision lights on structures may result in an increased number of bird strikes, especially at night or during fog and overcast conditions. The number of strikes can apparently be reduced by strobe or blinking the anti-collision lights. The LNG storage tanks would not be illuminated with high-intensity lighting. The intensity and number of lights would be limited to what is required for security and operations. Use of low-intensity lighting should reduce the likelihood of adverse effects on birds from collision with the LNG storage tanks compared to use of high intensity lighting.

Similar to lighting, birds can be drawn to the terminal flares. For example, some 7,500 songbirds were killed in September 2013 when they flew into the 30-meter-tall flare at the Canaport LNG import terminal in Saint John, New Brunswick, Canada (CBC News 2013). The flares at the LNG terminal are unlikely to have a similar adverse effect on birds due to design features. These flares would be lower in height and only be used for temporary periods, such as during start-up and shutdown, maintenance, and in response to unplanned pressure changes in the system to maintain safe operations. Jordan Cove can also implement measures through a lighting plan that would minimize effects on birds from terminal lighting. However, Jordan Cove would not develop its final lighting plan until final design. We have recommended above that Jordan Cove produce a final lighting plan prior to construction, for our review and approval that outlines measures to be implemented to ensure that facility lighting would not have major effects on birds and other wildlife.

Birds would also be at risk of colliding with LNG carriers in the waterway during operation of the terminal. Although the annual ship traffic would increase due to the Project, LNG carriers in the navigation channel would be traveling slowly and escorted by tugboats, and operate in compliance with Coast Guard as well as Oregon State requirements. Therefore, we conclude that LNG carrier marine traffic in the waterway would not significantly affect birds.

Jordan Cove proposes to implement various measures to avoid, minimize, and in some instances mitigate, effects on birds and their local habitats. All vegetation clearing at the LNG terminal would be conducted prior to March 1 or after August 31 to ensure most nesting birds have fledged. If construction activities must occur during the nesting season, Jordan Cove would conduct focused pre-construction surveys to determine if there are active migratory bird nests present that need to be avoided. The surveys would be conducted within the construction limits and within 100 feet (200 feet for raptors) of the construction limits. If active nests are encountered within the limits of the survey, construction and vegetation removal activities would be halted in the immediate vicinity (to approximately 20 feet away) until a qualified biologist has determined that the individuals have fledged from the nest (evacuated) or that the nest has failed from natural causes. If no active nests are encountered within the limits of the survey, construction and vegetation removal would proceed. Empty or abandoned nests would be removed; permits are not required (except for eagles and listed species) to remove an empty or abandoned nest or to remove or alter the structure the nest is built in or on (FWS 2003a, 2013a). Jordan Cove would coordinate with the FWS prior to proceeding with construction, and any consultation exchange with the FWS would be provided to the FERC. Further description of avoidance, minimization, and mitigation measures is provided in the draft *Migratory Bird Conservation Plan* filed with FERC on August 31, 2018.

Structures associated with the Project would be monitored to discourage use by avian predator species. Frequent inspections would ensure that nests are not being constructed and all nests found would be removed immediately, before birds could lay eggs. It is anticipated that there would be sufficient inspections and other activities mandated by safety and security requirements to keep the structures nest free. However, in the unlikely event that a nest becomes established and it is not discovered until eggs or young birds are present, the disposition of the nest would be handled in accordance with the provisions of the MBTA in consultation with the FWS. The FWS would require a special use permit if an active nest is encountered that would need to be removed, relocated, or transferred to a rehabilitation center. The Commission requires that all necessary permits be obtained prior to construction, including a Migratory Bird Special Use permit under 50 CFR section 21.27 if needed.

Additionally, in August 2018 both Jordan Cove and Pacific Connector jointly filed a draft *Migratory Bird Conservation Plan*. Both companies continue to consult with the FWS to finalize the plan and to prioritize conservation of migratory birds during construction and operation of all facilities. Therefore, we conclude that the Project would not significantly affect birds.

Effects on Amphibians and Reptiles

Potential Project-related effects on amphibians and reptiles would include mortality from construction if they were not able to avoid equipment or traffic, and habitat loss. Fill activity in wetlands would reduce available habitat for some amphibians and reptiles. Removal of dune forest for the Project would reduce habitat for the clouded salamander (*Aneides ferreus*), should this species occur in these areas. Jordan Lake and nearby wetlands on the east side of the terminal tract may offer suitable breeding habitat for the western toad (*Anaxyrus boreas*), although the species was not found during surveys of the site.

Jordan Cove proposed to mitigate potential effects on amphibians and by conducting pre-construction surveys for the western pond turtle, northern red-legged frog, and clouded salamander. Individuals located in the construction area would be captured and transported to suitable nearby habitats, as agreed to by the ODFW.

4.5.1.2 Pacific Connector Pipeline

Wildlife Habitats

Wildlife associations with habitats in the area that would be affected by the Pacific Connector Pipeline Project include the following (adapted from Johnson and O'Neil 2001):

- close association: a species is known to depend on a specific habitat for part or all of its life history requirements (feeding and reproduction) implying that the species has an essential need for a particular habitat for its maintenance and viability;
- general association: a highly adaptable species that is supported by a number of habitats that provide for its maintenance and viability; and
- present: a species that occasionally uses a habitat that provides marginal support for its maintenance and viability.

Sixteen wildlife habitat types (Johnson and O'Neil 2001) coincide with one or more of the vegetation types described for the Pacific Connector pipeline area in Section 4.4.1.2. Wildlife species associations with these habitat types provide a basis for evaluating Project effects on biodiversity and in some cases, on individual species. Two additional wildlife habitat types are not specifically addressed in Johnson and O'Neil (2001) but are well represented in the area affected by the Project: Grass-Shrub-Sapling or Regenerating Young Forest and Roads. Table 4.5.1.2-1 lists the miles of each of these habitat types crossed. Westside Lowland Conifer-Hardwood Forest and Southwest Oregon Mixed Conifer-Hardwood Forest are the most abundant habitats crossed, with 60.1 and 47.1 miles crossed, respectively.

Specialized habitat features also occur within the area affected by the pipeline project. Such features include cliffs that provide nesting for peregrine falcons and possibly other raptors. Snags provide roosting locations for several bat species, and nesting locations for cavity-nesting birds. LWD is present, which could be used by reptiles and amphibians.

TABLE 4.5.1.2-1

Wildlife Habitat Types Crossed by the Pacific Connector Pipeline and Wildlife Species Associated with Habitats

General Habitat Type	Mapped Habitat Type	Late Successional or Old-Growth Forest Crossed a/,f/ (miles)	Mid-Seral Forest Crossed b/,f/ (miles)	Clearcut/ Regenerating Forest Crossed c/,f/ (miles)	Total Miles	Percent of Total Project Mileage per Habitat Type	Number of Species Associated d/
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	9.5	22.8	27.8	60.1	26.2	32 – Herpetofauna 115 – Birds 66 – Mammals
	Montane Mixed Conifer Forest	1.4	0.9	4.0	6.3	2.7	22 – Herpetofauna 95 – Birds 64 – Mammals
	Southwest Oregon Mixed Conifer-Hardwood Forest g/	20.0 (1.6)	8.9 (0.4)	18.2 (0.2)	47.1 (2.2)	20.6 (1.0)	36 – Herpetofauna 127 – Birds 65 – Mammals
	Ponderosa Pine Forest and Woodlands	4.4	4.2	5.5	14.1	6.2	31 – Herpetofauna 128 – Birds 60 – Mammals
	Westside Oak and Dry Douglas-fir Forest and Woodlands	2.2	2.1	0.0	4.4	1.9	33 - Herpetofauna 116 – Birds 65 – Mammals
	Western Juniper and Mountain Mahogany Woodlands	0.2	4.2	3.7	8.1	3.5	19 - Herpetofauna 93 – Birds 40 – Mammals
	Subtotal	**39.3**	**43.6**	**59.4**	**142.2**	**62.1**	
Grasslands Shrubland	Shrub-steppe	–	–	–	17.8	7.8	23 – Herpetofauna 76 – Birds 47 – Mammals
	Westside Grasslands	–	–	–	11.8	5.1	26 – Herpetofauna 82 – Birds 38 – Mammals
	Eastside Grasslands	–	–	–	4.5	2.0	21 – Herpetofauna 80 – Birds 47 - Mammals
	Subtotal	–	–	–	**34.0**	**14.8**	
Wetland/ Riparian e/	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	–	–	–	0.3	0.1	38 – Herpetofauna 156 – Birds 78 – Mammals
	Herbaceous Wetlands	–	–	–	5.6	2.5	18 – Herpetofauna 134 – Birds 44 – Mammals
	Subtotal	–	–	–	**5.9**	**2.6**	
Agriculture	Agriculture, Pastures, and Mixed Environs	–	–	–	26.6	11.6	34 – Herpetofauna 181 – Birds 78 – Mammals
	Subtotal	–	–	–	**26.6**	**11.6**	

TABLE 4.5.1.2-1 (continued)

Wildlife Habitat Types Crossed by the Pacific Connector Pipeline and Wildlife Species Associated with Habitats

General Habitat Type	Mapped Habitat Type	Late Successional or Old-Growth Forest Crossed a/,f/ (miles)	Mid-Seral Forest Crossed b/,f/ (miles)	Clearcut/ Regenerating Forest Crossed c/,f/ (miles)	Total Miles	Percent of Total Project Mileage per Habitat Type	Number of Species Associated d/
Developed/ Altered	Urban and Mixed Environs	–	–	–	2.2	1.0	37 – Herpetofauna 133 – Birds 64 – Mammals
	Roads				14.8	6.5	
	Subtotal				**17.0**	**7.4**	
Barren	Coastal Dunes and Beaches	–	–	–	<0.1	<0.1	8 – Herpetofauna 103 – Birds 26 – Mammals
	Subtotal	–	–	–	**<0.1**	**<0.1**	
Open Water	Open Water - Lakes, Rivers, and Streams	–	–	–	0.9	0.4	17 – Herpetofauna 95 – Birds 20 – Mammals
	Bays and Estuaries	–	–	–	2.4	1.0	1 – Herpetofauna 132 – Birds 12 – Mammals
	Subtotal	–	–	–	**3.3**	**1.4**	
	Project Total	**39.3**	**43.7**	**59.5**	**229.1**	**100.0**	

Note: Mileages rounded to nearest tenth of a mile; values less than 0.1 miles shown as "<0.1". Rows/columns may not sum correctly due to rounding.

a/ Late Successional (80 to 175 years) and Old-Growth Forest (175 + years).
b/ Mid-Seral Forest (40 to 80 years).
c/ Clearcut (0 to 5 years) and Regenerating Forest (5 to 40 years).
d/ Numbers of species associated with each habitat type crossed by the Pacific Connector Project were summarized from Pacific Connector's Environmental Resource Report 3, Appendix 3D, Table 3D-1.
e/ Following wetland regulation protocols, construction of the pipeline would initially affect 112.2 acres of wetlands. See section 4.3 for results of jurisdictional wetland delineation and discussion of Project effects on wetlands.
f/ Cells with no data result from the fact that non-forested habitat types did not identify seral stage; thus, miles are identified only in the "total miles" column.
g/ Distances in parentheses indicate crossing through recently burned Southwest Oregon Mixed Conifer-Hardwood Forest.

Grasslands and/or meadows provide habitats for animals that are adapted to areas dominated with perennial bunchgrasses and forbs. A wide variety of species use grasslands and meadows, including songbirds, amphibians, and reptiles. We estimate that the pipeline route would cross about 16.3 miles of grasslands (see table 4.5.1.2-1). Wetlands provide habitat for migrating and breeding waterfowl, shorebirds, waterbirds, songbirds, mammals, amphibians, and reptiles (ODFW 2006b). Riparian zones (including forested wetlands) support high species diversity (Johnson and O'Neil 2001). In total, the pipeline route would cross about 6 miles of wetlands and riparian habitats.[109]

The pipeline route would cross about 142 miles of woodlands and forest habitats. Deciduous hardwood species, such as oak and tanoak, occur in the area affected by the pipeline project. Mixed coniferous and deciduous forests, deciduous-dominated riparian areas, and oak woodlands are found most often in Douglas and Jackson Counties. In Coos County, many of the historical deciduous woodlands have been reduced as a result of conifer plantings and changes in fire frequency and intensity, as well as conversion to agricultural and residential uses. A wide variety of species use deciduous and young conifer forest habitats, including songbirds, reptiles, and small mammals.

Mature (greater than 40 years old), late successional (80 to 175 years old), and old-growth (greater than 175 years old) forests are unique, important habitat elements. Tree species common in mature to old-growth forests are western hemlock, Douglas-fir, western redcedar, Sitka spruce, red alder, and bigleaf maple (Chappell et al. 2001). Bird species that are obligates of old-growth forests include the federally threatened NSO and MAMU (further discussed in section 4.6). Old-growth forests are most common along the pipeline route in the Klamath Mountains (see section 4.4).

Terrestrial Animals in the Project Area

The areas crossed by the Pacific Connector pipeline route provide diverse habitats for wildlife, including forests, shrublands, and grasslands. These habitats support an array of wildlife species. Overall, 47 amphibian and reptile, 281 bird, and 108 mammal species are known or suspected to occur in the area affected by the Project.

Mammals

Based on their distributions in southwestern Oregon and habitat associations described by Johnson and O'Neil (2001), 108 species of mammals may be present in habitats that coincide with and/or are adjacent to the Pacific Connector pipeline. The most numerous groups likely to occur are rodents (46 species, such as Baird's shrew, coast mole, least chipmunk, and Douglas' squirrel), carnivores (19 species, such as coyote, gray fox, black bear, and mink), and bats (13 species; see subsection below). Mammal species with special state or federal status are discussed in section 4.6.

The highest diversity of mammals can be expected in the Johnson and O'Neil (2001) Agriculture, Pastures, and Mixed Environs habitat and Eastside and Westside Riparian-Wetlands habitat (78 species, respectively). Mammalian species diversity is also relatively high in Westside Lowland Conifer-Hardwood-Forest (66 species), Southwest Oregon Mixed Conifer-Hardwood Forest

[109] Following wetland regulation protocols, construction of the pipeline would initially impact 112.2 acres of wetlands. See section 4.3 for results of jurisdictional wetland delineation and discussion of Project effects on wetlands.

(65species), Westside Oak and Dry Douglas-Fir Forest and Woodlands (65), Montane Mixed Conifer Forest (64 species), as well as in Developed-Urban and Mixed Environs (64 species). The lowest species diversity of mammals is expected in Bays and Estuaries (12).

Wild Horses

The BLM and the Forest Service manage wild horses to ensure healthy herds and healthy rangelands in Oregon. The Pokegama Herd Management Area (HMA) is in the southwestern corner of Klamath County and the southeast corner of Jackson County, on both private and BLM lands in the Lakeview District. While the pipeline does not cross it, the HMA is in the general vicinity of the Project. From 1972 to 2002, the average number of horses in the HMA was 42.7, but the population has ranged from 23 to 55 horses over that time. Relative to other wild horse herds (which increase about 22 percent per year), the Pokegama herd has a low yearly increase of 4 to 5 percent. This may be due to illegal removal or mountain lion predation (BLM 2002).

Bats

A total of 15 species of bat occur in Oregon; 13 of the species potentially occur in the area affected by the Project. All of the species except for little brown myotis, big brown bat, and Brazilian free-tailed bat have some special status, whether identified by the State as sensitive, the FWS as a Species of Concern, or by the BLM or the Forest Service as a Sensitive Species. Special status species are discussed in section 4.6; special status bats are listed in table I-3 of appendix I. Uses of different habitats that may occur along the pipeline route vary between little brown myotis, big brown bat, and Brazilian free-tailed bat (table 4.5.1.2-2).

TABLE 4.5.1.2-2

Non-Special Status Bat Species and Associated Habitats Likely to Occur In the Project Area

Species	Distribution in Southern Oregon	Habitat Types	Foraging Habitat
Little brown myotis *Myotis lucifugus carissima*	Yearlong throughout Oregon	Associated with all habitats described in table 4.5.1.2-1	Forages for insects in scattered trees, along edges of dense timber, near water in shrub-grassland
Big brown bat *Eptesicus fuscus*	Yearlong throughout Oregon	Associated with all habitats described in table 4.5.1.2-1	Forages for insects over forest canopy, along roads/edges through trees, forest clearing
Brazilian free-tailed bat *Tadarida brasiliensis mexicana*	Non-migratory southern Oregon only	Westside Lowland Conifer-Hardwood Forest, Southwest Oregon Mixed Conifer-Hardwood Forest, Ponderosa Pine Forest and Woodlands, Westside Oak and Dry Douglas-fir Forest and Woodlands, Western Juniper and Mountain Mahogany Woodlands, Shrub-steppe, Westside Grasslands, Westside Riparian-Wetlands, Herbaceous Wetlands, Agriculture, Pastures, and Mixed Environs, Urban and Mixed Environs, Open Water - Lakes, Rivers, and Streams	Forages for insects in heated buildings or outside during warm spells during winter. During other periods, will forage almost anywhere from valley bottoms to Cascade / Siskiyou Mtn. crest, foraging long distances, e.g., 30+ miles round trip per night

Sources: Maser and Cross (1981), Verts and Carraway (1998), Johnson and O'Neil (2001), Weller (2008), ODFW (2013a)

All of the bat species consume insects, and most are associated with tree-dominated habitats that occur in the area affected by the pipeline project. Bats have roosts used by nursing females and young, roosts used during daylight, and hibernacula that are used to survive during winter while hibernating or in torpor. White-nose syndrome is a disease of hibernating bats, caused by a fungus that affects skin for the nose, ears, and wings of hibernating bats (USGS 2013b).

White-nose syndrome has spread from the northeastern United States to 28 states and has most recently been identified in the state of Washington in 2016; since 2006 over 6 million insect-eating bats have died from the effects of this disease. ODFW, along with other federal agencies, has been surveying caves for the disease with no positive indications that the disease is presently in Oregon bat populations (ODFW 2017b).

Birds

Based on their distributions in southwestern Oregon, 281 bird species may be present in habitats that would be crossed by the Pacific Connector pipeline (Johnson and O'Neil 2001). The highest diversity of bird species can be expected in habitats associated with agriculture, pastures, and mixed environs (181 species). Many species are also associated with riparian-wetland habitats (156 species), herbaceous wetlands (134 species), bays and estuaries (132 species), and developed-urban and mixed environs (133 species; table 4.5.1.2-1). The fewest number of bird species are associated with sagebrush shrub-steppe (76) and eastside grasslands (80).

Annual breeding bird survey (BBS) counts were used to determine additional potential bird species presence in habitats crossed by the Pacific Connector pipeline. Fewer species have been documented on BBS routes (241 species observed) than the number of species associations of wildlife habitats coinciding with the Pacific Connector Project (281 species expected). The disparity is likely due to several factors: the BBS does not usually document all of the species possibly present at the time of the survey (i.e., nocturnal owls and birds that do not sing or call regularly); species reported are present only during the season of the survey; and survey routes may not include or be representative of all habitat types crossed by the pipeline. Regardless, the BBS survey counts can be used as an index of some species' population trends over time.

The Pacific Connector pipeline crosses two BCRs: (1) BCR 5 – Northern Pacific Rainforest, from MP 1.5R to MP 168.15; and (2) BCR 9 – Great Basin, from MP 168.15 to MP 228.81. Bird species diversity and population trends in the region surrounding the Project were evaluated from data collected on 33 BBS routes that have been surveyed within 50 miles of the Project (17 routes in BCR 5, 16 routes in BCR 9). Of the 238 species observed on the BBS routes, 11 species are BCC in BCR 5 (excluding the MAMU, discussed in section 4.6) and 21 species are BCC in BCR 9. BCC in the area affected by the Pacific Connector pipeline are listed in table 4.5.1.2-3.

TABLE 4.5.1.2-3

Birds of Conservation Concern in BCR-5 and BCR-9 that Have Been Observed on BBS Routes within 50 Miles of the Pacific Connector Pipeline Project with Regional and Local Population Trends, and Breeding Dates, if Known

Common Name a/ *Scientific Name*	**Regional BCR Trend 1996 to 2015 b/**	**Local Trend 1997 to 2016 c/**	**Confirmed Breeding Dates d/**	
			Earliest	**Latest**
BCR-5, Northern Pacific Rainforest				
pelagic cormorant *Phalacrocorax pelagicus*	No Trend	No Data	22 Mar	26 Jul
bald eagle *Haliaeetus leucocephalus*	Increasing ($p<0.05$)	Insufficient Data	8 Mar	9 Aug
northern goshawk *Accipiter gentilis*	No Trend	Insufficient Data	10 May	9 Aug
peregrine falcon *Falco peregrinus*	Increasing ($p<0.05$)	Insufficient Data	26 Apr	26 Jul
Caspian tern *Sterna caspia*	No Trend	Insufficient Data	14 Jun	19 Jul
marbled murrelet *Brachyramphus marmoratus*	No Analysis	Insufficient Data	No Data	No Data
Rufous hummingbird *Selasphorus rufus*	Decreasing ($p<0.05$)	Increasing ($p<0.01$)	22 Mar	
olive-sided flycatcher *Contopus cooperi*	Decreasing ($p<0.05$)	No Trend	14 Jun	30 Aug
willow flycatcher *Empidonax traillii*	Decreasing ($p<0.05$)	Increasing ($p<0.10$)	7 Jun	9 Aug
horned lark e/ *Eremophila alpestris*	Decreasing ($p<0.05$)	No Data	3 May	26 Jul
Vesper sparrow f/ *Pooecetes gramineus*	No Trend	Insufficient Data	26 Apr	16 Aug
purple finch *Carpodacus purpureus*	No Trend	Increasing ($p<0.01$)	10 May	19 Jul
BCR-9, Great Basin				
eared grebe *Podiceps nigricollis*	No Trend	Insufficient Data	31 May	23 Aug
Bald eagle *Haliaeetus leucocephalus*	Increasing ($p<0.05$)	No Trend	8 Mar	9 Aug
Ferruginous hawk *Buteo regalis*	No Trend	No Data	29 Mar	19 Jul
golden eagle *Aquila chrysaetos*	No Trend	Insufficient Data	22 Feb	19 Jul
Pperegrine falcon *Falco peregrinus*	No Trend	Insufficient Data	26 Apr	26 Jul
yellow rail *Coturnicops noveboracensis*	No Analysis	Insufficient Data	7 Jun	5 Jul
Snowy plover *Charadrius alexandrinus*	No Analysis	Insufficient Data	17 May	5 Jul
long-billed curlew *Numenius americanus*	Increasing ($p<0.05$)	Insufficient Data	19 April	12 Jul
yellow-billed cuckoo *Coccyzus americanus*	No Analysis	No Data	No Data	No Data
Calliope hummingbird *Stellula calliope*	No Trend	No Trend	31 May	26 Jul
Lewis's woodpecker *Melanerpes lewis*	No Trend	No Trend	24 May	23 Aug
Williamson's sapsucker *Sphyrapicus thyroideus*	No Trend	Insufficient Data	17 May	26 Jul
white-headed woodpecker *Picoides albolarvatus*	Increasing ($p<0.05$)	Insufficient Data	24 May	26 Jul
loggerhead shrike *Lanius ludovicianus*	No Trend	Insufficient Data	10 May	19 Jul
Pinyon jay *Gymnorhinus cyanocephalus*	Decreasing ($p<0.05$)	Insufficient Data	7 Jun	19 Jul

TABLE 4.5.1.2-3 (continued)

Birds of Conservation Concern in BCR-5 and BCR-9 that Have Been Observed on BBS Routes within 50 Miles of the Pacific Connector Pipeline Project with Regional and Local Population Trends, and Breeding Dates, if Known

Common Name a/ *Scientific Name*	**Regional BCR Trend 1996 to 2015 b/**	**Local Trend 1997 to 2016 c/**	**Confirmed Breeding Dates d/**	
sage thrasher *Oreoscoptes montanus*	Decreasing ($p<0.05$)	Insufficient Data	10 May	26 Jul
Green-tailed towhee *Pipilo chlorurus*	No Trend	No Trend	17 May	9 Aug
Brewer's sparrow *Spizella breweri*	No Trend	No Trend	3 May	9 Aug
black-chinned sparrow *Spizella atrogularis*	No Analysis	No Data	No Data	No Data
Sagebrush sparrow g/ *Artemisiospiza nevadensis*	No Trend	Insufficient Data	10 May	
tricolored blackbird *Agelaius tricolor*	No Trend	Increasing ($p<0.10$)	12 Apr	9 Aug
eared grebe *Podiceps nigricollis*	No Trend	Insufficient Data	31 May	23 Aug

a/ BCC species listed by BCR in FWS (2008).
b/ Regional trend analyses available at https://www.mbr-pwrc.usgs.gov/bbs/bbs.html (Sauer et al. 2017).
c/ BBS data retrieved from https://www.pwrc.usgs.gov/bbs/RawData/ (Pardieck et al. 2017). Local population trends in each BCR were estimated from average number observed per BBS route if data were sufficient (average occurrence per route per year ≥1, average number of routes per year with species counted ≥5).
d/ Confirmed breeding dates from Oregon Breeding Bird Atlas (Adamus et al. 2001).
e/ Only applies to streaked horned lark (*Eremophila alpestris strigata)* subspecies not differentiated in data sources.
f/ Only applies to Oregon vesper sparrow (*Pooecetes gramineus affinis)* subspecies not differentiated in data sources.
g/ Sage sparrow was recently split into two species: Bell's sparrow (*Artemisiospiza belli*) and sagebrush sparrow (*Artemisiospiza nevadensis*). Sagebrush sparrows were observed within 50 miles of the pipeline in BCR-9 and are assumed to be BCC in that region.

For BCR 5 regional trends, peregrine falcons and bald eagles are increasing and for the rest of the birds either there is a decreasing trend (4) or no trend (5). For BCR 5 local trends, rufous hummingbird, willow flycatcher, and purple finch are increasing and for the rest of the birds either there is no data or insufficient data (7 birds), or no trend (1 bird). For BCR 9 regional trends, bald eagle, long-billed curlew, and white-headed woodpecker have increasing trends, the sage thrasher and pinyon jay display a decreasing trend, and for the rest of the birds either there is a no trend (13) or no analysis (4). The local trend for BCR 9 is increasing for tricolored blackbird. For the other birds in BCR 9, there are 4 exhibiting no local trend and the rest do not have sufficient data to report a trend.

Many migratory bird species have been observed during the annual Christmas Bird Count (CBC), sponsored by the Audubon Society in the vicinity of the Project. At least 272 bird species (common names are reported and have not been standardized) have been counted at eight locations proximate to the area affected by the Pacific Connector Pipeline Project. While 152 bird species have been reported by both BBS and CBC, 91 species have only been reported by the CBC. The species include various seabirds (auklets, murres, guillemots, jaegers, gulls, albatrosses, shearwaters, and cormorants), waterfowl (scoters, geese, swans), and shorebirds (dowitchers, sandpipers, plovers, turnstones). The local population of common ravens has been increasing during the breeding period in BCR 9 and during winter on CBC count circles near the Pacific Connector pipeline.

Several raptor species are known or suspected to nest, migrate, and seasonally reside in the general vicinity of the pipeline route. Those reported for BBS routes in the region include turkey vulture, osprey, white-tailed kite, bald eagle, northern harrier, sharp-shinned hawk, Cooper's hawk, northern goshawk, red-shouldered hawk, Swainson's hawk, red-tailed hawk, ferruginous hawk, golden eagle, American kestrel, American peregrine falcon, and prairie falcon. Several additional raptor species have only been observed during CBC surveys. Those include rough-legged hawk, gyrfalcon, and merlin. Bald eagles, northern goshawks, and peregrine falcons have nest sites within 3 miles, some much closer to the Project (data from ORBIC 2012 and 2017a; BLM 2017a; Forest Service 2017c; and pipeline surveys for the northern goshawk on Rogue River-Siskiyou National Forest). Other raptor species have been observed, some nesting, along the Project route during surveys focusing on other rare species. Bald eagles, ospreys, sharp-shinned hawks, Cooper' hawks, goshawks, golden eagles, red-shouldered hawks, red-tailed hawks, peregrine falcons, and turkey vultures have been reported during surveys in 2007 and 2008 but nest sites were not included in the documentation. Some of these raptor species have probably nested in the Project vicinity in the past.

There are also several species of owls that have been documented on BBS routes and are likely to occur in the areas crossed by the pipeline. They include barn owl (*Tyto alba*), western screech owl (*Otus kennicottii*), great horned owl (*Bubo virginianus*), northern pygmy-owl (*Glaucidium gnoma*), barred owl (*Strix varia*), great gray owl (*Strix nebulosa*), short-eared owl (*Asio flammeus*), and NSO. Owls seen only during the winter CBC surveys include northern saw-whet owls (*Aegolius acadicus*) and burrowing owls (*Athene cunicularia*). Additionally, boreal owl (*Aegolius funereus*), flammulated owl (*Otus flammeolus*), and long-eared owl (*Asio otus*) are expected to occur in habitats crossed by the Pacific Connector pipeline route. The burrowing owl, flammulated owl, and great gray owl have special state or federal status and more information on their occurrence is included in appendix I. The NSO has threatened state and federal status and is discussed in more detail in section 4.6. Great horned owls, western screech owls, NSOs, barred owls, northern pygmy owls, and great gray owls have been reported during surveys in 2007 and 2008 but nest sites were not included in the documentation.

Game Animals

Several species of mammals and birds are considered game animals and are harvested through recreational and/or subsistence hunting. Except for wildlife harvest administered and managed under tribal authorities, hunting is regulated by the ODFW in defined Wildlife Management Units. Big game species that may occur in the areas crossed by the Pacific Connector pipeline route include black-tailed deer, mule deer, Roosevelt elk, Rocky Mountain elk, black bear, and cougar. Demographic data and harvest data for game animals are compiled by ODFW and are available in online reports, listed by animals taken by each hunt unit.

Two subspecies of mule deer occur in the Pacific Connector pipeline area: the larger Rocky Mountain mule deer, usually found east of the Cascade Mountain crest, and the black-tailed deer, generally found west of the Cascades (ODFW 2008). A second species, Columbian white-tailed deer, was state and federally delisted in 2003 and may occur between MPs 56.0 and 61.0, and MPs 65.5 and 66.2, in an area mapped by ODFW as "peripheral big game range" and "impacted habitat" (ODFW 2017c, 2017d). Black-tailed deer are considered management indicator species (MIS) for both the Umpqua and Rogue River National Forests (Forest Service 1990a, 1990b).

In eastern Oregon, mule deer are mainly confined to open woods or isolated mountain ranges, although they once ranged into sagebrush plains in canyons or rimrock. During the winter, a period considered critical for the mule deer, they descend to lower elevations to browse sagebrush, bitterbrush, rabbitbrush, juniper, and mountain-mahogany, which are high in fats (ODFW 2003a, 2011; Csuti et al. 2001). In western Oregon, black-tailed deer are found in forested areas and heavy brush areas at the edges of forests and chaparral thickets. Black-tailed deer prefer early successional stages created by clear-cuts or burns, providing grasses, forbs, and shrubs (ODFW 2008; Csuti et al. 2001). Most black-tailed deer that summer in the high Cascades winter at lower elevations on the west slope, although some wintering may occur east of the Cascade crest (ODFW 2008). Winter loss of black-tailed deer is generally far less than for mule deer, because the snow does not remain on the valley floors for extended periods and a crust does not form on the surface as it does on the east side of the Cascades (ODFW 2008). In Jackson County, black-tailed deer are highly migratory and often move along well-defined migration trails at night during the months between October and March (ODFW 2007a). In Douglas County, Columbian white-tailed deer are most often associated with riparian habitats, although they are known to use a variety of lower elevation habitat types, such as grasslands, grass shrub, oak woodlands, coniferous woodlands, and mixed deciduous and coniferous woodlands (FWS 2003b).

Rocky Mountain elk inhabit most of eastern Oregon and Roosevelt elk occupy most of western Oregon with concentrations in the Cascades and Coast ranges. They are known to make significant movements in response to disturbances from humans and predators, as well as seasonal weather patterns. Rocky Mountain elk is considered an MIS for both the Umpqua and Rogue River National Forests (Forest Service 1990a, 1990b). Note that MIS species are addressed in more detail in section 4.5.1.3

Several herds of elk are known to winter on the western slopes of the Cascades (ODFW 2003b). Summer elk forage consists of a combination of lush forbs, grasses, and shrubs, which is usually attained at higher elevations in wet meadows, springs, and riparian areas in close proximity to forested stands. Forage becomes less abundant and accessible in winter and the nutritional quality declines. Winter range is usually in forested sites, which provide protection against weather as well as lichens and other plants used as forage (ODFW 2003b); however, in Jackson County, winter range also consists of other habitat types such as grassy meadows, recent clearcuts, industrial forestlands, agricultural fields, orchards and urban edges. Most elk range is on BLM and NFS lands (ODFW 2003b); however, in the Pacific Connector pipeline area, most winter range occurs on private lands (table 4.5.1.2-4). Jackson County has the most winter range affected by the Project, followed by Klamath County, then Douglas County.

ODFW delineated digital GIS coverage of deer and elk habitat in Oregon, which include big-game winter management areas in Jackson and Klamath counties in the vicinity of the pipeline (ODFW 2012b, 2012c, and 2017d). The delineated areas do not necessarily represent complete deer and elk winter ranges in each county, but designate areas that provide some level of protection for big-game winter range while allowing development to occur (Milburn 2007). Additionally, our analysis incorporates GIS coverage of big-game winter range on NFS lands, which also includes a few delineated areas in the Umpqua National Forest in Douglas County (Forest Service 2006). BLM Districts defer to winter range delineated by ODFW (Waddell 2017) Harvested small game and furbearer species that occur are beaver, bobcat, gray fox, red fox, marten, mink, muskrat, otter, raccoon, badger, coyote, nutria, opossum, spotted skunk, striped skunk, and weasel (Hiller 2011).

TABLE 4.5.1.2-4

Designated Big Game Winter Range Crossed by the Pacific Connector Pipeline

Winter Range or Management Area	Miles Crossed Per Landowner BLM	Forest Service	Other a/, b/	Total
Douglas County				
Big Game Winter Range – Umpqua National Forest	0.0	0.6	0.0	0.6
Douglas County Total	**0.0**	**0.6**	**0.0**	**0.6**
Jackson County				
Sensitive Wildlife Area c/	2.3	0.0	2.3	4.6
Very Sensitive Wildlife Area d/	11.1	1.4	19.7	32.3
Jackson County Total	**13.5**	**1.4**	**22.0**	**36.9**
Klamath County				
Deer Low/Medium Density Winter Range e/	0.0	0.0	4.4	4.4
Deer Low/Medium Density Winter Range f/	0.3	0.0	14.2	14.5
Elk Winter Range g/	0.0	0.0	1.2	1.2
Klamath County Total	**0.3**	**0.0**	**19.8**	**20.1**
Overall County	**13.7**	**2.1**	**41.9**	**57.7**

Note: Rows/columns may not sum correctly due to rounding. Mileages rounded to the nearest tenth of a mile (values below 0.1 are shown as "<0.1").

a/ Other includes non-federal lands, such as private, county, and state.

b/ Seasonal restrictions are specific to landownership. "Other" designation is stipulated by ODFW.

c/ Sensitive Wildlife Areas coverage (ODFW 2017c) also incorporates Forest Service Deer Winter Range coverage (Trail Creek, Big Butte Creek, and Lake Creek). Occurs in Evans Creek and Rogue ODFW big game management units.

d/ Very Sensitive Wildlife Area coverage (ODFW 2017c) also incorporates BLM Deer (Camel Hump, BFRA Salt Creek, Little Butte Creek South) and Elk (Camel Hump, BFRA Salt Creek) Winter Management Area coverages, as well as Forest Service Deer Winter Range coverages (Big Butte Creek, Lake Creek). Occurs in Rogue ODFW big game management units.

e/ Deer Low/Medium Density Winter Range coverage (ODFW 2012b) includes the ODFW Keno big game management unit.

f/ Deer Low/Medium Density Winter Range (ODFW 2012a) incorporates BLM Deer Winter Management coverages (Stukel, South Bryant). Occurs in Klamath Falls big game management unit.

g/ Elk Winter Range for Eastern Oregon (ODFW 2012c).

Amphibians and Reptiles

Based on their distributions in southwestern Oregon, 23 amphibian species and 24 reptile species may be present in habitats that would be crossed by the Pacific Connector pipeline route (Leonard et al. 1993; Nussbaum et al. 1983). Habitats in the area of the pipeline that support the highest diversity of reptiles and amphibians include Wetlands/Eastside Riparian-Wetlands (38 species), Developed, Urban, and Mixed Environments (37 species), and Mixed Conifer-Hardwood Forest (36 species). One reptile species (western terrestrial garter snake) is potentially found in bays and estuarine habitats. Amphibian and reptile species that could potentially occur near the Project include, but are not limited to, clouded salamander, tailed frog, western toad, western pond turtle, sagebrush lizard, rattlesnake, king snake, western fence lizard, gopher snake, and rubber boa.

Some amphibian species potentially occurring in the area affected by the pipeline project are associated with a variety of habitats and thus are common and widespread with healthy populations, such as the Pacific tree frog and rough-skinned newt. Other species that have been documented, such as the foothill yellow-legged frog (a federal species of concern, state sensitive, BLM and Forest Service sensitive species), are declining (ODFW 2006b; Oregon Conservation Strategy 2016). Amphibians demonstrate close associations with aquatic and riparian habitats, though they may occur in other habitat types if not too distant from water, for example, the ensatina (a lungless salamander), which is found in forests. Amphibians with extremely limited distributions and relatively specific ecological requirements may be more at risk of further population declines (Walls et al. 1992).

Reptiles present along the pipeline project are also associated with a variety of habitats crossed, although not all are as closely associated with water and/or water-dominated features as amphibians.

Invertebrates

Terrestrial invertebrates occur along the Pacific Connector pipeline. Arthropods occur in all habitat types crossed by the pipeline, though terrestrial mollusks (gastropods) are considerably more restricted. With few exceptions, terrestrial mollusks are generally found in moist habitats associated with springs, seeps, decaying wood, moist mature forests, and habitats maintained in the coastal "fog" zone near the ocean. Other invertebrate species would likely be widespread and abundant throughout the area affected by the Project; some examples include *Peromyscopsylla selenis*, earthworm (*Lumbricus variegatus)*, orb weaver spider (family *Araneidae)*, and grass spiders (*Agelenopsis* spp*.)*. Some invertebrates, such as bees (from families such as *Apidae*, *Halictidae*, *Andrenidae*, *Megachilidae*, and *Colletidae*), play an important role in pollination of native plants in the area affected by the Project.

Effects on Wildlife Habitat and Terrestrial Wildlife Species from Construction and Operation of the Pacific Connector Gas Pipeline Facilities

Effects on Habitats

The acres of wildlife habitat types (from Johnson and O'Neil 2001) that would be affected by construction of the Pacific Connector pipeline are listed in table 4.5.1.2-5. Westside Lowland Conifer Forest, Southwest Oregon Mixed Conifer-Hardwood Forest, Shrublands and Grasslands, Agriculture, Pastures, and Mixed Environs, and Urban and Mixed Environs would be the wildlife habitats most affected by construction.

At aboveground facilities, native habitats would be cleared, and on private lands the area would be permanently converted into developed-industrial land. During pipeline operation, a 30-foot-wide corridor, centered over the pipe, would be kept clear of trees. As a result, areas cleared of forest during pipeline construction would be maintained in a shrub/herbaceous state within this 30-foot-wide corridor. The remainder of the temporary pipeline construction right-of-way would be revegetated with native species, although it would take years to many decades for forested and shrub-steppe habitat to regenerate. Other habitats, such as grasslands, within the temporary construction right-of-way would typically be restored within three years. A 10-foot-wide corridor centered on the pipeline may be mowed annually and maintained in an herbaceous state. The remainder of the 30-foot-wide corridor within the permanent easement may be subject to vegetation clearing every three years. The acres of wildlife habitat that would be affected by operation of the Pacific Connector Project are listed in table 4.5.1.2-6.

TABLE 4.5.1.2-5

Summary of Construction-Related Effects on Habitat by the Pacific Connector Pipeline (acres a/)

			Pipeline Facilities								**Subtotals**	
General Habitat Type	**Mapped Habitat Type**	**Forest Stand by Age**	**Construction Right-of-Way**	**Temporary Extra Work Areas**	**Uncleared Storage Areas**	**Rock Source/Disposal**	**Access Roads (TARs/PARs/ Improvements)**	**Pipe Yards**	**Aboveground Facilities - Klamath Compressor Station**	**Subtotal by Age Class**	**Subtotal by Habitat Type**	**Percent of Total Habitat**
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	L-O b/	113.5	25.6	89.9	0	0	0	0	229.1	1,297	26.2
		M-S c/	264.5	67.6	122.6	1.0	<1	<1	0	455.9		
		C-R d/	323.3	129.5	154.4	4.9	<1	0	0	612.2		
	Montane Mixed Conifer Forest	L-O b/	15.7	<1	6.1	0	0	0	0	22.5	114	*2.3*
		M-S c/	9.2	<1	4.5	0	0	0	0	14.2		
		C-R d/	45.0	16.7	15.8	0	0	0	0	77.5		
	Southwest Oregon Mixed Conifer-Hardwood Forest	L-O b/	251.5	41.3	111.7	1.5	<1	0	0	406.3	940	19.0
		M-S c/	108.7	36.4	33.9	<1	<1	0	0	179.0		
		C-R d/	210.6	61.0	82.4	0	<1	0	0	354.3		
	Ponderosa Pine Forest and Woodlands	L-O b/	50.9	15.9	6.0	0	0	0	0	72.8	220	4.5
		M-S c/	50.9	8.9	<1	<1	0	0	0	60.4		
		C-R d/	63.1	16.0	7.0	1.0	0	0	0	87.0		
	Westside Oak and Dry Douglas-fir Forest and Woodlands	L-O b/	26.7	9.0	3.9	0	0	0	0	39.6	74	*1.5*
		M-S c/	25.0	7.4	1.9	0	<1	0	0	34.3		
		C-R d/	0	0	0	0	0	0	0	0		
	Western Juniper and Mountain Mahogany Woodlands	L-O b/	2.3	<1	0	0	0	0	0	2.7	105	2.1
		M-S c/	48.7	7.6	0	0	<1	0	0	56.4		
		C-R d/	42.3	3.4	0	0	<1	0	0	45.6		
	Subtotal Forest-Woodland		**1,652**	**448**	**641**	**8**	**1**	**<1**	**0**	**2,750**	**2,750**	***55.6***
	Percent of All Forest-Woodland		***60.1***	***16.3***	***23.3***	***0.3***	**<1**	**<1**	**0.0**	***100.0***	***100.0***	
Grasslands -Shrubland	Sagebrush Steppe	n/a	78	33	0	0	<1	0	21	n/a	133	*2.7*
	Shrublands	n/a	122	41	11	0	<1	0	0	n/a	174	*3.5*
	Westside Grasslands	n/a	132	87	6	<1	2	148	0	n/a	376	*7.6*
	Eastside Grasslands	n/a	51	8	<1	1	0	122	0	n/a	183	*3.7*
	Subtotal Grasslands-Shrubland		**383**	**170**	**17**	**2**	**2**	**271**	**21**	**n/a**	**865**	***17.5***
Wetland / Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	L-O b/	0	0	0	0	0	0	0	0	2	*0.0*
		M-S c/	<1	<1	0	0	0	0	0	1		
		C-R d/	1	<1	0	0	0	0	0	1		
		Shrub	1	<1	<1	0	0	0	0.4	n/a	2	*0.0*
	Herbaceous Wetlands	n/a	64	45	<1	0	<1	<1	0	n/a	111	*2.2*
	Subtotal Wetland / Riparian		**67**	**46**	**<1**	**0**	**<1**	**1**	**0**	**n/a**	**114**	***2.3***
Agriculture	Agriculture, Pastures, and Mixed Environs		306	132	<1	3	2	14	0	n/a	458	*9.3*
	Subtotal Agriculture		**306**	**132**	**<1**	**3**	**2**	**14**	**0**	**n/a**	**458**	***9.3***

TABLE 4.5.1.2-5 (continued)

Summary of Construction-Related Effects on Habitat by the Pacific Connector Pipeline (acres a/)

			Pipeline Facilities								Subtotals	
General Habitat Type	**Mapped Habitat Type**	**Forest Stand by Age**	**Construction Right-of-Way**	**Temporary Extra Work Areas**	**Uncleared Storage Areas**	**Rock Source/Disposal**	**Access Roads (TARs/PARs/ Improvements)**	**Pipe Yards**	**Aboveground Facilities - Klamath Compressor Station**	**Subtotal by Age Class e/**	**Subtotal by Habitat Type**	**Percent of Total Habitat**
Developed / Barren	Urban and Mixed Environs	n/a	22	54	<1	26	<1	336	0	n/a	439	8.9
	Roads	n/a	143	61	18	2	23	47	<1	n/a	295	*6.0*
	Beaches	n/a	<1	6	0	0	0	0	0	n/a	7	*0.1*
	Subtotal Developed / Barren		**166**	**122**	**18**	**28**	**23**	**383**	**<1**	**n/a**	**740**	***15.0***
Open Water	Open Water - Lakes, Rivers, Streams	n/a	8	5	1	0	<1	<1	0	n/a	14	0.3
	Bays and Estuaries	n/a	0	<1	0	0	0	5	0	n/a	5	*0.1*
	Subtotal Open Water		**8**	**5**	**1**	**0**	**<1**	**5**	**0**	**n/a**	**19**	***0.4***
	Subtotal Non-Forest		**930**	**475**	**36**	**33**	**27**	**674**	**21**		**2,197**	***44.4***
	Percent of All Non-Forest		***42.4***	***21.7***	***1.6***	***1.5***	***1.3***	***30.7***	***0.8***		***100.0***	
Project Total		n/a	**2,582**	**923**	**676**	**41**	**28**	**674**	**21**		**4,946**	
Percent of Pipeline Facilities		n/a	***52.2***	***18.7***	***13.7***	***0.8***	***0.6***	***13.6***	***0.4***		***100.0***	

General: Columns and rows do not necessarily sum correctly due to rounding. Acres rounded to nearest whole acre. Values less than 1 acre shown as "<1".
Acres of disturbance to non-vegetated areas are included in this table for consistency in values reported in this document.

a/ Acres disturbed were evaluated using GIS; footprints for each component (aboveground facilities, permanent easement, and 30-foot maintenance corridor) were overlaid on the digitized vegetation coverage.

b/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

c/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.

d/ The "Grass-shrub-sapling or Regenerating Young Forest" category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years). Forest areas in this category are divided into forest vegetation types based on their potential to become those types of forests.

TABLE 4.5.1.2-6

Summary of Operation-Related Effects on Habitat by the Pacific Connector Pipeline (acres a/)

General Habitat Type	Mapped Habitat Type	Forest Stand by Age	Pipeline Facilities: *30-foot Maintenance Corridor*	Pipeline Facilities: Permanent Access Roads	Pipeline Facilities: Subtotal Late Successional Old-Growth Forest	Pipeline Facilities: Subtotal Mid-Seral Forest	Pipeline Facilities: Subtotal Clearcut / Regenerating Forest	Pipeline Facilities: Subtotal By Habitat Type e/	Permanent Easement (50-foot)	Aboveground Facilities	Total Operation Disturbance by Habitat Type
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	L-O b/	35	<1					59		
		M-S c/	83	<1	35	83	101	219	139	<1	**219**
		C-R d/	101	<1					170		
	Montane Mixed Conifer Forest	L-O b/	5	0					9		
		M-S c/	3	0	5	3	15	23	5	<1	**23**
		C-R d/	14	<1					24		
	Southwest Oregon Mixed Conifer-Hardwood Forest	L-O b/	78	0					130		
		M-S c/	34	0	78	34	68	180	57	<1	**180**
		C-R d/	67	<1					113		
	Ponderosa Pine Forest and Woodlands	L-O b/	16	0					27		
		M-S c/	16	0	16	16	20	51	26	0	**51**
		C-R d/	20	0					33		
	Westside Oak and Dry Douglas-fir Forest and Woodlands	L-O b/	8	0					14		
		M-S c/	8	<1	8	8	0	16	13	0	**16**
		C-R d/	0	0					0		
	Western Juniper and Mountain Mahogany Woodlands	L-O b/	1	0					1		
		M-S c/	15	<1	1	15	13	29	24	<1	**29**
		C-R d/	13	0					22		
Subtotal Forest-Woodland			**517**	1	**143**	**158**	**216**	**518**	**866**	**1**	**519**
Grasslands-Shrubland	Sagebrush Steppe	n/a	26	<1	n/a	n/a	n/a	26	44	21	**48**
	Shrublands	n/a	39	<1	n/a	n/a	n/a	39	65	<1	**39**
	Westside Grasslands	n/a	42	2	n/a	n/a	n/a	44	71	<1	**45**
	Eastside Grasslands	n/a	16	0	n/a	n/a	n/a	16	27	0	**16**
Subtotal Grasslands-Shrubland			**101**	**<1**	**n/a**	**n/a**	**n/a**	**126**	***207***	**23**	**148**
Wetland/ Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	L-O b/	0	0					*0*		
		M-S c/	<1	0	0	<1	<1	1	<1	0	**1**
		C-R d/	<1	0					<1		
		Shrub	<1	0	n/a	n/a	n/a	<1	1	0	**<1**
	Herbaceous Wetlands	n/a	20	<1	n/a	n/a	n/a	20	34	0	**20**
Subtotal Wetland/Riparian			**21**	**<1**	**n/a**	**n/a**	**n/a**	**21**	***35***	**<1**	**21**
Agriculture	Agriculture, Pastures, and Mixed Environs	n/a	97	2	n/a	n/a	n/a	99	161	<1	**99**
Subtotal Agriculture			**97**	**2**	**n/a**	**n/a**	**n/a**	**99**	***161***	**<1**	**99**

TABLE 4.5.1.2-6 (continued)

Summary of Operation-Related Effects on Habitat by the Pacific Connector Pipeline (acres a/)

General Habitat Type	Mapped Habitat Type	Forest Stand by Age	Pipeline Facilities: *30-foot Maintenance Corridor*	Pipeline Facilities: Permanent Access Roads	Pipeline Facilities: Subtotal Late Successional Old-Growth Forest	Pipeline Facilities: Subtotal Mid-Seral Forest	Pipeline Facilities: Subtotal Clearcut / Regenerating Forest	Pipeline Facilities: Subtotal By Habitat Type e/	Permanent Easement (50-foot)	Aboveground Facilities	Total Operation Disturbance by Habitat Type
Developed / Barren	Urban and Mixed Environs	n/a	8	<1	n/a	n/a	n/a	8	13	2	**10**
	Roads	n/a	52	<1	n/a	n/a	n/a	53	85	<1	**53**
	Beaches	n/a	<1	0	n/a	n/a	n/a	<1	<1	0	**<1**
	Subtotal Developed / Barren		**60**	**1**	**n/a**	**n/a**	**n/a**	61	***98***	**2**	**62**
Open Water	Open Water - Lakes, Rivers, and Streams	n/a	2	<1	n/a	n/a	n/a	3	4	0	**3**
	Bays and Estuaries	n/a	<1	0	n/a	n/a	n/a	<1	3	0	**<1**
	Subtotal Open Water		**3**	**<1**	**n/a**	**n/a**	**n/a**	**3**	***7***	**0**	**3**
	Subtotal Non-Forest		**304**	**5**	**0**	**<1**	**<1**	**309**	**508**	**25**	**334**
	Project Total		**821**	**6**	**143**	**159**	**217**	**827**	**1,374**	**25**	**852**

General: Columns and rows do not necessarily sum correctly due to rounding. Acres rounded to nearest whole acre. Values less than 1 acre shown as “<1”.
Acres of disturbance to non-vegetated areas are included in this table for consistency in values reported in this document.

a/ Acres disturbed were evaluated using GIS; footprints for each component (aboveground facilities, permanent easement, and 30-foot maintenance corridor) were overlaid on the digitized vegetation coverage.
b/ The “Late Successional and Old-Growth” category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.
c/ The “Mid-Seral” category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.
d/ The “Grass-shrub-sapling or Regenerating Young Forest” category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years). Forest areas in this category are divided into forest vegetation types based on their potential to become those types of forests.
e/ Subtotal by Habitat Type includes the 30-foot maintenance corridor, permanent access roads, and only aboveground facilities with a meter station or compressor station (mainline block valves located within the 30-foot maintenance corridor).

During construction and restoration, Pacific Connector would implement numerous measures to minimize impacts on vegetation and ensure successful revegetation of disturbed areas (see section 4.4). These measures include those found in the ECRP, *Leave Tree Protection Plan*, *Integrated Pest Management Plan*, *Fire Prevention and Suppression Plan*, and the *SPCC Plan*. These measures would be applied to all lands crossed by the pipeline route; however, federal land-managing agencies may impose additional measures on federal lands. Measures specific to federally managed lands are addressed in the upland vegetation section 4.4.1.3.

Effects on Terrestrial Wildlife Species

General Effects Applicable to All Terrestrial Wildlife

Many species have very specific habitat requirements that may or may not be present in the area affected by the Project and would not be described in the relatively broad habitat types used in this section (habitat types described by Johnson and O'Neil 2001). Consequently, the assumption has been made that if a species' occupied range is known or likely to coincide with the area affected by the Project, and if general habitat types that would be affected by the Pacific Connector pipeline could include more specific habitat components required by that species, then the species could occur and be affected in some way by the Project.

Constructing and operating the Project could cause habitat degradation by spreading noxious weeds, herbicide use, noise, and habitat fragmentation. Wildlife may be affected by construction vehicles traveling to and from construction sites. Species most susceptible to vehicle-related injury and mortality include those that are inconspicuous (salamanders, frogs, snakes, small mammals), those with limited mobility (amphibians), burrowing species (mice and voles, weasels, beaver, frogs and toads, snakes, subterranean mollusks), and wildlife with behavioral activity patterns making them vulnerable, such as deer that are more active at dusk and dawn, and wildlife that may scavenge roadside carrion (Leedy 1975; Bennett 1991; Forman and Alexander 1998; Trombulak and Frissell 2000). Vegetation clearing during operations of the pipeline could also affect wildlife.

Other species are likely to be displaced from habitats that are cleared of vegetation (passerine birds, and tree-dependent/cavity-dependent birds and mammals such as woodpeckers and bats) and from areas adjacent to construction sites (waterfowl, raptors and medium-sized mammals). Populations may also be negatively affected if individuals emigrate from habitats affected by project-related disturbances. Displacement of mobile wildlife would most likely be a short-term effect. Once construction and restoration of the right-of-way is complete, displaced individuals are expected to return to the original area they occupied. If adjacent habitats are at carrying capacity for the species, displaced individuals would cause increased competition for resources, increased susceptibility to predation, or promote disease that may be facilitated by crowding.

Activities associated with constructing the pipeline could decrease individuals' reproductive success by increasing neonate or nest abandonment and possibly by interfering with breeding behaviors, sustenance, and growth of fetuses and/or young, conception rates, and fetal survival. These impacts may affect population growth through diminished rates of survivorship and fecundity.

Both long-term and short-term effects could occur to amphibians and reptiles associated with waterbodies and the riparian areas. Removal of riparian vegetation along stream edges that are crossed by the Project could increase sedimentation input into the waterbody and/or increase water temperatures. Changes in hydrology could also occur in wetlands and waterbodies used for breeding, limiting dispersal or reducing breeding habitat (ODFW 2006b).

Construction of the pipeline through upland forests would require removal of deciduous and coniferous trees and would remove those habitat features over the long-term. It would take decades for trees to grow to their original size in temporary workspaces in cleared forested areas that are restored and revegetated after construction. Former forested habitats in Pacific Connector's 30-foot-wide operational right-of-way would be converted to shrub-sapling dominated or herbaceous cover for an extended period of time (50 years or more). This conversion could benefit some wildlife species that characteristically inhabit shrub or grassland habitats but would be detrimental to wildlife species adapted to forest interiors. Construction through forested areas would also result in the removal of snags and LWD that are used by a variety of wildlife, including cavity nesters and bats.

Construction through existing shrub-dominated areas would mostly result in short-term habitat loss. After restoration and revegetation, grasses and shrubs would be allowed to regenerate across the entire right-of-way. There would be long-term habitat loss in some areas, where shrubs, such as species of sagebrush, would require longer than 5 years to become reestablished. Loss of this habitat type could potentially affect certain species of birds and mammals that utilize shrubs, by reducing forage and nesting opportunities.

Noxious Weeds and Invasive Species

Short- or long-term effects on wildlife habitat would also occur if the pipeline causes the establishment and spread of noxious weeds, as well as other invasive species (animals and microbes) not native to a region. In general, habitats with more bare ground, such as grasslands, riparian areas, relatively dry, open forests, and disturbed areas such as roads are more susceptible to invasive species establishment than are dense, moist forests, high mountain areas, and serpentine areas that have relatively closed plant cover or have extreme climate or soils.

Noxious weeds often out-compete native vegetation. They displace native species by spreading rapidly and utilizing resources (nutrients, water, sunlight) that can eventually lead to a weed-dominated monoculture. Such transformed habitat can be unsuitable to former wildlife inhabitants. Often, as habitat quality degenerates, wildlife diversity declines. For example, purple loosestrife forms dense monocultures that inhibit native vegetation, causing decreasing species' diversity, limit water flows and wildlife access to water, and in some instances can make waterfowl nesting areas unsuitable (Whitson 1996). A summary of noxious weed species found along the pipeline route is provided in table 4.4.1.2-4.

Clearing of vegetation from the linear right-of-way and soil disturbance from right-of-way grading would increase the chance of spreading noxious weeds through the removal of native, established species and soil disturbance, which could encourage the establishment of invasive plants. Equipment moving along the right-of-way could also bring seeds from one place to the next, aiding the spread of these species. Pacific Connector has measures in place to help prevent this as described in the ECRP.[110] Weed surveys would take place prior to vegetation removal, and infested areas would be pretreated through mechanical methods and herbicide spot treatment to minimize the spread of invasive plants. Equipment would also be inspected and cleaned of any

[110] See Appendix I to the POD, which was included in Pacific Connector's application to the FERC.

potential weed seed or propagules (i.e., soil roots or rhizomes). During restoration, disturbed areas would be revegetated with native seed mixtures. Monitoring would typically occur for a period of three to five years (as described in the *Integrated Pest Management Plan* and ECRP) to ensure that no non-native plants establish themselves in lands disturbed by pipeline activities. Due to measures that would be employed before, during, and after construction, the risk of the pipeline causing noxious weeds to spread in the area of the pipeline should be low.

Pacific Connector would mitigate for the spread of noxious weeds, forest pathogens, and soil pests by following the measures outlined in its *Integrated Pest Management Plan*.[111] Further measures for controlling the spread of noxious weeds are contained in its ECRP. See section 4.4.1.2 for more details on invasive plants and mitigation measures.

Invasive insects, mites (e.g., spruce spider mite), and terrestrial mollusks (e.g., the predatory spotted leopard slug) can similarly disperse along a newly created corridor where native vegetation formerly presented barriers to dispersion. In general, invasive exotic wildlife species can adversely affect native species and their populations through various pathways, singly or in combination that include:

- introduction of disease or parasites to native wildlife;
- interbreeding (hybridization) with native wildlife;
- competition for habitat with native wildlife;
- degradation of habitat of native wildlife; and/or
- predation on native wildlife.

The measures outlined in the *Integrated Pest Management Plan* would help decrease the adverse effects of invasive insects.

Invasive animals such as introduced bullfrogs have adversely affected various native frog populations through predation (Hayes and Jennings 1986), including populations of Oregon spotted frogs in Washington (Watson et al. 2000). Bullfrogs prey on and out-compete native frog species. They spread very quickly due to their prolific nature, lack of predators, ability to travel long distances over dry land, and wide habitat and diet preferences. Pacific Connector has developed BMPs to avoid the potential spread of the aquatic invasive species and pathogens of concern during Project hydrostatic testing operations (see the *Hydrostatic Testing Plan*[112]). While bullfrogs are not specifically addressed in the *Hydrostatic Testing Plan*, it is anticipated that the screening/filtering, chlorine treatment, and upland dewatering BMPs would be effective at eliminating the potential spread of bullfrogs and their eggs or tadpoles.

The range of the barred owl has expanded into NSO habitat, and this species competes with NSO for resources and has been known to displace NSO from suitable habitat (Kelley et al. 2003; Kelley and Forsman 2004). Barred owls negatively affect NSO populations, primarily by reducing survival and increasing local territory extinctions (Dugger et al. 2016).

[111] See Appendix N to the POD, which was included in Pacific Connector's application to the FERC.
[112] See Appendix M to the POD, which was included in Pacific Connector's application to the FERC.

Herbicides

Herbicides could affect native plant species, thereby affecting wildlife habitat and potentially the animals themselves. While adverse effects on wildlife tend to be low, some symptoms include breakdown of vital organs, reduction in numbers of healthy offspring, decreased fitness, and direct mortality (Forest Service 2005b). Amphibians can be deformed or killed by some herbicides if these chemicals get into the water. Herbicides tend to form residue on grasses more readily than other vegetation; therefore, wildlife that eats grass, as well as those species above them on the food chain, tend to be most susceptible to the effects of herbicides (Forest Service 2005b).

Pacific Connector would control all ODA A- and T-listed weeds, along with some B-listed weeds (ODA 2017b). To determine if an herbicide is to be used over hand and mechanical weed control methods, Pacific Connector would implement integrated weed management principles following BLM (2010b) and Forest Service (2005c) guidelines (see section 4.4 for more details).

In accordance with Pacific Connector's *Integrated Pest Management Plan*, only specific spots would be treated with herbicides to control noxious weeds. Because agency-approved herbicides are generally of low toxicity to animals when applied per label instructions, adverse effects on wildlife should be low.

Noise

Noise from construction and operation of the Pacific Connector Pipeline Project is discussed in detail in section 4.12.2.2 of this EIS. We estimate that noise from general construction of the pipeline would range from the L_{eq} of about 93 dBA at 50 feet, to 85 dBA at 100 feet, and 72 dBA at 300 feet. Ambient sound levels in much of the Pacific Connector pipeline route area probably would be similar to the Arcata Fish and Wildlife Office's projections (FWS 2006a). Ambient sound is defined as the sound qualities as they might exist currently and might include human-generated sources over the long term. The typical ambient sound level for forest habitats ranges from 25 dB to 44 dB. Considering ambient sound as a base, noise levels associated with some common machines and activities that would be present during pipeline construction are included in table 4.5.1.2-7. Noise from HDD drilling would range from L_{dn}[113] of about 32 to 73 dBA at NSAs, with no noise mitigation. This compares to current ambient L_{dn} levels at these NSAs ranging from about 42 to 66 dBA. Double rotor helicopters may be used for timber clearing along a portion (15.4 miles) of the Pacific Connector pipeline route. This type of helicopter generates noise of about 92 dBA within 700 feet of its area of use. Operation of the Klamath Compressor Station would result in estimated L_{dn} noise of about 51 dBA at an NSA located about 1,230 feet away. Current ambient noise at this residence is an L_{dn} level of about 43 dBA.

TABLE 4.5.1.2-7

Common Sound Levels for Equipment/Activities Potentially Associated with the Pacific Connector Pipeline

Measured Sound Source	Range of Reported dB Values (at Distance Measured 50 feet)	Relative Sound Level a/
Forest Habitats	25 – 44	Ambient
Yelling	70	Low
Chain Saw (various types/conditions)	61 – 93	Low – Very High
Pickup Truck (idle to driving)	55 – 71	Very Low – Moderate
Mowers	68 – 85	Low – High

[113] Appendix B of Pacific Connector's POD filed with the FERC on January 23, 2018.

TABLE 4.5.1.2-7

Common Sound Levels for Equipment/Activities Potentially Associated with the Pacific Connector Pipeline

Measured Sound Source	Range of Reported dB Values (at Distance Measured 50 feet)	Relative Sound Level a/
Log Truck	77 – 97	Moderate - Very High
Dump Truck	84 – 98	High - Very High
Rock Drills	82 – 98	High - Very High
Pumps, Generators, Compressors	87	High
Drill Rig	88	High
General Construction	84 – 96	High – Very High
Track Hoe	91 – 106	Very High – Extreme
Helicopter or Airplane (various types/conditions)	96 – 112	Very High – Extreme
Rock Blast	112 b/	Extreme
Logging Helicopter (Columbia double rotor)	108 – 123	Extreme

Source: FWS 2006a

a/ A general, subjective ranking of noise levels created by the sources considered when used for analysis of relative noise effects on species.
b/ Blasting required for the Pacific Connector pipeline would be underground and muffled, which should result in a lower dB value at 50 feet.

Noise could potentially affect wildlife in localized areas for a short duration during pipeline construction activities, including clearing and grading the right-of-way, and HDD operations. The average time a given point along the pipeline would be disturbed by construction noise is approximately 8 weeks. This would vary, as the speed at which a crew would be able to work would be affected by terrain, construction methods, weather, and environmental windows. HDD operations may occur 24 hours per day, seven days a week. HDD operations are estimated to last from 20 to 100 days depending on the location.

Distances at which noise would attenuate to ambient levels would depend on local conditions such as tree cover and density, topography, weather (humidity), and wind, all of which can alter background noise conditions. Consequently, short-term effects on wildlife by construction noise would vary along the length of the pipeline route.

Noise would most likely displace wildlife some distance away from noise sources especially if wildlife species are nearby. However, any short-term effects on wildlife by noise would occur simultaneously with human presence and the presence of heavy machinery normally required for pipeline construction. Most likely, any effects on wildlife due to noise could not be separated from those due to all other construction-related activities occurring concurrently. Noise and human presence would move along the construction right-of-way, albeit at a rather slow pace. Therefore, effects on wildlife because of noise would be of short duration and spatially localized.

Research has demonstrated varying short-term reactions of wildlife to noise. Most research has focused on wildlife reaction to more constant noise generated by roads and high-volume traffic (e.g., Forman and Alexander 1998). Some research has recorded wildlife reaction to airplanes, sonic booms, helicopters, artillery, and blasting that could produce similar reactions from noises associated with construction activities for the Pacific Connector Pipeline Project. For example, Golden et al. (1980) provided the following behavioral and physiological reactions of animals to known noise levels ranging between 75 and 105 dB from various disturbances, including aircraft:

- fish demonstrate reduced viability, survival, and/or growth (20 dB for 11 to 12 days);
- ungulates become nervous and/or run (82 to 95 dB) or panic (95 to 105 dB);

- waterfowl flock (80 to 85 dB), move and/or become nervous (85 to 95 dB), or startle (95 to 105 dB); and
- birds scare (85 dB).

Raptors and other forest-dwelling bird species have demonstrated more adverse effects on project-generated sound during nesting and breeding when levels substantially exceed ambient conditions existing prior to a project. For instance, the FWS has determined that sound exceeding ambient nesting conditions by 20 to 25 dB or exceeding 90 dB when added to ambient conditions may be considered take under ESA when evaluating effects on NSO and MAMU (FWS 2006a). Such sound levels could potentially result in egg failure or reduced juvenile survival, malnutrition or starvation of the young, or reducing the growth or likelihood of survival of young. However, these effects may be minimal; Awbrey and Bowles (1990) found that raptors flushed from their nests while incubating did not leave the eggs exposed for more than 10 minutes and concluded that multiple, closely spaced disturbances would be required to cause lethal egg exposure. Some raptors, for example osprey, refuse to be flushed from their nest despite closely approaching helicopters (Poole 1989).

Specific studies to determine effects on wildlife from noise generated from construction of a pipeline have not been conducted. However, it is expected that construction noise in remote areas that are relatively free from noise would have a greater potential to disrupt wildlife. Potential effects on wildlife from some noises generated from construction activities can be evaluated to an extent, such as noise from vehicles and/or increased road traffic, blasting, helicopter timber harvest or pipeline delivery, and aerial fly-overs.

Animals could flee the area because of helicopter disturbance. Pacific Connector has filed an *Air, Noise and Fugitive Dust Control Plan*[114] that describes helicopter noise and potential mitigation. In the case of birds, helicopter noise could cause adult birds to flush leaving eggs exposed to weather and predators. For all animals, helicopter disturbance could have negative energetic effects. Mitigation for helicopter noise includes operational restrictions, such as scheduling restrictions near sensitive areas, maintaining a high altitude and flight paths away from noise sensitive areas whenever possible.

The USDOT (2004) has summarized numerous studies and literature that have reported the effects of noise on wildlife, specifically focusing on noise associated with roads. Overall, existing information suggests that fish are unlikely to be adversely affected by noise levels produced from road traffic; reptiles and amphibians show some barrier effect due to roads (but no clear evidence of a noise effect alone); bird numbers and breeding can be strongly affected by the proximity of roads; large mammals can be repelled by road/vehicle noise; and small mammals do not appear to be adversely affected by road noise.

Blasting may be required for pipeline trench excavation in areas where hard, non-rippable bedrock occurs in the trench profile. Approximately 117 miles of the pipeline alignment is considered to have moderate to high blasting potential, although not all substrate in those areas identified may require blasting to achieve the required trench depth. Blasting activities may involve a single blast or a repetitive blasting sequence. Blasting during trench excavation is discussed in more detail in section 4.1.2.5.

[114] Appendix B of Pacific Connector's POD filed with the FERC on January 23, 2018.

Noise from blasting would be short-term and localized. The noise associated with blasting activities is reported to be in the range of 112 dB within 50 feet of the trench (see table 4.5.1.2-7), and may cause alarm in wildlife (e.g., birds, terrestrial mammals, etc.). With the proposed Best Management Practices and mitigation measures applied to trench blasting, the blasting noise would attenuate to 92 dB within 200 feet and 70 dB within 1,025 feet. Mitigation includes blasting methods, which reduce noise through charge placement and timing of detonation, and physical mitigation such as covering the blast areas with soil or blast mats. Pacific Connector has filed a *Blasting Plan* (Appendix C to the POD) and an *Air, Noise and Fugitive Dust Control Plan* (Appendix B to the POD) that further discusses blasting mitigation methods. Noise from blasting would disturb wildlife individuals near blast areas for short periods of time resulting in temporary changes in foraging or breeding behaviors. We conclude that the Project would not significantly affect terrestrial wildlife.

In 2005, a study was conducted during a 4,000-foot-long HDD crossing of the Nooksack River crossing in Whatcom County, Washington, to determine if drilling noise associated with the HDD (noise levels between 47 and 52 dBA at the study area) had a negative effect on wintering bald eagles. Eagles were observed from November 1, 2005, through April 7, 2006, and results indicated that bald eagles were not negatively affected by HDD rig activity (Edge Environmental, Inc. 2006).

Pacific Connector proposes to cross the Coos, Rogue, and Klamath Rivers, Coos Bay at two separate locations, and a BPA powerline corridor using HDD technology. Pacific Connector would cross the South Umpqua River using DP. Noise studies conducted for the HDD and DP of each proposed crossing determined that, with the use of mitigation measures (such as special vinyl fabric acoustic tents or other barriers), noise levels at the seven crossings are not expected to exceed the Oregon State noise regulations of 55 dBA during the day and 50 dBA at night within 25 feet of an NSA. To ensure adequate mitigation and monitoring, we are recommending Pacific Connector file HDD noise mitigation plans for review and approval prior to construction (see section 4.12.2.4). Noise effects on wildlife from the operation of the drilling equipment from the HDD crossings at Coos, South Umpqua, Rogue, and Klamath Rivers should be negligible.

A minimal increase in ambient noise levels would occur during periodic right-of-way vegetation maintenance activities (i.e., mowing, chainsaws) during operation. The major source of operational noise for the Project would be from the Klamath Compressor Station, which is located in an area surrounded by rural residences, agricultural lands, and rangelands and grasslands. Noise from the compressor station would be long-term but localized to one site. The expected increase in L_{dn} noise levels would range from 0.5 dBA to 7.2 dBA above current ambient noise at the nearby NSAs during normal station operations. In terms of environmental noise effects, an increase to the ambient sound level of 10 dBA typically results in the perception of a doubling of sound. Consequently, the Klamath Compressor Station would have noise effects on the surrounding NSAs because of the very quiet existing ambient conditions. With appropriate mitigation measures, we expect the compressor station to operate below our standard of 55 dBA for all NSAs. This sound level could have localized adverse effects on wildlife near the station.

Habitat Fragmentation and Edge

One manifestation of fragmentation is the amount of edge created through otherwise contiguous habitats. In the context of habitat fragmentation, edge is the portion of habitat (or ecosystem on a larger scale) "near its perimeter, where influences of the surroundings prevent development of interior environmental conditions" (Forman 1995). As compared to interior habitats, edge habitats generally support different species composition, structure, and species' abundance. For example, vertebrate species richness (bird and amphibian) has been positively associated with edges in fragmented Douglas-fir forests (Rosenberg and Raphael 1986), although species benefitted are typically habitat generalists. Edge habitat would no longer favors species that are dependent on forest interior conditions, allowing species that utilize the edge habitat to disperse into the forest interior which can have adverse effects on wildlife and plants through competition for resources, increased predations, spread of disease and insect infestation, and establishment of noxious weeds (Bannerman 1998).

Along with the creation of edge, pipeline construction would further fragment habitat. Habitat fragmentation has already occurred to some extent in the areas crossed by the pipeline route because of existing residential developments, tree harvests, roads, and utility corridors. These sources of habitat fragmentation are expected to increase in the foreseeable future outside of protected areas such as LSRs). Fragmentation can also affect the rate and scope of blowdowns in forested habitats (the effects of blowdowns are discussed in section 4.4).

Because the pipeline is linear, the created patch associated with the new edge would be narrow and elongated unlike edges created by forest practices (Forman and Gordon 1986). Creation of edges by the Project would affect seral stands differently. Douglas-fir or western hemlock would be replanted during restoration of temporary work areas, including TEWAs, in the pipeline right-of-way (except in the 30-foot-wide maintenance corridor centered on the pipe), where conifers would be removed during construction activities. It is anticipated that both temporary and permanently cleared areas in forest habitats would increase the occurrence of windthrow (snapping of branches and uprooting, snapping of boles), which could result in greater effects on forest habitat than just those areas identified for disturbance.

Douglas-fir and western hemlock planted adjacent to edges of clearcut and/or early regenerating stands (assuming conifers from 1 to 10 feet tall at the time of construction) would modify edges with the seral stands from hard to soft to no edge as they grow. In 50 years, which is the operational life of the Project, trees replanted in temporary workspaces outside of the 30-foot-wide maintenance corridor would similarly modify edges of regenerating and mid-seral stands adjacent to the right-of-way, from hard to soft edge characteristics as tree heights increase. As the replanted trees grow, edge contrasts would decrease, as would the effects on forest interiors, because taller trees would reduce direct solar radiation and increase soil moisture and humidity along the edges of stand interiors (Chen et al. 1993; Heithecker and Halpern 2007). During operations, Pacific Connector would use mechanical vegetation management methods or, where access of machinery is infeasible, manual clearing to maintain the existing right-of-way; this vegetation management would increase the edge effect beyond the maintained right-of-way (e.g., light and wind would be able to penetrate farther into previously "interior" forests).

Different species composition and abundance occurs in edge habitats (Forman and Gordon 1986) than in patch interiors, depending on species' tolerances for the variation in microclimatic parameters. Some terrestrial amphibians, for example, have narrow temperature and moisture tolerances (Spotila 1972; Feder 1983). Moist, cool, and stable microclimatic conditions are essential to these species. Loss of canopy cover and coarse wood can affect amphibians' microclimatic conditions. Some wildlife species use right-of-way corridors created by pipelines and other linear utilities. For example, bird species' diversity in powerline corridors through forested vegetation was found to be higher in the corridor than in the adjacent forest (Kroodsma 1984). Often present along the edge are higher levels of flower and fruit production, pollinator, and frugivore densities and seed dispersal. Also, deer and elk use of available browse in corridors or on edges of corridors that are adjacent to hiding and thermal cover have been documented (Hartley et al. 1984; Brusnyk and Westworth 1985). Increased herbivore density in edge habitat provides a food source for predators (Forman 1995); therefore, predator density is expected to increase along the edge.

Few studies have evaluated the establishment of forage in pipeline corridors and utilization by big game. The study conducted in Alberta by Brusnyk and Westworth (1985) focused on forage and browse production on a 17-year-old pipeline right-of-way and on a 2-year-old right-of-way. They compared big game use (moose, deer, and elk) of forage on the two rights-of-way to use in adjacent undisturbed forest ecotones and undisturbed forest. Deer appeared to utilize browse in the 17-year-old corridor but returned to adjacent undisturbed forest, probably utilizing available hiding or thermal cover. Deer utilized the corridors for travel in early winter prior to limiting snow depths. Elk utilized forage on the two-year-old right-of-way primarily where portions were adjacent to forested habitats. The principal conclusion of this study was that pipeline corridors increased local habitat diversity and that diversity—juxtapositions of browse or forage to undisturbed forested habitat—influenced use of the corridors by ungulates. Similarly, studies in Washington and Oregon have shown that elk prefer habitat that is close to cover-forage edges (Rowland et al. 2018).

During right-of-way restoration, Pacific Connector would create habitat diversity features in the right-of-way corridor, such as rock and brush piles, that would provide habitat for a variety of wildlife species including mollusks, amphibians, and small mammals. Such features reduce fragmentation effects of abrupt edge characteristics by creating local irregularities. LWD placed in and/or across the right-of-way may eventually contribute to microsite diversification and provide corridors for some wildlife (e.g., terrestrial mollusks) to travel across an otherwise potential barrier. Such movements would be essential to avoid potential genetic isolation of relatively non-mobile species.

Effects on Mammals

Effects discussed for "General Effects Applicable to All Terrestrial Wildlife" would be relevant to mammals. Because it will not be known where mammals are specifically located, effects can be quantified by acres of disturbance in habitats in which they could occur (see table 4.5.1.2-1). The Project would be cutting a narrow swath out of larger areas of potentially suitable habitat. Because of the low percentage of all available habitat in the area being affected, the Project is not expected to have population-level effects on mammals.

The Pacific Connector Project is not expected to affect the Pokegama wild horse herd, as the Project would not cross through or affect the HMA.

Timber clearing in winter and early spring would coincide with the bat hibernation period. Bats utilizing trees for hibernation would be killed by timber clearing. Timber clearing in spring and early summer would coincide with natal or maternity periods but would not occur between April 1 and July 15 in order to avoid the migratory bird nesting season. Females and young inhabiting roosts in tree cavities would likely be killed if occupied roost trees and/or snags were felled. Likewise, bats utilizing day roosts under loose bark or in snags with cavities could be killed by timber clearing at any time of the year. Young bats would likely be killed if roost trees were felled before they were able to fly. Most bat species, especially Townsend's big-eared bat, are sensitive to disturbance and would abandon disturbed roosts (Csuti et al. 2001; Verts and Carraway 1998; ODFW 2013a). This disturbance and subsequent abandonment would have energetic repercussions, potentially decreasing successful reproduction and survival.

Noise from traffic and other sources is believed to interfere with bats' echolocation (Jones 2008). We estimate that noise from general construction of the pipeline would be about 72 dBA at 300 feet. construction-related traffic and other pipeline construction noise would be limited to daylight hours, except for HDDs, and would mostly avoid periods when bats use echolocation to forage. Consequently, pipeline construction noise would not significantly affect bats. Pipeline construction noise is discussed in more detail in section 4.12.2.2.

Night lighting could act as barriers to bat movements (Kuijper et al. 2008), reduce bat activity in the immediate vicinity (Stone et al. 2009), or have an opposite effect by attracting nocturnal insects (Svensson and Rydell 1998; Rydell and Racey 1993). The Klamath Compressor Station would be equipped with outside lighting to support night work activities. During normal operations, nighttime work or maintenance activities would generally not be scheduled; therefore, these lights would only be used periodically and possibly for short periods during the winter when daylight hours are short.

Pacific Connector would operate 15 new communication towers ranging in height from 40 to 170 feet tall (table 2.1.2.2-2). Of the 15 new towers, 7 would be associated with new project features and Pacific Connector would attempt to co-locate the other 8 towers with existing facilities. It is possible that bats would fly into the communication towers. Placement of 8 towers within existing facility sites is not expected to affect habitat or wildlife more than has already been affected with the original construction and operation of these facilities. New towers would not significantly affect bats, as these towers would not have guy wires or lighting, which would decrease the possibility of collisions but would not entirely eliminate that risk.

Because it will not be known where bat roosts are specifically located, effects on bats are assumed to occur in forested habitat types. Timber clearing is expected to injure or cause mortality to an unknown number of individual bats. Because white-nose syndrome is not known to affect bats in Oregon, the Pacific Connector pipeline is not expected to facilitate spread of this disease. Considering the amount of available forested habitat adjacent to the pipeline, and the dispersed nature in which tree-roosting bats typically roost in the west, construction and operation of the Pacific Connector pipeline would not be expected to significantly effect these bat species.

Effects on Birds

Effects on migratory bird occupied nests, eggs, pre-fledgling young, and potentially adults would be minimized by Pacific Connector's commitment to various seasonal restrictions during construction. Tree felling and brush removal during construction would be conducted outside of the primary migratory bird nesting season, which is April 1 through July 15. The primary migratory bird nesting season is based on data from Adamus et al. (2001) and determined in consultation with FWS as described in the draft *Migratory Bird Conservation Plan*. In addition, tree felling within 0.25 mile of an NSO activity center would occur after September 30 and before March 1, and tree felling within 330 feet of MAMU stands would occur after September 15 but before April 1. Routine vegetation clearing during operations would only be done between August

1 and April 15 of any year, to reduce effects on nesting birds during the primary spring and summer breeding season. Additional restrictions for other migratory birds are listed in the draft *Migratory Bird Conservation Plan* filed with the FERC on August 31, 2018. While these timing restrictions would minimize effects on migratory birds, some mortality could occur outside of the primary nesting season.

If a species' breeding period begins or ends outside of the primary breeding season, the active nest, eggs, or unfledged juvenile birds would be at risk. Numbers of migratory birds, nests, and eggs that might be affected during vegetation clearing and/or construction on spreads 1 through 5 are estimated and summarized in table I-13 in appendix I. Construction spreads 1, 2, and 3 are in BCR 5; spread 4 is mostly in BCR 5 with about 1.5 miles in BCR 9; and spread 5 is in BCR 9.

To estimate the amount of birds and eggs affected, Pacific Connector compiled data for 33 BBS routes within 50 miles of the pipeline. Numbers of birds for species observed each year on a route were divided by the length of the BBS route (birds per mile), averaged each year for routes reporting the species, and averaged for the 20-year period 1997 to 2016. For each species that had a close or general association with habitats affected by the pipeline, the average number of birds per mile was multiplied by miles of habitat affected in each construction spread 1 through 5 (miles of habitat affected are included in table I-13 in appendix I).

Edge habitat created by the pipeline right-of-way is expected to have both positive and negative effects on bird species. Expected positive effects are increased diversity and density of bird species, increased access to a variety of food resources, and increased ground cover favoring ground-nesting species (Rosenberg and Raphael 1986). Potential negative effects include increased brood parasitism, increased nest depredation in grasslands, forests and edge habitats, and lower nesting success (Thomas and Towiell 1982; Burger et al. 1994; Vickery et al. 1994; Marini et al. 1995; Danielson et al. 1997; Brand and George 2000). There have been declines of sagebrush-dependent migratory passerine bird species with loss of sagebrush steppe vegetation and increased fragmentation in remaining sagebrush-dominated habitats (Knick and Rotenberry 1995; Knick et al. 2003). Densities of Brewer's sparrow and sagebrush sparrow, as well as other species dependent on sagebrush for nesting habitat, were greatly reduced near well-field roads and pipelines compared to densities beyond 300 feet (Ingelfinger 2001). Nest parasitism by brown-headed cowbirds is especially likely in fragmented shrub-dominated habitats (Vander Haegen and Walker 1998). Such effects would be facilitated over the long term because maintenance of the 30-foot permanent easement would create areas of early-seral habitat throughout the operational life of the project. These corridor areas would not only provide habitat used by some wildlife species, but would also connect patches of suitable habitat, allowing wildlife to move between one patch and another (Turner et al. 2001).

Corvids, including common ravens and American crows (also jays and magpies), are opportunistic predators and will prey on other species' nests (Marzluff and Neatherlin 2006; Vander Haegen et al. 2002; Luginbuhl et al. 2001). Studies have shown that corvid populations expand and nest predation increases near human developments (Marzluff and Neatherlin 2006) and corvid predation increases in habitats that have been fragmented by humans (Vander Haegen et al. 2002). Potential effects on nesting birds by predatory corvids attracted to the right-of-way would be addressed by ensuring that all construction contractors practice appropriate and responsible trash disposal every day.

Pacific Connector would apply spatial and temporal buffers to known NSO, golden eagle, peregrine falcon, and great gray owl nesting habitat. Pacific Connector would also perform eagle and buteo hawk nest surveys prior to construction or timber clearing, and any occupied nests would be subject to spatial and temporal buffers appropriate for the species. FWS has drafted *Guidelines for Raptor Conservation in the Western United States* (Whittington and Allen 2008). The draft guidelines recommend spatial buffers for nests of breeding raptors during the breeding periods, which vary by location across the western states. Table 4.5.1.2-8 lists the raptor species that have been reported along the Pacific Connector Pipeline Project route by various sources and the recommended spatial buffers during nesting periods (not included in the table). Human disturbances in spatial buffers risk nest abandonment by adults and nest failure (Whittington and Allen 2008). As previously described for migratory birds, timber clearing and project construction during the breeding period would affect raptor nests, eggs, young, and adults; many effects would be avoided or minimized through vegetation clearing timing restrictions during the breeding season, raptor nest surveys, and other conservation measures provided in the draft *Migratory Bird Conservation Plan*.

TABLE 4.5.1.2-8

FWS Recommended Spatial Buffers Surrounding Raptor Nests of Species that May Occur in the Vicinity of the Pacific Connector Pipeline

Common Name	Scientific Name	Spatial Buffer (miles) c/
Hawks, Eagles, Falcons		
Osprey	*Pandion haliaetus*	0.25
Bald Eagle a/	*Haliaeetus leucocephalus*	0.5–1.0 (0.25)
Northern Harrier b/	*Circus cyaneus*	0.25
Sharp-shinned Hawk	*Accipiter striatus*	0.25
Cooper's Hawk	*Accipiter cooperii*	0.25
Northern Goshawk	*Accipiter gentilis*	0.50
Red-shouldered Hawk	*Buteo lineatus*	0.25
Red-tailed Hawk	*Buteo jamaicensis*	0.33
Ferruginous Hawk b/	*Buteo regalis*	1.00
Golden Eagle	*Aquila chrysaetos*	0.50 (0.50)
American Kestrel b/	*Falco sparvarius*	0.125
Peregrine Falcon	*Falco peregrinus*	1.00 (1.50)
Owls		
Western Screech Owl	*Megascops kennicottii*	0.125
Great Horned Owl	*Bubo virginianus*	0.125
Northern Pygmy Owl	*Glaucidium gnoma*	0.25
Burrowing Owl b/	*Athene cunicularia*	0.25

TABLE 4.5.1.2-8

FWS Recommended Spatial Buffers Surrounding Raptor Nests of Species that May Occur in the Vicinity of the Pacific Connector Pipeline

Common Name	Scientific Name	Spatial Buffer (miles) c/
Northern Spotted Owl	*Strix occidentalis caurina*	0.50 (0.25)
Barred Owl	*Strix varia*	0.25
Great Gray Owl	*Strix nebulosa*	0.25 (0.25)
Short-eared Owl b/	*Asio flammeus*	0.25
Northern Saw-whet Owl	*Aegolius acadicus*	0.125

Source: Whittington and Allen (2008)
Note: Includes special status species that are otherwise addressed in section 4.6.
a/ Spatial buffer dependent on line-of-sight to nest.
b/ Species added to table based on occurrence on BBS routes.
c/ Spatial buffers committed to in the Draft Migratory Bird Conservation Plan are in parenthesis. Note that the National Bald Eagle Management Guidelines (FWS 2007b) recommend a 660-foot (200-meter) buffer surrounding nests during the breeding season applied to timber harvest, road construction, chain saw, and yarding operations (assumed similar to timber clearing & pipeline construction).

Pacific Connector would use eight existing communication towers and construct seven new towers (see table 2.1.2.2-2). Communications towers are estimated to kill millions of birds each year, with mortality near guyed towers greater than self-supporting towers (FCC 2006). Also, the majority of bird-tower collisions are reported from towers over 500 feet tall (Gehring 2004). Most bird-tower collisions occur at night, generally during conditions with low visibility, and during the day under foggy conditions. Bird-tower collisions may also increase with lighting on the towers. Research indicates that white strobe lights on towers may create less of a hazard to migratory birds, although these types of lights are not allowed within three nautical miles of an airport (FCC 2006). Additionally, some research has indicated that marking guy-wires to make them more visible may reduce avian mortality (FCC 2006).

Use of eight currently existing towers is not expected to affect habitat or wildlife more than has already been affected with the original construction and operation of these facilities. New towers would not have guy wires or lighting and are either 40 or 170 feet tall, which would decrease the possibility of bird collisions but would not eliminate that risk entirely. Some additional mortality could occur from collision with towers but, given the relatively low height and the fact that towers do not have lighting or guy wires, additional mortality is expected to be minimal.

As described above, the Pacific Connector Project would affect migratory bird nests, eggs, young, and adults from tree clearing occurring outside of the primary migratory bird nesting season. Where vegetation clearing cannot be avoided during the breeding season, Pacific Connector would have qualified biologists perform pre-construction surveys of the area to be disturbed, plus a 20-foot buffer adjacent to areas affected. If nests are encountered, Pacific Connector would work with the FWS to avoid nests as feasible. The FWS would require a special use permit if an active nest is encountered that would need to be removed, relocated, or transferred to a rehabilitation center.

Laws and regulations regarding the treatment of migratory birds, including the MBTA and EO 13186, are described above (see section 1.5.1.10). In accordance with the March 2011 MOU between the FERC and the FWS to implement the policies of EO 13186, a draft *Migratory Bird Conservation Plan* was filed with the FERC on August 31, 2018. The draft *Migratory Bird Conservation Plan* identifies avoidance and minimization strategies, as well as habitat restoration.

With incorporation of the draft and anticipated final *Migratory Bird Conservation Plan,* we conclude that the Project would not significantly affect migratory bird species.

Effects on Game Animals

Numerous studies have shown that both Rocky Mountain and Roosevelt elk are sensitive to human disturbances such as motorized travel on and off roads (Rowland et al. 2000). Roads are generally avoided by elk when they are open but are heavily utilized by elk as travel corridors when closed. During construction of the Pacific Connector pipeline, there would be short-term, localized effects on hunter success rates in the affected hunt units. When construction in a particular hunt unit coincides with hunting seasons, hunter utilization and success in the immediate vicinity would probably be adversely affected for the duration of construction in that area. However, hunter success rates for any species in each affected hunt unit are relatively low despite seemingly extensive hunter efforts (ODFW 2014a).

Where the Pacific Connector pipeline crosses existing roads, the newly created corridor would be potentially accessible from each road and probably more so at points crossed where access roads are adjacent to previously dense and/or forested habitats. The Project would require construction of 15 PARs. Increased hunter success as a result of those access points is likely but any changes in success cannot be predicted or estimated because so little area (the pipeline corridor) in any given hunt unit would be subject to increased hunter access.

After construction, there could potentially be a secondary effect (Comer 1982) on harvest rates because of increased access by hunters using the pipeline right-of-way to access remote areas. Increased public recreation along cleared rights-of-way in the fall hunting season, especially near crossings of existing access points, has been documented elsewhere (Crabtree 1984). Increased public access because of the cleared pipeline right-of-way could increase poaching of game animals and non-game wildlife on a local level. Enforcement of wildlife regulations is the responsibility of the Oregon State Police, Fish and Wildlife Division.

In big game winter management areas in Douglas, Jackson, and Klamath Counties, mature and regenerating forest would be converted to an herbaceous/shrub vegetative cover for the long term, increasing the amount of forage available to big game adjacent to forested stands potentially used for thermal cover (table 4.5.1.2-9). Forested areas would be the most commonly affected, followed by grasslands/shrublands. Temporary disturbance areas that are forested, regenerating, or recently clear-cut stands removed during construction on big game winter range would be replanted with trees after construction of the pipeline, eventually providing similar habitat to that present prior to construction.

TABLE 4.5.1.2-9

Acres of Habitat Types Affected in Big Game Winter Ranges by Construction and Operation of the Pacific Connector Pipeline by Landowner

			Acres of Habitat Affected in Winter Range					
Project Component	**County**	**Landowner**	**Forest – Woodland**	**Regenerating or Clear-cut Forest**	**Grasslands/ Shrublands**	**Wetland/ Riparian**	**Other Terrestrial Habitat a/**	**Total Habitat**
Pacific Connector Pipeline and Facility Construction	Douglas	Umpqua National Forest	9	<1	0	0	<1	9
	Jackson	Medford BLM	116	26	67	<1	5	214
		Rogue River National Forest	12	6	2	0	<1	20
		Private / State Forest	119	64	138	11	13	343
		Jackson County Total	*247*	*95*	*207*	*11*	*18*	*577*
	Klamath	Lakeview BLM	3	0	<1	0	0	4
		Private/Other	43	26	149	<1	30	248
		Klamath County Total	*46*	*26*	*150*	*<1*	*30*	*252*
	Total Pipeline and Facility Construction		**301**	**122**	**357**	**11**	**48**	**838**
Pacific Connector Operation/ Maintenance 30-foot Corridor b/	Douglas	Umpqua National Forest	2	0	0	0	<1	2
	Jackson	Medford BLM	28	6	15	<1	<1	49
		Rogue River National Forest	4	1	<1	0	<1	5
		Private / State Forest	29	15	31	2	2	80
		Jackson County Total	*60*	*22*	*46*	*2*	*3*	*134*
	Klamath	Lakeview BLM	<1	0	<1	0	0	1
		Private/Other	11	8	40	<1	6	65
		Klamath County Total	*12*	*8*	*41*	*<1*	*6*	*66*
	Total Operation/Maintenance Corridor		**74**	**30**	**87**	**2**	**9**	**203**
Revegetation Outside 30-foot Maintenance Corridor c/	Douglas	Umpqua National Forest	6	<1	0	0	<1	7
	Jackson	Medford BLM	89	20	52	<1	4	165
		Rogue River National Forest	8	4	2	0	<1	15
		Private / State Forest	89	48	107	8	10	261
		Jackson County Total	*186*	*73*	*161*	*8*	*15*	*443*
	Klamath	Lakeview BLM	2	0	<1	0	0	3
		Private/Other	32	19	109	<1	24	183
		Klamath County Total	*34*	*19*	*109*	*<1*	*24*	*186*
	Total Revegetation Outside Operation/ Maintenance Corridor		**227**	**92**	**270**	**8**	**39**	**636**

Note: Rows/columns may not sum correctly due to rounding. Acres rounded to nearest whole acre. Acreages less than 1 are shown as “<1”.

a/ Other terrestrial habitat includes agriculture, developed, and barren. Restoration efforts will allow habitat type to be converted back to original state.

b/ Upland 30-foot Operation/Maintenance Right-of-Way will be maintained in an herbaceous/shrub state less than 6 feet in height. Riparian 30-foot Operation/Maintenance Right-of-Way will be maintained in an herbaceous/shrub state within a 10-foot corridor centered over the pipeline and the additional 10 feet either side of the pipeline will be maintained in an herbaceous/shrub/tree state less than 15 feet in height (see Typical Drawings 3430.34-X-0015, 3430.34-X-0016 and 3430.34-X-0017 in Appendix 1B to Resource Report 1).

c/ Habitat Revegetation: trees planted in forested habitats, including regenerating and clear-cut forest; grasses and shrubs planted in non-forested habitat and 30-foot maintenance corridor (except riparian areas). On private lands, revegetation will occur in consultation with the landowners.

Sources: BLM Deer and Winter Management Areas, Forest Service Deer Winter Range, ODFW 2007 GIS data delineated from County planning maps, ODFW (2012c) Elk Winter Range for Eastern Oregon.

In addition, big game are expected to be displaced from habitats adjacent to construction-related disturbance. In general, deer and elk return to habitats from which they have vacated in some relatively short period of time, which would likely depend on the time of year, available hiding cover, and duration of local disturbances. Following reclamation of the pipeline corridor, big game may utilize the corridor for travel and for foraging, depending on vegetation species planted and rapidity of successful revegetation.

Construction of the Pacific Connector pipeline may coincide with big game calving and fawning times, generally in late spring (May to early June). Calving and/or fawning areas may be close to winter ranges or may be at higher elevations than winter range. During active construction, big game would most likely avoid construction areas and may be adversely affected in one or more ways, including increased energy expense if they escape from disturbances or are displaced to areas of deeper snow accumulation, use of suboptimal habitats that do not provide adequate functions (food, shelter, escape cover), and use of habitats that increase the risk of predation. The expected consequences of these responses would be decreased over-winter survival and decreased calving/fawning success (for example, see Bradshaw et al. 1998).

The BLM, Forest Service, and ODFW recommend the application of seasonal construction restrictions on big-game winter range. Pacific Connector would apply the following ODFW, BLM, and Forest Service recommended seasonal closures for big game winter range (with the exception of big game winter range located in Klamath Basin, where a waiver would be obtained): November 1 to April 15 (BLM - Medford), December 1 to April 30 (Forest Service), and non-federal lands from December 1 to March 31 (private and state). Timber felling and construction activities may occur in ODFW, BLM, and/or Forest Service big game winter ranges in Douglas (Umpqua National Forest), Jackson, and Klamath counties to minimize or avoid effects on migratory birds, NSO, and MAMU.

The ODFW expressed concern that open trenches during construction of the Pacific Connector pipeline could entrap deer and elk. To minimize the potential effect of open trenches on big game in delineated big-game winter and summer range, Pacific Connector would leave breaks at least 5 feet wide at approximately 0.5-mile intervals, and at visible wildlife trails, to serve as routes for big game to cross the construction right-of-way until pipe is ready to be installed (Forman et al. 2003). Alternatively, Pacific Connector would install soft plugs (backfilled trench materials) in the trench after excavation at these distances to provide wildlife passage. Additionally, 20-foot-wide gaps would be left in spoil and topsoil stockpiles at all hard or soft plug locations, and a corresponding gap in the welded pipe string would be left in these locations. Suitable ramps would also be installed from the bottom of the trench to the top to allow any wildlife that enters the trench to escape.

Pacific Connector would install barriers at locations along its pipeline route to discourage unauthorized public access to the right-of-way. These barriers may include boulders, dirt berms, log barriers, signs, and locked gates. Slash from clearing operations would be redistributed on the right-of-way, to improve habitat and to make OHV travel difficult. These barriers should minimize OHV access to the right-of-way and reduce unauthorized hunting or poaching of game animals (see section 4.10.2.5 of this EIS for a further discussion about OHV traffic).

Effects on Amphibians and Reptiles

Effects discussed above under General Effects Applicable to All Terrestrial Wildlife would be relevant to amphibians and reptiles. Because it will not be known where amphibians and reptiles are specifically located, effects are assumed to occur in Wetlands/Eastside Riparian-Wetlands, Developed, Urban, and Mixed Environments, and Mixed Conifer-Hardwood Forest. Some threats to amphibians in habitats crossed by the Project include loss of habitat and its connectivity, changes in hydrology and water quality, predation, and competition with invasive species (ODFW 2006b; Oregon Conservation Strategy 2016). The primary threats to reptiles are habitat loss and fragmentation, predation, and competition with nonnative invasive species, such as turtles, fish, and bullfrogs (ODFW 2006b; Oregon Conservation Strategy 2016). The Pacific Connector Pipeline Project would be cutting a narrow swath out of larger areas of potentially suitable habitat. Because of the low percentage of all available habitat in the area being affected, we conclude that the Project would not significantly affect these species.

Effects on Invertebrates

Effects discussed above under General Effects Applicable to All Terrestrial Wildlife would be relevant to invertebrates. Invertebrates are assumed present in all habitat types crossed by the Pacific Connector Project. Because of the low percentage of all available habitat in the area being affected, we have determined that the Project would not significantly affect these species. Of specific concern to invertebrate pollinators is the use of chemical herbicides to control noxious weeds and other invasive plant species that can often colonize areas disturbed by construction activities. Implementation of Pacific Connector's *Integrated Pest Management Plan*[115] would reduce the likelihood of establishment and spread of noxious weeds from construction activities. Control of noxious weeds helps to preserve native plants that pollinators require for survival; however, some chemicals used to control noxious weeds have been shown to have a detrimental effect on pollinators when used within typical to maximum application rates, such as 2,4-D, glyphosate, and triclopyr (Forest Service 2005b). These three herbicides are included in the Pacific Connector's *Integrated Pest Management Plan* and would likely have adverse effects on pollinators when applied in the immediate vicinity of project disturbances.

4.5.1.3 Environmental Consequences on Federal Lands

Wildlife species present on federal lands crossed by the Pacific Connector pipeline would be similar to those discussed for all land ownerships above in section 4.5.1.2, including mammals, birds, amphibians, reptiles, and invertebrates. Wildlife on federal lands is managed under a variety of directives. Species managed on federal lands include NWFP Survey and Manage species, BLM and Forest Service sensitive species, and federally threatened, endangered, and proposed species. The presence of these species on federal lands and potential effects on these species are discussed in section 4.6.

The Forest Service additionally identifies MIS, which include wildlife monitored during forest plan implementation to assess the effects of management activities on their populations and the populations of other species with similar habitat needs which they may represent (Forest Service Manual [FSM] 2620.5). On the Umpqua National Forest, MIS include NSO, pileated woodpecker, primary cavity excavators (nesters), American marten, Roosevelt elk, Columbian black-tailed deer,

[115] See Appendix N to the POD, which was included in Pacific Connector's application to the FERC.

peregrine falcon, bald eagle, and steelhead (water quality indicator). On the Rogue River National Forest, MIS species include Columbian black-tailed deer, Roosevelt elk, American marten, NSO, pileated woodpecker, and primary cavity excavators (nesters). On the Winema National Forest, MIS include NSO, pileated woodpecker, northern goshawk, three-toed woodpecker or black-backed woodpecker, bald eagle, mule deer, resident trout, and American marten. Potential effects of the pipeline on MIS, and by association wildlife with similar habitat needs, are assessed in the MIS Report (appendix F.6 of this EIS). Additionally, effects on some of these species (Roosevelt elk, Columbian black-tailed deer, peregrine falcons, northern goshawks, mule deer, and bald eagles), including effects on federal lands, are discussed above in section 4.5.1.2.

Federal lands crossed by the pipeline contain 16 of the 17 wildlife habitats affected by the pipeline across all ownership; only the wildlife habitat "Bays and Estuaries" is not affected on federal lands. Wildlife species' associations with these habitats provide a basis for evaluating potential effects on wildlife. The acreage of each wildlife habitat that would be affected on federal land during pipeline construction, and the number of species of herpetofauna (i.e., amphibians and reptiles), birds, and mammals associated with those habitats are shown below in table 4.5.1.3-1. Agriculture and Westside Riparian-Wetlands/Eastside Riparian-Wetlands have the highest number of associated species (290 and 270, respectively), but have very few acres affected. Of all the forest habitats, Southwest Oregon Mixed Conifer-Hardwood Forest would be the most affected by the pipeline (most acres of disturbance) as well as being the forest habitat that supports the greatest number of wildlife species (226 species associated).

TABLE 4.5.1.3-1

Acres of Construction-Related Disturbance to Wildlife Habitat Types by the Pacific Connector Pipeline on Federal Land, and Wildlife Species Associated with Johnson and O'Neil (2001) Habitats

General Habitat Type	Mapped Habitat Type	Late Successional or Old-Growth Forest Crossed a/e/ (acres)	Mid-Seral Forest Crossed b/e/ (acres)	Clearcut/ Regenerating Forest Crossed c/e/ (acres)	Total Acres	Number of Species Associated d/
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	173	123	137	433	32 – Herpetofauna 115 – Birds 66 – Mammals
	Montane Mixed Conifer Forest	22	14	67	103	21 – Herpetofauna 94 – Birds 60 – Mammals
	Southwest Oregon Mixed Conifer-Hardwood Forest	374	118	127	619	36 – Herpetofauna 126 – Birds 64 – Mammals
	Ponderosa Pine Forest and Woodlands	58	1	23	81	31 – Herpetofauna 126 – Birds 64 – Mammals
	Westside Oak and Dry Douglas-fir Forest and Woodlands	31	<1	0	31	32 - Herpetofauna 115 – Birds 62 – Mammals
	Western Juniper and Mountain Mahogany Woodlands	0	3	0	3	19 - Herpetofauna 93 – Birds 35 – Mammals
	Subtotal	**658**	**259**	**354**	**1,271**	

TABLE 4.5.1.3-1 (continued)

Acres of Construction-Related Disturbance to Wildlife Habitat Types by the Pacific Connector Pipeline on Federal Land, and Wildlife Species Associated with Johnson and O'Neil (2001) Habitats

General Habitat Type	Mapped Habitat Type	Late Successional or Old-Growth Forest Crossed a/e/ (acres)	Mid-Seral Forest Crossed b/e/ (acres)	Clearcut/ Regenerating Forest Crossed c/e/ (acres)	Total Acres	Number of Species Associated d/
Grasslands Shrubland	Shrub-steppe	–	–	–	68	23 – Herpetofauna 76 – Birds 47 – Mammals
	Westside Grasslands	–	–	–	17	26 – Herpetofauna 82 – Birds 37 – Mammals
	Eastside Grasslands	–	–	–	2	20 – Herpetofauna 80 – Birds 46 - Mammals
	Subtotal	–	–	–	**87**	–
Wetland/ Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	–	–	–	<1	38 – Herpetofauna 155 – Birds 77 – Mammals
	Herbaceous Wetlands	–	–	–	<1	18 – Herpetofauna 134 – Birds 44 – Mammals
	Subtotal	–	–	–	**<1**	
Agriculture	Agriculture, Pastures, and Mixed Environs	–	–	–	1	32 – Herpetofauna 181 – Birds 77 – Mammals
	Subtotal	–	–	–	**1**	
Developed/ Altered	Urban and Mixed Environs	–	–	–	28	37 – Herpetofauna 133 – Birds 64 – Mammals
	Roads	–	–	–	93	N/A
	Subtotal	–	–	–	**121**	
Barren	Coastal Dunes and Beaches	–	–	–	2	6 – Herpetofauna 100 – Birds 26 – Mammals
	Subtotal	–	–	–	**2**	
Open Water	Open Water - Lakes, Rivers, and Streams	–	–	–	1	17 – Herpetofauna 95 – Birds 20 – Mammals
	Subtotal	–	–	–	**1**	
	Project Total	**658**	**259**	**354**	**1,484**	

Note: Rows and columns may not sum correctly due to rounding. Acreages rounded to nearest whole acre; values less than 1 acre shown as "<1".

a/ Late Successional (80 to 175 years) and Old-Growth Forest (175 + years).

b/ Mid-Seral Forest (40 to 80 years).

c/ Clearcut (0 to 5 years) and Regenerating Forest (5 to 40 years).

d/ Numbers of species associated with each habitat type crossed by the Pacific Connector pipeline were summarized from Pacific Connector's Environmental Resource Report 3, Appendix 3D, Table 3D-1.

e/ Cells with no data result from the fact that non-forested habitat types did not identify seral stage, thus acres are identified only in the "total acres" column.

Effects on wildlife would be similar on federal lands to those discussed for all land ownerships above in section 4.5.1.2, including direct mortality to individuals unable to move away from construction equipment, noise and visual disturbance during construction, and habitat loss and modification. Less mobile wildlife species that are not able to move away from construction activities during clearing and site preparation could experience direct mortality. More mobile species would likely be displaced from the site during active construction. Wildlife in the vicinity of the pipeline would also be disturbed by construction activities and noise, and may move away from the construction site. However, the primary effect on wildlife from construction and operation of the pipeline would be habitat loss.

The discussion of effects on big game in section 4.5.1.2 under Game Animals includes effects on big game on federal lands. Table 4.5.1.2-4 lists the miles of designated big game winter range crossed by the pipeline within and outside federal lands, and table 4.5.1.2-10 lists the acres of habitat types in big game winter ranges affected by pipeline construction and operation within and outside federal lands.

Seasonal road closures on public lands have been applied to big-game winter range on BLM and NFS lands to minimize the effect of winter stress on deer and elk. Additionally, the BLM, Forest Service, and ODFW recommend the application of seasonal construction restrictions on big-game winter range. The following are recommended seasonal closures for big game winter range: November 1 to April 15 (BLM), December 1 to April 30 (Forest Service), and December 1 to March 31 (private and state). Pacific Connector notes that the numerous seasonal restrictions to protect applicable species pursuant to the ESA and the MBTA would require timber-clearing activities to be conducted outside nesting seasons during the spring and summer months. Therefore, Pacific Connector would be required to complete timber-clearing and other construction activities during recommended seasonal closures for big game winter range and appropriate waivers for recommended seasonal big game closures would be necessary.

Effects on wildlife associated with late-successional and riparian habitat on federal land would be generally similar to those described above wherein direct effects would occur during clearing and pipeline construction if individuals are killed, injured, and/or displaced to other locations where possible mortality increases and/or fecundity decreases. The goal for the LSR and Riparian Reserve Forest Service and BLM land allocations is to encourage healthy late-successional and riparian forests; see appendix F. Direct effects on late-successional and riparian habitat (removal and/or conversion to different vegetation) may indirectly affect wildlife by decreasing the amount of habitat locally available and decreasing the effectiveness of adjacent habitats in providing life-requisite functions for wildlife. That effect would not be able to be mitigated on-site and is assumed to persist through the long term. Effects on species inhabiting other, non-forested habitats in the affected areas in late-successional and riparian habitat on federal land (including LSRs, Riparian Reserves and the Matrix/Harvest Land Base) would be similarly affected, although the amount of time required to restore affected non-forested habitats would be shorter (see section 4.4.2.4). Effects on LSRs and Riparian Reserves on federal lands from construction and operation of the Pacific Connector pipeline are addressed in section 4.7.3 and appendix F.

Loss of snags is expected to be a long-term effect. Estimates of snag density (numbers per acre) that would be affected in the construction right-of-way and TEWAs were made on each of the three National Forests during timber reconnaissance conducted in 2006 and 2007, and verified in 2015 (Chapman 2017). Estimates of snag density by size class (inches dbh) and decay class (hard or soft) are provided in table 4.5.1.3-2. In the areas affected by construction, conifer snags less than 13 inches dbh are generally most dense on each forest, although there are numerous hardwood snags in that size category on the Rogue River National Forest. Most of the smaller snags (less than 13 inches dbh) were observed as hard wood, rather than softened due to decay.

TABLE 4.5.1.3-2

Snag Density Estimates on NFS Lands

National Forest	Tree Type	Decay Class	Estimates of Snag Density a/ (Number per Acre) by Size Category (inches dbh) <13	13-24	25-36	>36
Umpqua	conifer	Hard	5.7	0.7	1.0	0
		Soft	0.1	1.0	1.0	0.5
Rogue River	conifer	Hard	1.7	0.2	0.1	0
		Soft	0	0.5	0.2	0.1
	hardwood	Hard	1.7	0	0	0
		Soft	0	0.1	0	0
Winema	conifer	Hard	3.3	0.2	0.1	0
		Soft	0	0.4	0.1	0

a/ Snag density was verified in 2015 but was prior to Stout's Creek fire that affected acreage in Umpqua National Forest.
Source: Chapman 2017

Although no other portions of the pipeline route have been similarly examined, available data for the BLM districts crossed by the proposed pipeline generally show that snag density is higher on the BLM districts (BLM 2008). It is also assumed that snag densities on the Umpqua National Forest have increased following the 2015 Stout's Creek fire. Nevertheless, loss of snags regardless of decay class is expected to be a long-term effect because recruitment of new snags in the affected areas would take much longer than three years.

The Forest Service will require mitigation to meet their respective land use plans; those mitigation actions are described in table 2.1.5-1. Road decommissioning, fuel breaks, and forest thinning mitigation actions will assist in the recovery of late-seral habitat, reduce habitat fragmentation and edge effects, and enhance resilience of mature forest stands. Proposed snag creation and placement of LWD will mitigate the effect of loss of snag habitat and reduction in the contribution of large down wood due to clearing of forested habitat. Reallocation of matrix lands to LSR will meet the neutral to beneficial standard for new developments that affect LSRs and habitat improvement of meadow habitat within LSRs will mitigate effects on unique habitat. Livestock fencing will be used to protect revegetation efforts associated with construction disturbances.

4.5.1.4 Conclusion

Constructing and operating the Project would have both short- and long-term adverse effects on wildlife habitat and terrestrial wildlife species. We expect that some wildlife individuals would experience displacement or mortality during construction and operation, and some wildlife habitat would be removed or modified temporarily or permanently. However, based on the characteristics of the terrestrial wildlife species and habitat, the applicant's proposed construction and operations procedures and methods, and their implementation of impact minimization and mitigation measures, we conclude that the Project would not significantly affect terrestrial wildlife.

4.5.2 Aquatic Resources

4.5.2.1 Waterway for LNG Carrier Traffic

The waterway for LNG carrier traffic to Jordan Cove's terminal contains a diverse collection of anadromous, estuarine, and marine organisms and associated habitats (figure 4.5-1). The marine environment along the transit route outside of Coos Bay consists of varied habitats used by aquatic organisms including commercial and recreational fish and shellfish and marine mammals. This habitat includes gently sloping nearshore intertidal and subtidal sand area near the Coos Bay mouth and rocky shoreline to the south. Habitats near the mouth of the bay range from sand beaches to rocky shorelines. Offshore, deeper soft bottom habitats extend over 100 feet deep with main pelagic surface water along the ship transit route.

The Coos Bay estuary is described in section 4.3.2.1. Several freshwater streams and sloughs enter the bay, so that its habitats range from marine to estuarine. The bay contains shellfish resources, as well as marine fish. It is a migration corridor for salmon (*Oncorhynchus* spp.) and steelhead (*O. mykiss*) that spawn and rear in the streams that drain into Coos Bay. The bay along the transit route for LNG carrier marine traffic contains mostly sloping beaches with algae and eelgrass beds that supply important habitat for the estuarine organisms. A total of over 14,000 acres of habitat is present in Coos Bay, including some 1,400 acres of eelgrass beds.

Many fish, shellfish, and marine mammal species are common in the waterway leading to the Jordan Cove LNG terminal (see appendix I, table I-1). Most of these aquatic species are mentioned below.

The status and potential project effects of federally listed fish, marine mammals, and turtle species are presented in our pending BA. EFH fish species that are managed under the MSA will be presented in our EFH Assessment that will be attached to our BA. The federally listed species information is summarized in section 4.6, and the EFH assessment is summarized in appendix I.

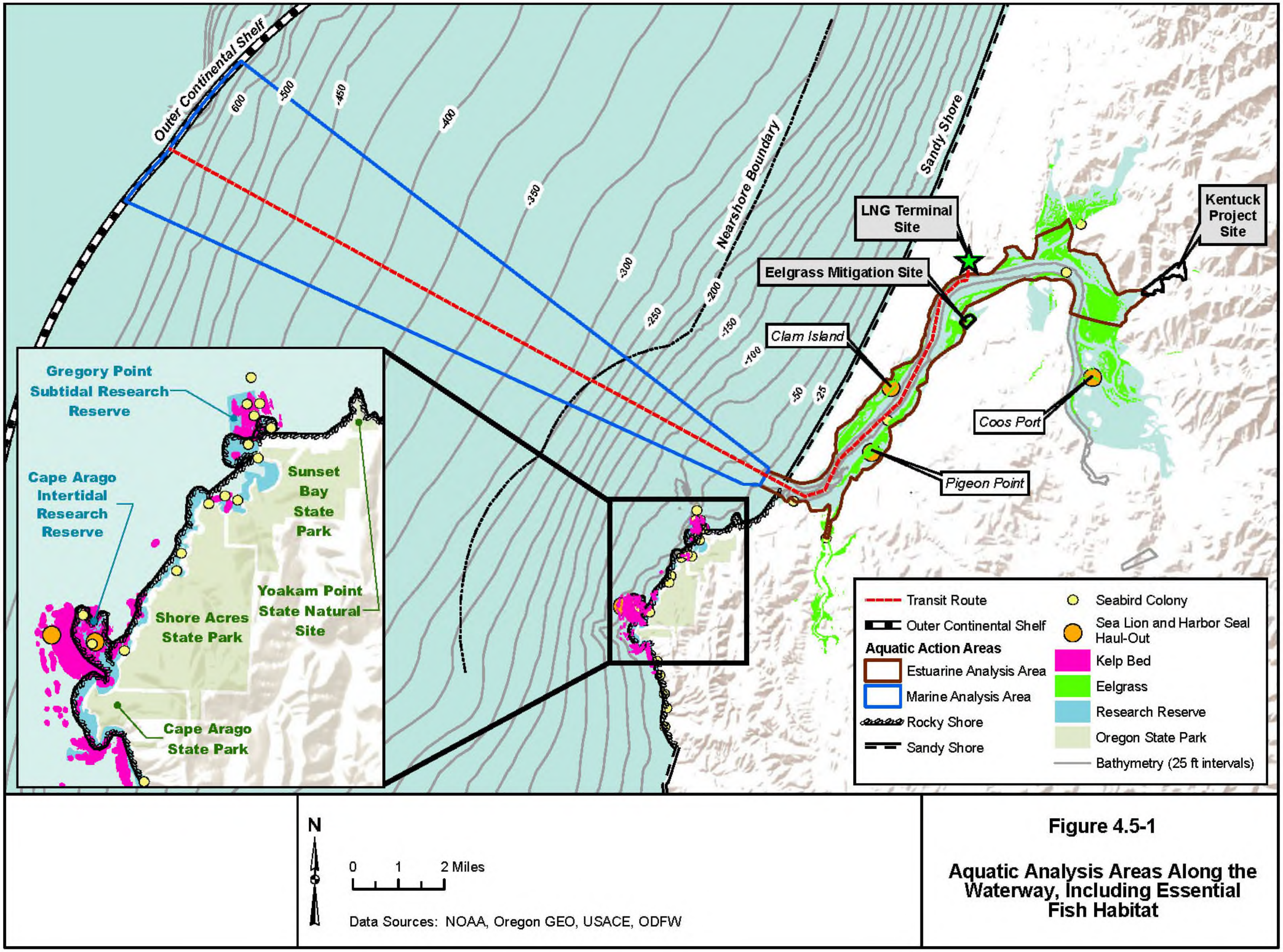


Figure 4.5-1

Aquatic Analysis Areas Along the Waterway, Including Essential Fish Habitat

Marine Fish

Species of groundfish, pelagic, anadromous, and marine species would be present in the waterway for LNG carrier traffic to the terminal, in the nearshore and marine waters outside of the Coos Bay estuary. This includes a variety of rockfish, flatfish, shark, skates, sturgeon, sablefish, cod, and migratory fish such as anchovy and sardine and in the outer regions may rarely include some highly migratory species such as thresher shark (*Alopias* spp.) and tuna.

Marine fish communities in Coos Bay consist of species found in estuarine and marine waters. Their distribution and abundance vary with physical factors such as bottom conditions, slope, current, salinity, and temperature, as well as season, which can affect migration and spawning timing. Some of the more commonly abundant fish include Pacific herring (*Clupea pallasii*), and the non-native American shad (*Alosa sapidissima*). Most fish species are migratory or seasonal, spending only part of their life in these waters. Other common seasonal marine fish species include surfperch (family *Embiotocidae*), lingcod (*Ophiodon elongatus*), rock greenling (*Hexagrammos lagocephalus*), sculpin, surf smelt (*Hypomesus pretiosus*), Pacific herring (*Clupea pallasii*), English sole (*Parophrys vetulus*), black rockfish (*Sebastes melanops*), northern anchovy (*Engraulis mordax*), eulachon (*Thaleichthys pacificus*), longfin smelt (*Spirinchus thaleichthys*), Pacific tomcod (*Microgadus proximus*), sandsole (*Psettichthys melanostictus*), and topsmelt (*Atherinops affinis*). California halibut (*Paralichthys californicus*) is also present in the bay near Jordan Cove. A few common species like kelp greenling (*Hexagrammos decagrammus*) and starry flounder (*Platichthys stellatus*) reside in the bay year-round. The bay from just beyond the LNG terminal site to its mouth is a prime feeding area for many local and seasonal fish species.

Fish abundance varies with salinity. Near NCM 1.5, the sloughs are mostly of high salinity, while farther up the bay, near NCM 15.5, sloughs are generally brackish, of lower salinity. Toward the mouth of the bay, the salinity is higher, especially in the summer, which is when the number of fish increase.

Anadromous Fish

A common group of anadromous fish species found in the waterway for LNG carrier traffic to the terminal includes Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), chum salmon (*O. keta*), steelhead, coastal cutthroat trout (*O. clarkii clarkii*), Pacific lamprey (*Lampetra tridentata*), river lamprey (*L. ayersi*) , white sturgeon (*Acipenser transmontanus*), green sturgeon (*A. medirostris*), striped bass (*Morone saxatilis*), and American shad (*Alosa sapidissima*). Anadromous is a term describing fish that return from the ocean to the rivers where they were born to spawn. Adult anadromous fish spend a portion of their adult life in the ocean; the amount of time varies among the species. Sexually mature adults migrate or “run” from the ocean and estuaries upstream to fresh water streams to spawn for most salmonid anadromous fish in shallow gravel stretches. Other anadromous stocks noted above have varied spawning habitat uses. After a period, which varies with the species, juveniles migrate downstream to estuaries typically in late winter to summer. Salmon and steelhead undergo smolting (physiological maturation to adjust from fresh to salt water) before entering marine waters as juveniles. Salmon and steelhead and cutthroat typically rear in the ocean for one to five years before returning as adults to their natal streams to spawn, while other anadromous fish (striped bass, American shad, sturgeon, and lamprey) have a range of ocean-rearing periods ranging over multiple years, with striped bass largely confined to the estuary. Salmon typically return to streams in late summer through fall.

Steelhead and sea-run cutthroat trout may return to streams in the summer, fall, winter, or spring depending. Lamprey return from spring to fall to fresh water; striped bass are not native but spawn in the spring over a brief period in Coos River. Salmon species die after spawning but some steelhead and anadromous coastal cutthroat survive to return to the ocean and can spawn again. Steelhead typically remain in freshwater streams after emergence for two to three years before migrating to the ocean, with adults returning to spawn in their fourth or fifth year. Sea-run cutthroat usually remain in fresh water for two to four years before smolting and migrating to saltwater, usually staying in the estuaries or near shore (Behnke 1992).

There are eight native species of coldwater anadromous fisheries in the area affected by the Jordan Cove LNG Project: Chinook salmon, coho salmon, chum salmon, steelhead, coastal cutthroat trout, Pacific lamprey, river lamprey, and green sturgeon. The Oregon Coastal Coho Salmon Evolutionarily Significant Unit (ESU) is present and is listed under the ESA. The North American Green Sturgeon – Southern Distinct Population Segment (DPS), and Southern DPS Pacific eulachon, which are both listed as Threatened under the ESA, may be present or migrate through Coos Bay. The Project effects on these ESA listed fish and their critical habitat are presented in section 4.6 of this EIS.

Shellfish

A large and diverse population of benthic and epibenthic invertebrates is present beyond the entrance to Coos Bay. Clams, crabs, oysters, and shrimp make up important components of these invertebrates in the bay. Some of the most abundant and commercially important of these species include bentnose clams (*Macoma nasuta*), Pacific oyster (*Crassostrea gigas*), Dungeness crab (*Metacarcinus magister*), and ghost shrimp (*Neotrypaea californiensis*). Distribution varies along the route from the LNG terminal to the bay mouth. Principal subtidal clam beds are found in the lower bay and South Slough although the upper bay also has substantial clamming areas. Clam Island, located at the mouth of Coos Bay, has an abundance of recreationally important clams. Some of the highest recreational harvest of clams and crabs occurs at the mouth of Coos Bay with much of the crabbing occurring from the BLM boat ramp, west of the LNG terminal site to the mouth. Razor clams (*Siliqua patula*) are an important commercial and recreational species. In Jordan Cove, ghost shrimp, a commonly harvested bait shrimp, are found in the fine sediment and eel grass beds. Mud shrimp (*Upogebia pugettensis*) are also harvested in this region.

Coos Bay contains one of only three known native Oregon coastal populations of the Olympia oyster (*Ostrea lurida*). Within its native range, this species has significantly diminished from historical levels (National Fish and Wildlife Federation et al. 2010). Efforts have been taken in the bay to restore this species and improvements in bay water quality and sediment have resulted in self-sustaining populations over the last two decades (Groth and Rumrill 2009; Rumrill 2007). A pilot restoration project began in 2010 that resulted in stocking 4 million juvenile Olympic oysters in South Slough. Because of its low abundance and efforts to improve the quality of the Coos Bay environment and its survival, the Olympia oyster is not harvested.

Marine Mammals

Thirty species of marine mammals occur in Oregon, including seven species of baleen whales, nine species of toothed whales, eight species of dolphins and porpoises, five species of pinnipeds (seals and sea lions), and a single species of sea otter (NMFS 2017a).

Steller sea lions (*Eumetopias jubatus*), California sea lions (*Zalophus californianus*), northern elephant seals (*Mirounga angustirostris*), and Pacific harbor seals (*Phoca vitulina*) use haulout sites in the vicinity at Cape Arago, Three Arch Rocks, and Shell Island, along the southwest Oregon Coast. Eight species of whales are federally and state-listed. All marine mammals are protected under the MMPA.

Sea Turtles

Four species of sea turtles have been documented off the coast of Oregon: the green (*Chelonia mydas*), olive ridley (*Lepidochelys olivacea*), leatherback (*Dermochelys coriacea*), and loggerhead sea turtles (*Caretta caretta*).

Effects on Aquatic Habitat and Aquatic Species Along the Waterway for LNG Carrier Transit

The following section discusses transit-related effects of the LNG carriers. Although the regular transit of LNG carriers is a part of the operation of the Project, the carriers and their operation do not fall under the jurisdiction of the Commission; therefore, we can disclose but not require mitigation for these activities. Project-related effects from the LNG facility construction actions (including dredging of areas abutting the Federal Navigation Channel) are presented in section 4.5.2.2.

<u>Vessel Strikes</u>

Jordan Cove anticipates that as many as 120 LNG carriers each year would use the waterway to reach its terminal. In addition, in accordance with the WSR and LOR, there must be three tugboats and additional security ships that assist each LNG carrier in transit along the Coos Bay navigation channel. These vessels have the potential to strike aquatic species, including sea turtles and marine mammals, and seabirds and shorebirds during their transit to and from the Jordan Cove terminal.

In the open ocean prior to entering the Coos Bay Federal Navigation Channel, it is estimated that LNG carriers would travel at speeds of about 12 knots. Jordan Cove has proposed to provide measures supplied by NMFS to vessel operators in order to minimize potential ship strikes to cetaceans, and possibly other listed (sea turtles) and non-listed marine species by LNG carriers in a *Ship-Strike Reduction Plan*. Jordan Cove would provide operators of LNG carriers that would visit the terminal with copies of this plan for avoidance of marine mammals or sea turtles while in transit at sea. Some of the suggested measures would include the following:

- train LNG carrier crews to watch out for and avoid marine mammals and sea turtles;
- keep on board vessels copies of marine species reference guides, such as Marine Mammals of the Pacific Northwest, including Oregon, Washington, British Columbia and South Alaska by Pieter Folkens (2001);
- request LNG carriers to establish navigation policies when marine mammals or sea turtles are sighted, including:
  - maintain a distance of 90 meters or greater.
  - attempt to maintain a parallel course to the animal and avoid abrupt changes in direction until the animal has left the area.

  - reduce speed when pods or assemblages of marine mammals or sea turtles are observed nearby; and
- report sightings of any injured or dead marine mammal or sea turtles to the NMFS, regardless of whether the injury or death was caused by the LNG carrier. If the injury or death were caused by collision with an LNG carrier heading to or from the Jordan Cove terminal, the FERC should be notified within 24 hours of the incident. Information to be provided would include the date and location (latitude/longitude) of the strike, the ship name, and the species, if possible.

LNG carriers would enter the waterway at speeds between 8 and 10 knots, and slow between 4 to 6 knots as they proceed up the Coos Bay navigation channel to the Jordan Cove terminal. As required by the WSR, two tugs would escort each LNG carrier in the navigation channel, and another tug would assist in docking the vessel at the terminal. Use of tugs would allow the LNG carriers to maintain steerage even at these slow speeds.

Most sea turtles, marine mammals, and seabirds and shorebirds would be able to avoid LNG carriers traveling at slow speed through the waterway. Even with the additional LNG carriers in the waterway, the number of ships would still be below historic levels for deep-draft traffic to the Port. Effects on aquatic resources from LNG carriers would be not much greater than the effects of current deep-draft cargo ships visiting the Port. Based on the reduced speed of the LNG carriers and the efforts by Jordan Cove to increase the awareness of vessel operators, we conclude that the incidence of accidental strikes of aquatic species by LNG carriers in transit to and from the Jordan Cove terminal would be low.

<u>Ship Grounding</u>

During scoping some commenters raised the possibility that an LNG carrier waiting offshore to enter Coos Bay, either to avoid another ship coming out of the Port or seeking proper tidal conditions, could lose anchorage or steerage and run aground on the North Spit, like the *New Carrisa* incident of 1999. A ship grounding would have the potential to affect aquatic resources, as oil and fuel could leak from a grounded vessel. However, a Coast Guard investigation found that the *New Carrisa* grounding was caused by the captain's error in not having the ship well anchored.

All LNG carriers visiting the Jordan Cove terminal would have to adhere to Coast Guard regulations, including anchoring procedures offshore, in addition to the measures outlined in the WSA, WSR, and LOR. A pilot would board the LNG carrier to guide it through the Coos Bay navigation channel, and the vessel would be accompanied by tugs and security escort boats to keep it on course. In addition, the geometry of the navigation channel would keep the LNG carrier within its confines, away from the shore.

<u>Shoreline Erosion from Waves and Propeller Wash</u>

Propeller wash from LNG carriers and tugboats transiting the waterway to and from Jordan Cove's terminal could cause shoreline and bottom erosion and displace bottom organisms due to scour. Wakes and waves caused by vessels in the waterway could increase erosion along the shoreline and resuspend loose sediments in the bay. Increased erosion and suspended sediment levels can adversely affect fish eggs and fish survival, benthic community diversity and health, and spawning habitat. At high concentrations, suspended sediments can affect oxygen exchange over the gills, resulting in weakened individuals or mortality. Waves from vessels breaking on the shoreline can also cause fish stranding.

The possible magnitude and effects of the Jordan Cove Project on shoreline erosion were approximated by Jordan Cove through models that assessed effects of waves and propeller wash from LNG carriers in Coos Bay and at the LNG docking area (i.e., Moffat & Nichol 2008; CHE 2011; Moffatt & Nichol 2017f), and the details of the model results on physical conditions in the bay resulting from LNG carrier traffic and docking are presented in section 4.3.

Overall, the models estimated that additional waves generated by the new LNG carrier traffic could increase shoreline sediment transport at the modeled point by 5 to 8 percent over existing conditions (e.g., wind-generated waves plus existing large vessel–generated waves). While both models indicated some additional shore sediment movement could occur from the waves generated by the passage of LNG carriers through Coos Bay, the effects would be small because low magnitude and relative frequency of waves, contributing a small portion of total annual wave energy and sediment transport, and be within the normal magnitude of waves that naturally occur in the bay. Therefore, the total effect would likely be within the range of natural annual variability of wave conditions. Overall, increased sedimentation and disruption of aquatic nearshore habitat from additional tugboat and LNG carrier–generated waves would be unlikely because of the factors discussed in section 4.3.

The effects of propeller wash from LNG carriers and related tugboat vessels on bottom erosion and turbidity likewise would not reach levels to cause substantial disruption to benthic or pelagic resources other than in the immediate access channel and slip area (see section 4.3 for details of modeling results). The bottom velocity caused by the propeller would be similar to the maximum velocity of peak tidal exchange (about 4 fps) along most of the route. Because the disturbance would be relatively similar to what occurs during tidal exchange and confined to the relatively coarse sediment within an 80-foot-wide swath along the 9-mile-long Federal Navigation Channel, the bottom area disturbed would be slight along most of the route. Few organisms would be displaced by physical disturbance or affected by turbidity (see section 4.3 for details); however, as noted below, there are some areas near the entrance to the access channel that would experience bottom erosion and likely benthic disruption as the LNG carrier and tug boat leave after loading.

Mobile organisms would be able to return to the area affected, while some benthic organisms could be permanently displaced. Turbidity would likely be slight due to the coarse characteristics of the navigation channel sediment that is resistant to current induced suspension. The one area that would have marked local bottom scour and increased turbidity would be in the east side of the access channel and slip where bottom scour over about 12 acres may occur during each LNG carrier departure (Moffatt & Nichol 2017g). Overall, some loss of benthic organisms could occur from LNG carrier propeller wash during each transport trip near the slip approach, but the magnitude would be small and likely less than currently occurs under each existing large vessel trip. There would be some additional local bottom disturbance in the docking area. In most cases, this disturbance would likely be much less than estimated because of the conservative assumptions used for the model. While some sessile benthic organisms may be displaced during LNG carrier docking, the limited extent of bottom disturbance and sediment suspension would result in unsubstantial effects on organisms in the slip.

Fish Stranding

Fish stranding can occur when fish become caught in a vessel's wake and are deposited on shore by the wave generated by the vessel's passing. Stranding typically results in mortality unless another wave carries the fish back into the water. A study of strandings (Pearson et al. 2006) suggests that a series of interlinked factors act together to produce stranding during a ship passage. These factors include:

- Water-surface elevation—Low tides are generally more likely to result in strandings than high tides.
- Beach slope—Low-gradient beaches are generally more likely stranding locations than high-gradient ones.
- Wake characteristics—Ship wakes that result in both the greatest drawn-down and run-up on the beach are generally most likely to result in strandings. Wake characteristics are influenced by a number of dynamics including vessel size and hull form ("short and fat" vessels have a greater displacement effect and generate larger wakes than "long and thin" vessels); vessel draught (the smaller the under-keel clearance, the larger the wakes; thus, loaded vessels are more likely to result in strandings than unloaded vessels); vessel speed (fast moving vessels generate larger wakes than slow vessels); and the distance between the passing vessel and the beach (strandings are generally more likely at beaches close to the shipping channel than more distant beaches). Fish strandings were observed because of four types of vessel passages including oil tankers, container ships, car carriers, and bulk carriers (in order of the vessels observed to cause the highest to lowest stranding frequency).
- Various biological factors—For example, the larger the number of subyearling salmon that are present near the shoreline, the more fish that are likely to be stranded; salmon that are larger and relatively strong swimmers are generally less prone to stranding.
- Vessel speed—No stranding has been observed on the Columbia River at speeds less than 8 to 9 knots (about 10 miles per hour).

The factors discussed above can vary simultaneously, making it difficult to predict where and to what degree strandings may occur. A few areas may have the potential to strand fish in Coos Bay. One is the mud flats on the west side of the navigation channel along the Coos Bay and Empire Range that have beach morphology that has been shown to have potential for stranding, especially at low tide. Jordan Cove (Moffat & Nichol 2008) modeled the potential wave height and overall energy from 200 LNG carrier transits a year (combined inbound and outbound). As noted in section 4.3, the wave's height would not exceed that of normal conditions in Coos Bay and vessel-induced waves contribute a small portion of total waves in the bay. In addition, the LNG carriers would be arriving and leaving at high tide, which is a period when gently sloping beaches are mostly covered, and less likely to be dewatered from waves. The maximum vessel speed once inside the navigation channel, about 6 knots, is less than that observed to cause stranding in the Pearson et al. (2006) study. The one exception is near the Coos Bay entrance (first mile), when vessels may be traveling 8 to 10 knots. While waves generated in this portion of the waterway may be larger than farther in the bay, this is an area likely already receiving larger ocean-generated waves, so the vessel-generated waves would be little different than current conditions in this region. Additionally, the presence in Coos Bay of subyearling Chinook salmon, which are the outmigrating fish most likely to be stranded, is limited to the summer months, approximately mid-

June through the end of August. Considering the conditions, including LNG carriers entering and leaving at high slack tide, low velocity in most areas, wave height within normal range, and infrequent occurrence of susceptible fish, it appears unlikely that LNG carrier traffic in the waterway would substantially contribute to fish stranding.

LNG Spills

In a highly unlikely scenario, there could be an accidental spill of LNG from a carrier transiting in the waterway. As explained in section 4.13, in the entire history of LNG carrier transport worldwide, there has never been a major incident resulting in a large LNG spill or fire on water. An LNG spill has an extremely low probability of occurrence and, as described below, would likely affect a small area. As more fully discussed in section 4.13 of this EIS, spilled LNG would not mix in the water column, but would vaporize as warmed by ambient temperature and, if the LNG ignited, a fire could result. The greatest threat to aquatic organisms near an LNG spill would be from changes in water temperature. A spill of LNG would float on the water surface and not mix, but in the process of changing state from solid to liquid would rapidly cool off the upper water layers closest to the LNG spill. As the LNG would vaporize and turn to natural gas, it would be less dense than air and would rise above the water. Aquatic species in the waterway would not be directly affected unless individuals come in direct contact with the LNG. Should an aquatic species directly contact the LNG when it is first released, it could have its flesh frozen because the temperature is very low. The chance of this occurring would be remote because it would require the individual to be near the water surface at the direct point of the LNG spill, before it warms. If an LNG spill from a carrier in the waterway were to ignite, it would cause localized heating of the surface water. Neither the cooling nor heating would likely cause the overall water column to change temperature to the point of affecting aquatic organism beyond the surface layer at the time of initial spill or ignition. Aquatic species, other than possibly the smallest planktonic stages and shellfish, near this spill would be able to detect undesirable temperatures and avoid the LNG spill by swimming away.

The mitigation measures outlined in the WSA, WSR, and LOR would protect public safety and the environment, and ensure that aquatic resources would not be adversely affected by LNG carrier traffic in the waterway to the Jordan Cove terminal.

Fuel or Oil Spills

Fuel (e.g., diesel) used for LNG carrier propulsion could possibly leak or be spilled while en route in the waterway; likewise, oil could be spilled. Adverse effect could occur on marine fish and shellfish from oil spills ranging from direct morality, reduced growth and feeding, and reduced spawning success depending on location magnitude and type of spill. Effect can be compounded when spills intersect the shoreline habitats. These effects can be both short and long term. LNG carriers would have measures aboard to contain fuel or oil spills should they occur, as required under the Coast Guard required hazardous spill response plan for vessels in U.S. waters of 2013 (78 FR 60099). Additionally, LNG carriers are double hulled, which should prevent the escape of fuel or oil, other than spills from the deck. The chance of a spill is low, and any quantities leaked are likely to be small. As reported by Pacific States/British Columbia annual reports (http://oilspilltaskforce.org/documents/), the number of oil spills reported from fishing, recreational, and other harbor marine vessels in Oregon ranged from about 9 to 65 per year, which is infrequent considering that thousands of marine vessels, both recreational and commercial, use Oregon coastal marine waters. Spills or releases of fuel or other oils into surface waters from LNG carriers are more likely to occur during fueling at the dock when the materials are being transferred onto the carrier. As discussed in section 4.3, LNG carriers are required to develop and implement a Shipboard Oil Pollution Emergency Plan, which includes measures to be taken if an oil pollution incident has occurred, or a ship is at risk of one. With the implementation each LNG carrier's Shipboard Oil Pollution Emergency Plan, impacts resulting from the spill of fuel, oil, or other hazardous liquids would be minimized both in occurrence and quantity. We conclude that because fuel or oil leaks from LNG carriers transiting in the waterway to and from the Jordan Cove terminal are not reasonably certain to occur, adverse effects on aquatic resources are not anticipated.

<u>Introduction of Nuisance Species</u>

LNG carrier origin locations are unknown now; they could originate from ports across the Pacific. Operators of commercial vessels have a significant economic interest in maintaining underwater body hull platings in a clean condition. Fouling of bottom platings would result in increased fuel costs for voyages and could reduce the vessel's maximum transit speed. To prevent fouling and the associated economic costs, operators aggressively and conscientiously implement hull plating preservation and maintenance programs. Failure to preserve and maintain hull plating not only raises short-term operation costs but also sets the stage for increased long-term hull maintenance costs. There is a sensitivity to this engineering and economic reality regarding commercial vessels operating at the higher end of the sailing rates schedule, as is the case for LNG carriers.

In addition to the antifouling program measures, fluid dynamics plays a practical role as a barrier to the introduction of invasive species. The amount of water that passes over the hull and through the sea chest is a massively large volume. A sea chest is an opening with associated piping in the hull below the waterline to provide seawater to condensers, pumps, and other associated equipment. The velocity of the seawater, abrasive by nature, along the hull would be expected to "waterblast" off anything that is not affixed to the hull (e.g., a barnacle). The sea chest would have the equivalent of untold multiples of seawater exchange such that an organism would be flushed out with much more velocity and volume of water than the accepted international ballast exchange procedure.

Ballast water may be another source of non-native organisms. Water is held in the ballast tanks and cargo holds of LNG carriers to provide stability and maneuverability during a voyage when vessels are not carrying cargo. Normal ballast exchange requires only three changes of water through the ballast tanks to purge any loading port organisms before arrival at the unloading port. The effects of ballast water exchange, and the measures that would be implemented to minimize or avoid effects from this action, are addressed in section 4.3.

Conclusion

Based on measures and actions that will be in place to eliminate or mitigate potential adverse effects from actions during operation of LNG carrier transit, including waves size and propeller wash, LNG gas or hazardous substance spills or introduction of invasive species to marine resources, we conclude that the Project would not significantly affect marine resources.

4.5.2.2 Jordan Cove LNG Project

Coos Bay contains a variety of habitat for anadromous, marine, and estuarine fish species. A large diverse invertebrate population exists in Coos Bay. Shellfish (predominantly clams, crabs, and shrimp) are of significant economic importance to the Coos Bay area. Of marine mammals in Coos Bay, only the harbor seal, California sea lion, and killer whale have been observed during field surveys at the proposed location of the Jordan Cove access channel. No turtles have been observed or would be expected in the bay. Fish, shellfish, and marine mammals that may occupy Coos Bay are more fully discussed in the section 4.5.2.1.

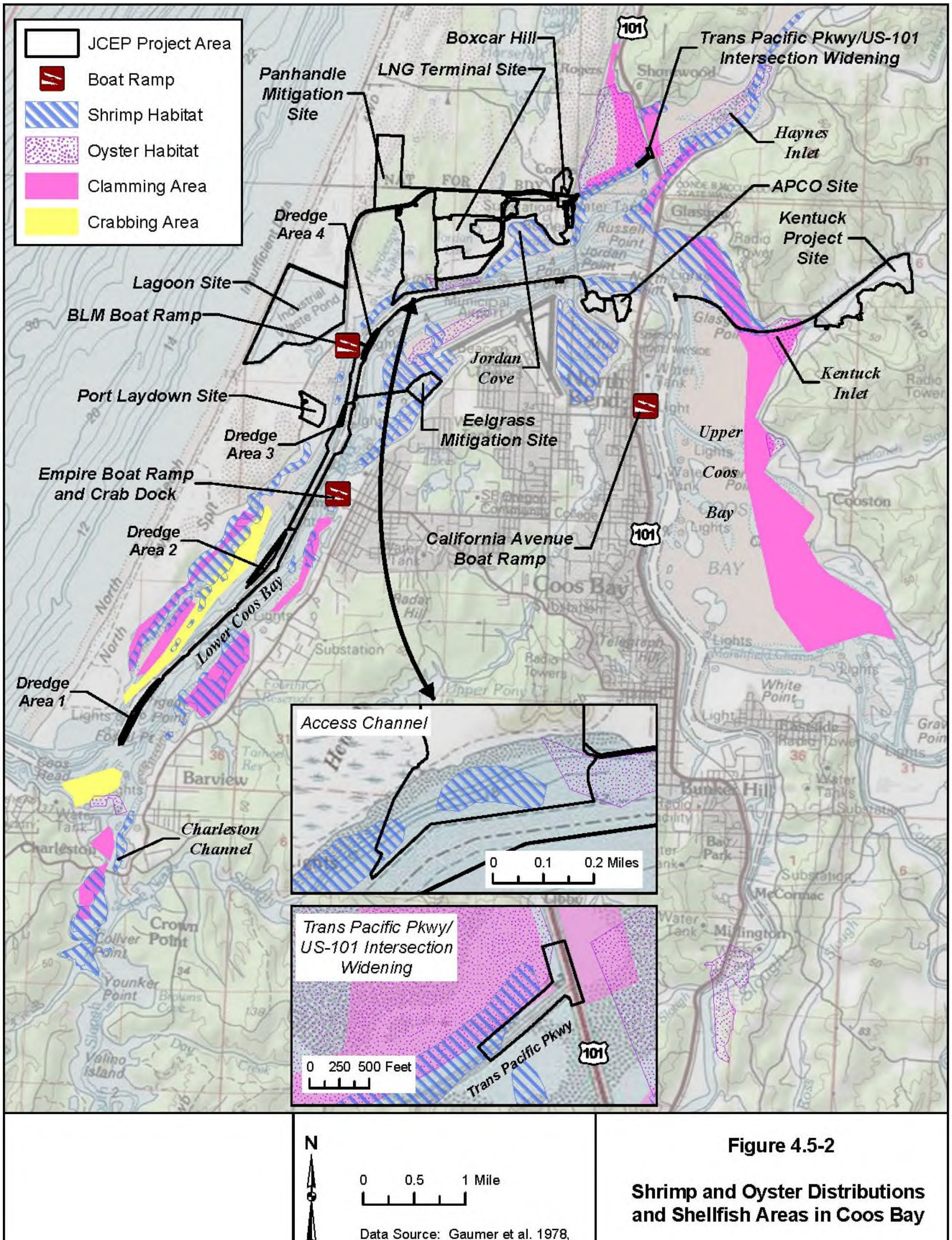
Juvenile and larval life stages of vertebrate and invertebrate marine organisms are varied in the bay and near the terminal site. Over 35 species of ichthyoplankton have been documented in Coos Bay (Miller and Shanks 2005). There are some seasonal trends, with highest occurrence October through May, but fewer differences by month in the upper bay than near the ocean. Shanks et al. (2010, 2011) sampled zooplankton and ichthyoplankton in Coos Bay near the Jordan Cove terminal. A variety of zooplankton were found to be present in the bay (see table 4.5.2.2-1). Among the potential forage items, copepod adults, larvaceans, harpacticoid copepods, and Daphnia had the highest peak abundance. Overall, larval fish abundance was generally low, with those that spawn primarily in or near estuaries common (surf smelt, sand lance, and staghorn sculpins [*Leptocottus armatus*]). At times, other larval or juvenile fish were relatively abundant including English sole, buffalo sculpin (*Enophrys bison*), anchovy, and pipefish. A total of nine fish species were captured. Primary fish species spawn in winter and early spring, and larval fish were most abundant in winter samples (Shanks et al. 2011). Over 12 taxa of crab and shrimp larvae were also collected, including some recreational and commercially important crab and shrimp species, such as Dungeness crab and ghost shrimp larvae. Major known oyster and shrimp habitat and clamming and crabbing areas in the bay relative to Project activities are shown in figure 4.5-2. These habitat areas are mostly oriented along shoreline and shallow areas of the bay except for crabbing areas which extend into deeper water.

TABLE 4.5.2.2-1

Taxa Groups Collected in Coos Bay Near the Jordan Cove Terminal During 2009–2011

Categories	Specific Taxa
Fish larvae/juvenile	Surf smelt, sand lance, staghorn sculpin, buffalo sculpin, anchovy, pipefish, English sole, gunnel, pricklefish
Crab/Shrimp larvae	Porcelain crabs, pea crabs (*Pinnotheres pisum*), green crab (*Carcinus maenas*) (invasive), xanthid crabs, majid crabs, cancer crabs (e.g., Dungeness, rock crab), Lithodidae, Hippidae, Pagurid (hermit crabs), Callinassa (ghost shrimp), Sergestid shrimp, Pachygrapus crassipes (striped shore crab)
Gastropod and Bivalves larvae	Mytilus (mussels), Clinocardium (cockles), Bivalve juveniles, Gastropod juveniles
Larval Invertebrates	Barnacle nauplii and cyprids, Mytilus larvae, bivalve larvae
Cnidaria/ctenophore	Sea anemone, Hydroids, sea goose berry
Polychaete Worm Larvae	Marine worms
Salmonid Food Prey	Mysids, Amphipods, Isopods, Cumaceans, Copepod adults, Harpacticoid copepods, Calanoid copepods, Daphnia, Larvaceans, larval fish

Source: Shanks et al. (2010, 2011)



Data Source: Gaumer et al. 1978,

Figure 4.5-2

Shrimp and Oyster Distributions and Shellfish Areas in Coos Bay

The slip, access channel, MOF, and adjacent rock pile apron for Jordan Cove's terminal would cover about 37 acres below the mean higher high water line. This would include less than 1 acre of salt marsh, about 13 acres of intertidal area of unvegetated sand plus algae/mud/sand habitat, about 4 acres of shallow subtidal, about 18 acres of deep subtidal, and about 2 acres of eelgrass. This would include a pile dike rock apron area that would modify about 2 acres of habitat through intertidal and subtidal addition of small riprap. The habitat areas affected by the access channel are illustrated on figure 4.5-3 and listed in table 4.5.2.2-2. Nearly all this habitat change would be permanently converted to deepwater habitat. Other Project facilities would also temporarily disturb intertidal and subtidal habitat during construction (table 4.5.2.2-2). The largest other area disturbing estuarine habitat would be from marine waterway modifications (i.e., the proposed modifications in the navigation channel) totaling about 40 acres of mostly deep subtidal habitat including the 27 acres from dredging and 13 acres from the dredge lines used for this dredging. All other facilities would disturb less than about 5 acres in habitat which includes less than 1 acre of eelgrass habitat.

TABLE 4.5.2.2-2

Estuarine Habitat Affected by Construction of the Jordan Cove LNG Project Facilities and Marine Waterway Modifications in the Federal Navigation Channel

	Acres Affected							
Habitat Type	**Slip, Access Channel, TMBB MOF, and Rock Pile Apron**	**Marine Waterway Modifications - Dredge Areas**	**Marine Waterway Modifications - Dredge Lines**	**Kentuck Temp. Dredge Transfer line**	**Eelgrass Site Temp. Dredge line**	**APCO Temp. Dredge Transfer**	**Hydraulic Dredge Pipeline**	**Trans-Pacific Parkway/ Hwy 101 a/**
Eelgrass Habitat	2		<1	<1	<1	<1		
Shallow Subtidal	4		<1	1			<1	
Salt Marsh	<1							
Intertidal	13		<1	<1	<1		<1	1
Deep Subtidal	18	27	12	2	1	1		
Total	**37**	**27**	**13**	**2**	**1**	**1**	**<1**	**1**

Note: Columns/rows may not sum correctly due to rounding. Acres are rounded to nearest whole acre. Acreages less than 1 acre are shown as "<1".
MOF – Material Offloading Facility
TMBB – Temporary Material Barge Berth
a/ Riprap addition

Submerged grasses are one of the important major habitat components in Coos Bay. Recreationally and commercially harvested species such as clams and shrimps, Dungeness crab, English sole, and salmonids use the eelgrass beds extensively. Previous studies (Akins and Jefferson 1973) have reported that Coos Bay has 1,400 acres of lower intertidal and shallow subtidal flats covered by eelgrass meadows. ODFW (1979) conducted habitat mapping in Coos Bay and documented intertidal and subtidal aquatic beds. Submerged grass meadows provide cover and food for many organisms including burrowing, bottom-dwelling invertebrates; diatoms and algae; herring that deposit eggs clusters on leaves; tiny crustaceans and fish that hide and feed among the blades; and, larger fish, crabs and wading birds that forage in the meadows at various tides. Eelgrass provides shelter for a variety of fish and may lower predation, allowing more opportunity for foraging. The protective structure attribute of eelgrass is primarily for smaller organisms and juvenile life history stages of fishes.

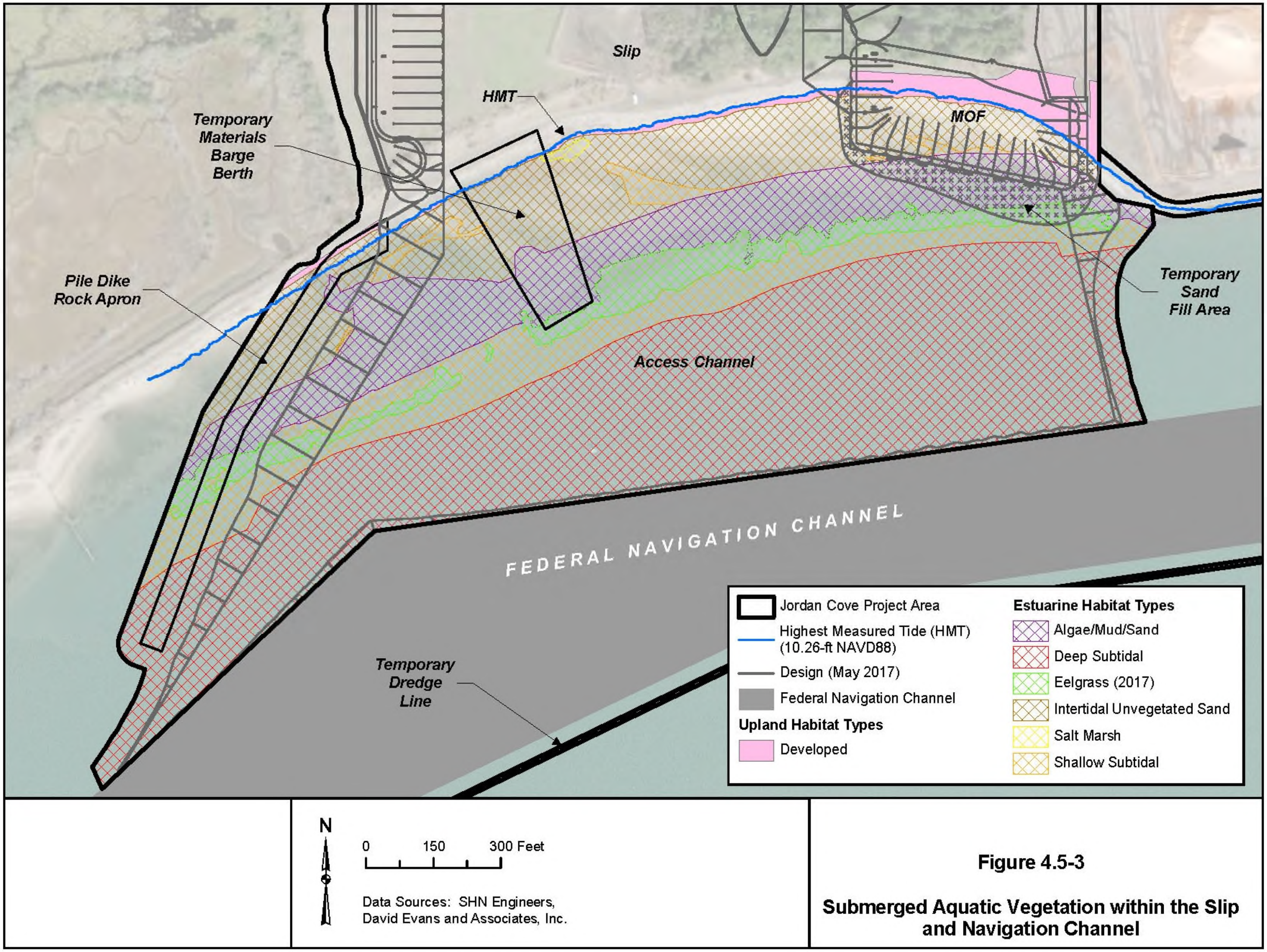


Figure 4.5-3

Submerged Aquatic Vegetation within the Slip and Navigation Channel

Project activities associated with the LNG terminal that could potentially affect aquatic resources include in-water construction activities, habitat modification, water appropriations, artificial lighting, and accidental spills of hazardous materials. Measures that would be implemented by Jordan Cove to avoid or reduce effects on aquatic resources are discussed below.

Effects on Aquatic Habitat and Aquatic Species from Construction of the Jordan Cove LNG Facilities

The estuarine portion of the Jordan Cove LNG terminal would include a marine slip, access channel, and MOF. The entire access channel would be located within Coos Bay, while most of the marine slip would be excavated or dredged from existing upland on the North Spit. Many of the construction supplies for the facility would be provided through transport by marine barge and break-bulk ships. This would require the construction of a temporary barge berth. There would also be construction of the Kentuck project site and Eelgrass Mitigation site to mitigate for lost estuarine and wetland habitat (see chapter 2 and section 4.3.3 for further descriptions).

Construction of the LNG facilities and channel improvements would temporarily and permanently affect known oyster and shrimp habitat areas. There are currently about 753 acres of oyster habitat and 1,730 acres of shrimp habitat in Coos Bay. About 3 acres of oyster habitat and 10 acres of shrimp habitat would be permanently reduced primarily from construction and operation of the access channel. The largest temporary effect would be from the construction of the Eelgrass Mitigation site that would reduce shrimp habitat by about 4 acres. Overall, there would be temporary short-term disturbance of about 1 acre of oyster habitat and 6 acres of shrimp habitat primarily from the construction of the Kentuck project and Eelgrass Mitigation sites in addition to temporary effects from construction of the access channel. Less than about 1 acre of shrimp habitat would be disturbed by the construction of the 1,100-foot-long pile dike rock apron, which would include modification from soft bottom to riprap habitat that could affect future habitat suitability for these organisms.

<u>Dredging of the Slip Access Channel, Navigation Channel, and Other Facilities</u>

About 1.4 mcy would be removed by marine dredging during creation of the access channel in the bay. Effects of dredged material placement to terrestrial habitats is addressed in other portions of the EIS including sections 4.3.3 (Wetlands), 4.4 (Upland Vegetation). and 4.5.1 (Terrestrial Wildlife). The creation of the access channel would result in the modification of about 37 acres of present-day subtidal and intertidal habitat to deeper water habitat in the bay. The dredging operation to create the access channel would change physical conditions of the bay bottom in this area, locally altering the bathymetry and potentially altering the morphology and water currents. About 19 acres of intertidal to shallow subtidal habitat, including approximately 2 acres of eelgrass habitat and less than 1 acre of salt marsh, would be modified to primarily deep subtidal habitat during the dredging process of the deepened channel. Increasing depth and removal of vegetation would reduce the quality of habitat for juvenile salmonids and other juvenile marine species.

The construction of the access channel would affect local aquatic resources by removal or conversion of some habitats. This would include construction of the temporary barge landing facility on the southwest portion of the access channel, that would occur prior to the excavation and dredging required to complete the LNG carrier offloading facility. Additionally, the MOF would be constructed in the southeast portion of the entrance as a permanent facility to allow offloading of large equipment. There would also be short-term turbidity from dredging in the bay, and additional erosion of the shoreline during construction activities could result in sedimentation. To control upland soil erosion and potential sedimentation, Jordan Cove would follow the measures outlined in its ESCP; for marine waters, measures in their *Dredged Material Management Plan*[116] would be followed.

There is also the potential for an accidental oil or fuel leak from dredging equipment to affect aquatic resources in the bay. To avoid or reduce effects from oil or fuel leaks, Jordan Cove developed a preliminary SPCC Plan.[117]

About 37 acres of current upland habitat excavated and dredged to create the marine slip would be converted to open water, primarily deep subtidal habitat. While this area would have little intertidal habitat due to steep banks, it would supply some subtidal habitat that would not have been present without the Project. This habitat, however, would be highly disturbed due to large vessel arrivals and departures, and would generally be of low quality habitat for most species because of its armored banks, steel retaining walls, and lack of current in the slip.

To improve navigation reliability for LNG carriers, Jordan Cove proposes to excavate four submerged areas in Coos Bay along the vessel access route. This would include the dredging of some 27 acres of deep subtidal habitat at bend areas along the route and the dredge lines for this activity would include another 13 acres of mostly deep subtidal habitat modification. These dredging activities and follow-up maintenance dredging would disturb this habitat and, in the short term, reduce function of these areas primarily from disturbance to benthic and epibenthic organisms living in these areas and organism that feed in these areas.

The installation of the pile dike rock apron would change habitat from soft bottom to rock habitat over an area of about 2 acres. The construction would include short-term increase of local turbidity from bottom disturbance and initial loss of benthic organisms by burial. While the preferred placement of the riprap would be from a barge, some may occur in the intertidal area by land-based equipment, which may cause short-term effects on benthic organisms from transit of vehicles across the intertidal areas as part of rock placement. Construction would be limited to one in-water work window period when many important fish species, such as salmon, are of low abundances, reducing potential effect from local turbidity increases and loss of benthic and epibenthic resources from rock placement and shoreline vehicle transit used to place the rock. Increased rock areas may supply more habitat for rock-oriented species and cover for potential juvenile salmonid predators. Jordan Cove has identified two specific sites in Coos Bay that would be set aside and/or developed as compensatory wetland mitigation[118] for loss of intertidal and subtidal habitat from dredging. Their construction would also contribute to local turbidity.

The loss of 2 acres of eelgrass would be mitigated by off-site development and planting of a minimum of 6 acres of eelgrass habitat in the bay. The area proposed has been used successfully for eelgrass mitigation in the past. Donor stock eelgrass would be obtained from a combination of sites, including managed commercial oyster beds and existing high-density eelgrass areas, for use

[116] The plan was attached as Appendix N.7 to Resource Report 2, as part of Jordan Cove's application to the FERC filed in September 2017.

[117] This plan was attached as Appendix F.2 to Resource Report 2 of Jordan Cove's application to the FERC filed in September 2017.

[118] Jordan Cove included a *Compensatory Wetland Mitigation Plan*, attached as Appendix O of their *Draft Applicant-Prepared Biological Assessment.*

in establishing new eelgrass beds at the mitigation site. There would be some short-term loss of eelgrass habitat from those areas dredged during construction and from the removal of donor stock areas when the Eelgrass Mitigation site is planted. The use of salvaged eelgrass from commercial oyster beds and taking donor stock only from high-density areas would reduce short-term effects caused by developing the Eelgrass Mitigation site. As noted above, the total area of eelgrass affected is small relative compared to that habitat in Coos Bay, but some local short-term reduction in productive estuarine habitat would result.

Disturbance to 17 acres of other estuarine habitats (non-eelgrass) would be mitigated with re-establishment of estuarine habitat on about 91 acres of unvegetated mudflats at the Kentuck project site. This mitigation site would reestablish 67 acres of tideland habitat and additional wetland acreage. It would be a combination of native estuarine habitats (saltmarsh, tidal sand/mudflats) and freshwater wetland habitat (forested, scrub/shrub and emergent) (see section 4.3.3). Kentuck Slough is located on the east shore adjacent to the main inner bay between the area affected by the Project and Coos River mouth. This area would be modified with the addition of some of the dredged tailings from the LNG slip excavation. Additionally, 2.7 acres of floodplain habitat would be re-established adjacent to Kentuck Creek and would include stream enhancements including realignment of Kentuck Creek through the site. This area is close to the main Coos Bay river channel, which would benefit early marine-rearing juvenile salmonids.

The details of the plan, measures of success, and contingencies are provided in the *Compensatory Wetland Mitigation Plan*; however, final acceptance of the adequacy of the plan by ODSL or other resource agencies is pending. Therefore, Jordan Cove must continue to consult with the COE, NMFS, ODSL, and ODFW and other appropriate resource agencies to develop a final wetland mitigation plan for permanent effects on eelgrass and other estuarine habitats (see section 4.3).

Considering the mitigation measures proposed, and the implementation of mitigation plans, dredging activities would have only short-term effects on subtidal and intertidal habitat in Coos Bay.

Increased turbidity and sediment from dredging for the slip construction and navigation channel expansion would also affect marine and estuarine organisms. There are other project actions that would also increase local turbidity such as eelgrass mitigation site dredging, pile dike rock apron construction, and others. These are discussed in section 4.3.2.2 of this EIS.

Jordan Cove has stated that their construction plans, including their ESCP, would prevent turbid water from on-land construction, dredge material placement, and slip formation to be discharged or allowed to flow into Coos Bay. All in-water work would be restricted to the in-water work window from October 1 to February 15, contributing to reducing effects on fish habitat and species.

A large quantity of suspended sediment can reduce light penetration, which in turn reduces primary production of both pelagic and benthic algae and grasses. Increased suspended sediment can affect feeding of benthic and pelagic filter feeding organisms (Brehmer 1965; Parr et al. 1998), and the settling of the suspended particles can cause local burial, affect egg attachment, and modify benthic substrate. High enough levels can have direct adverse effects on fish ranging from avoidance to direct mortality. Use of pumps to convey the material in a hydraulic dredging operation would serve to contain most of the siltation caused by the dredging. The siltation would be conveyed with the material removed to the disposal area where it would settle out before being discharged back to the waterbody. The suspended sediment and turbidity levels would decline to ambient levels following completion of dredging activities.

Because of the short duration and small areas of in-water work for project activities other than dredging, effects on aquatic organisms from elevated turbidity would be localized and short term, likely diminishing in a few hours. However, dredging of the access channel would require in-water work that would occur over a longer timeframe and larger area. Dredging of the access channel would result in temporary siltation and sedimentation effects similar to those that currently occur during COE maintenance dredging of the Coos Bay navigation channel. On average, the COE removes approximately 550,000 cy from the bar, 200,000 cy from NCM 2 to 12, and 150,000 cy from NCM 12 to 15 each year. In-water dredging of the slip and access channel would occur over four in-water work periods totaling about 4 to 6 months.

The ambient turbidity levels in the water (generated by flows, waves and ship traffic) create a background level of turbidity. Within Coos Bay, turbidity measurements observed as total suspended solids (TSS) at the Charleston Bridge over a two-year period show an average summer TSS level of 10 mg/l and an average winter level of 27.3 mg/l. Some individual events (e.g., winter storms) measured at the Charleston Bridge were recorded between 100 and 500 mg/l. Therefore, aquatic organisms in Coos Bay are adapted to and exposed to periods of high to moderate turbidity during the winter months. Dredge operations are expected to result in similar effects, with higher concentrations of TSS in the immediate area of dredging.

Jordan Cove conducted modeling to estimate turbidity and suspended sediment that would result from access channel construction (Moffatt & Nichol 2006a) and the construction and maintenance dredging for all proposed bay activities (Moffatt & Nichol 2017c). The details of the model results on quantity and distribution of these parameters are discussed in section 4.3.2.1. The maximum TSS at a specific dredge site using a clamshell dredge was estimated to be about 6,000 mg/l decreasing substantially away from the dredge location. Moffatt & Nichol (2006a) also estimated that average turbidity levels during dredging operations (covering changing tidal directions) would not exceed background levels (about 10 to 30 mg/l) for the mechanical dredge at the slip. These levels would be even less for the hydraulic dredge beyond the actual dredge location, while elevated levels would occur outside of the actual dredge area for periods not exceeding 2 hours in duration depending on tidal direction. At lower tidal velocities, values would not exceed 30 mg/l outside of 200 meters, and at high tidal velocity less than 50 mg/l in 200 meters.

The concentrations and distribution are partly dependent on the type of dredging method that would be used. Proposed methods for dredging include use of mechanical or hydraulic (suction) dredging equipment. While the hydraulic cutter suction dredge is preferred due to its lower turbidity generation, a type of mechanical dredge may be used, especially in portions of the nearshore area due to buried wood. Model results for the access channel and slip construction indicate that elevated TSS above background would extend about 0.2 to 0.3 mile beyond the dredge sites during a full tidal cycle with any method considered and would exceed about 500 mg/l for about 0.1 mile. Maximum concentrations outside of the specific dredge location would only occur for about 2 hours or less over the tidal cycle with the plume moving upstream or downstream of the dredge site on flood or ebb tide, respectively. TSS concentrations at the four navigation channel expansion sites (i.e., part of the marine waterway modifications) would reach background level (about 20 mg/l) over a distance of about 1.2 miles[119] with any of the dredging methods. However, hopper style suction dredging would have much higher concentrations during construction with TSS over 500 mg/l extending about 1.0 mile across the dredging site, while the hydraulic cutter suction dredge or mechanical clamshell dredge would produce TSS of 500 mg/l extending about 0.1 mile from the dredge site. The distribution of and concentrations of suspended sediment would be the same for construction or maintenance dredging. If a mechanical excavator would be used for the eelgrass site construction, a confined area of elevated TSS would extend less than 0.1 mile from point of dredging (Moffat & Nichol 2017c). The more limited effect of tidal flow over the area would help confine the distribution of the elevated sediment plume. These elevated levels would be short term and highly localized to the nearshore area of the eelgrass site.

During the dredging process, some small fish (such as sandlance), larvae, and fish eggs could be entrained. Larger fish would be able to avoid this process and would likely actively avoid the area during the dredging disturbance process. In a review of many maintenance dredge studies through 1998, Reine and Clarke (1998) concluded that "much of the available evidence suggests that entrainment is not a significant problem for many species of fish and shellfish in many bodies of water that require periodic dredging." However, Dungeness crab in some studies are highly susceptible to entrainment (Reine and Clarke 1998; Pearson et al. 2002, 2005). Based on this review, it appears that entrainment of marine fish and shellfish species would not be a substantial effect on the local marine resources, although some important fish and shellfish may be reduced in abundance locally. Effects would be minimized by the current in-water work windows (October 1 to February 15) and by maintaining the cutterhead near the bottom if a hydraulic dredge is used.

If salmonids are exposed to moderate to high levels of TSS for prolonged periods, many adverse effects could occur including behavioral changes, sub-lethal effects, and increased mortality from predators. Dredging is expected to create spikes of high to moderate turbidity in a localized area. Effects on estuarine organisms and their habitat are expected to be slight and not measurable due to the limited area affected and the short duration of dredging operations, and limitations on construction periods. Rearing and migrating salmonids including ESA listed salmon, which should be uncommon in Coos Bay during the in-water work window, would likely avoid active work areas.

In Coos Bay, suspended sediment from dredging activity could affect shellfish, including clams and oysters and other filter feeders in the immediate vicinity and downstream of the access channel dredging site. Depending on dredging-induced elevated suspended concentration and exposure duration, effects on individual species and life stage from elevated suspended sediment could include no, minor, or major behavioral effects, physiological stress, reduced growth, or reduced survival and reduced egg hatching success (Wenger et al. 2018). Entrainment of organisms, especially eggs and larvae, may also occur. Dredging of the access channel and marine waterway modifications would be in deep water areas away from major commercial oyster areas as well (figure 4.5-2) and would likely not results in substantial effects from elevated turbidity or entrainment of commercial shellfish.

Jordan Cove's dredging would also directly remove benthic organisms (e.g., worms, clams, benthic shrimp, starfish, and vegetation) from the bay bottom within the access channel and navigation channel modifications. Mobile organisms such as crabs, many shrimp, and fish could

[119] Plume distance noted includes total spread both upstream and downstream of dredge site.

move away from the region during the process, although some will be entrained during dredging so that direct mortally or injury could occur. Based on 1978 maps of shellfish (Gaumer et al. 1978), shrimp, soft shell calms, bentnose clams, and cockles are located within the intertidal areas near the slip and within dredge areas (west of the Roseburg Forest Products Company site). The four navigation channel modifications are not located in known clamming or crabbing areas, or shrimp or oyster habitat (figure 4.5-2). ODFW captured Dungeness crab and red rock crab in this area during 2005 seining efforts near the access channel location. Varied species could be injured or killed during dredging operations. Dredged areas typically have edge areas sloped to maintain their stability, reducing the potential for bank sloughing and restricting direct impacts on areas dredged. Dungeness crabs and sand shrimp (Crangon spp.) can be especially susceptible to entrainment, although many survive dredging (Reine et al. 1998). Dungeness crab entrainment has been reported as substantial in some areas depending on season, salinity, location, and type of dredge used (Pearson et al. 2005, 2002). Reine and Clark (1998) reviewed dredging studies and concluded that "much of the available evidence suggests that entrainment is not a significant problem for many species of fish and shellfish in many bodies of water that require periodic dredging." Dredge entrainment studies over a four-year period in the Columbia River found no juvenile or adult salmonids entrained during dredging, although some other pelagic fish including eulachon were entrained (Larson and Moehl 1990).

When benthic communities on mud substrates have been disturbed by dredging in Coos Bay, they typically recovered to pre-dredging conditions within 4 weeks (McCauley et al. 1977, as cited in Wilber and Clarke 2007). However, recovery in estuarine channel muds has been reported in a review paper of dredging to be typically six to eight months (Newell et al. 1998). In the lower Columbia River, McCabe et al. (1997, 1998) noted benthic organism recovery in three months. Studies of a dredged sandy substrate area in Yaquina Bay Oregon found recovery of benthos took one year (Swartz et al. 1980, as cited in Wilber and Clarke 2007). Because of the large quantity being dredged and type of substrate, it may take longer than a four-week period relative to typical dredging and thus the benthic communities in the areas to be dredged may take a more varied time period to recover. The similarity of sandy substrate, like that of Yaquina Bay, suggest it is likely that recovery would be closer to a year for benthic resources particularly in the navigation channel modifications.

We would also expect increased organic matter production to the Coos Bay system from Jordan Cove's proposed eelgrass and wetland mitigation sites. The Kentuck project would provide about 67 acres of shallow water habitat as mitigation for the loss of about 16 acres of shallow estuarine water habitat at the access channel and the Eelgrass Mitigation site would provide 6 additional acres of eelgrass habitat as mitigation for the loss of 2 acres of eelgrass habitat. The affected shallow water habitat is suitable habitat for oysters (about 3 acres) and shrimp (about 10 acres). The development of the Kentuck project would likely contribute to replacing this type of habitat loss since existing oyster and shrimp habitat is present near Kentuck Slough.

Additionally, although sediment samples to date have not indicated high organic content sediment, some high oxygen demand sediment could be encountered during dredging. This could remove oxygen from the local water areas, putting local organisms at risk from insufficient oxygen. This effect would be temporary, and tidal exchange would be expected to replenish oxygen. In most cases, where dredging and disposal occurs in open coastal waters, estuaries, and bays, localized removal of oxygen has little, if any, effect on aquatic organisms (Bray et al. 1997). Also, Nightingale and Simenstad (2001b) reviewed literature in a summary document on effects of dredging and could find no empirical data indicating reduction in oxygen was an issue of concern for estuarine and marine organisms for dredging actions.

Dredging may also resuspend nutrients to the water column and could affect primary production. At low levels, this could be of benefit, increasing phytoplankton production, which could benefit prey species eaten by fish. However, in estuaries, this production is limited by turbidity and flushing, so any effects would be slight and local.

The initial marine waterway modifications (i.e., widening) in four areas would have minor habitat changes in Coos Bay. Deepwater habitat area would be further deepened in the four areas totaling about 27 acres of benthic deepwater habitat disturbance, plus an additional 10 acres deepwater habitat for the slurry transport lines. Less than an additional acre of shallow water habitat would be disturbed from the dredge lines used. The deeper water habitat is generally less productive than the shallow water environments. As with all dredging, there would be an initial loss of benthic resources from the dredging of the navigation channel that would recover over time. Overall habitat structure of the bay would remain essentially unchanged from the widening of the channel in these areas. Some of this net loss would be offset by added annual benthic production from the newly formed 37-acre slip habitat, even though it would likely be of poor quality.

In conjunction with all dredging activities would be the placement of temporary pipelines (18 to 20 inches in diameter) possibly on the bottom of Coos Bay to the deposition areas of the dredged sediment. This would include a pipeline route up to about 7 miles from the navigation widening area 1 to 4 miles to APCO Sites 1 and 2, one from the Eelgrass Mitigation site to APCO Sites 1 and 2 (about 0.5 mile), and another line extending from the shipping channel near the APCO Site to the Kentuck project (about 1.5 miles). These would have some initial bottom disturbance from placement and would likely kill benthic organisms (e.g., clams, worms) that are under the pipe placements. Most of the line would be in deep water paralleling the navigation channel from the four navigation modifications, which is an area often currently disturbed by shipping and maintenance dredging. Overall, there would be some reduction in benthic organism abundance from this direct placement of the pipes. The effective periods of this activity would be brief each year, occurring only during the construction in-water work window taking about 5 months total over four in-water work windows.

Maintenance dredging would occur every three to five years, with dredging taking about a month for the slip and access channel and a week for the navigation channel modifications. This would keep the navigation channel depth as it is currently, and the LNG slip depth as originally developed. Thus, after the project-developed initial widening, the current habitat structure of the navigation channel would remain unchanged and slip area would be as originally developed following each maintenance dredging cycle.

Construction windows for in-water dredging, developed by the state, are intended to minimize effects on the overall aquatic environment. The in-water work window (October 1 through February 15) would minimize the exposure of juvenile salmonids to increased turbidity during outmigration but would occur during much of the adult salmonids' upstream migration. Resident estuarine species, however, would be present during the in-water work window.

New Deepwater Habitat

The construction of the slip and berth would add a new region of deeper water habitat in Coos Bay. The area would have steep riprap sides that would have little biological diversity in shoreline habitat. The deeper areas may have slightly different fish composition than the main bay but overall the change in depth would be slight relative to the main adjacent navigation channel. Based on COE surveys, the navigation channel adjacent to the proposed site is 44 feet deep, with proposed slip depth 45 feet similar to the local deep bay areas, although to the side of the channel. While future composition of the channel species cannot be predicted, it appears conditions would not be substantially different than the adjacent navigation channel area. This may, however, result in some species composition differences locally. It would remain a relatively disturbed area for organisms, with the frequency of LNG carrier traffic likely reducing its overall benefit to fish and invertebrate resources. However, the final use of this new environment and changes in use from the existing conditions cannot be completely estimated now and conditions may take time to fully develop. This also holds for the four navigation channel modifications; however, these areas are already deep (all greater than 26 feet and would be deepened to 37 to 41 feet) and would include gradually sloped banks to prevent slumping in these areas. Aquatic resources, such as fish, shellfish, and marine mammals that may use Coos Bay, are under the management of ODFW and NMFS. In its response to the FERC staff's pending BA and EFH Assessment (see section 4.6 of this EIS), the NMFS can impose conditions through its BO to protect aquatic resources in the new deepwater habitat created by the Jordan Cove terminal slip.

Pile Driving Acoustic Effects

There are three basic types of pilings proposed: steel sheet pile, steel post piles, and wood post piles. The methods of installation that can be used for installation is a vibratory hammer or impact hammer, with some piling installed using both methods. Generally, noise levels are less with the vibratory hammer. Most of the construction-related pilings would be installed well away from the water. However, some pilings would be installed directly in the water or near the water where sound waves may transmit substantially into the water. Jordan Cove would install pipe piles and sheet piles for the Project including the marine and upland piles (see chapter 2). About 600 of these pilings are associated with the marine facility. These steel piles would be for the LNG carrier berth and MOF on the southeast side of the marine slip. Most of these piles would be driven land-side adjacent to the berth and while the upland portions of the marine berth are still isolated from the bay by the berm. Additionally, about five metal piles would be installed in the shallow water in support of dredge tailings pipeline over eelgrass beds to the APCO Site. Some additional temporary pilings would be installed in the wet[120] for the MOF, temporary material barge berth (TMBB), temporary dredge off-loading areas, road widening area, and access bridge to the APCO site. A total of 119 in-water steel pipe piles would be driven for the Project considering all these facilities with a lesser number of sheet piles (most driven primarily by vibratory hammer and some limited impact hammer use). An additional 1,150 wood piles would be installed for the road widening at U.S. Highway 101.

Underwater noise that may result in harassment and/or take of marine mammals is regulated by the NMFS under the MMPA. Under the MMPA, Level A harassment is statutorily defined as any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine

[120] Installing a piling "in the wet" or "in water" means the piling is in direct contact with the water body when it is driven into the substrate with an impact or vibratory hammer

mammal stock in the wild; however, the actionable sound pressure level is not identified in the statute. Level B harassment is defined as any act of pursuit, torment, or annoyance that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.

In July 2016, the NMFS finalized their *Technical Guidance for Assessing the Effect of Anthropogenic Sound on Marine Mammals* (NMFS 2016c). Under this new NMFS guidance, Level A harassment is said to occur as a result of exposure to high noise levels and the onset of permanent hearing sensitivity loss, known as a permanent threshold shift (PTS). This revision to earlier NMFS guidelines is based on findings published by the Noise Criteria Group (Southall et al. 2007), which concluded that for transient and continuous sounds, the potential for injury is not just related to the level of the underwater sound and the hearing bandwidth of the animal, but is also influenced by the duration of exposure. The evaluation of the onset of PTS provides additional species-specific insight on the potential for affect that is not captured by evaluations completed using the previous NMFS thresholds for Level A and Level B harassment alone.

Frequency weighting provides a sound level referenced to an animal's hearing ability either for individual species or classes of species, and therefore a measure of the potential of the sound to cause an effect. The measure that is obtained represents the perceived level of the sound for that animal. This is an important consideration because even apparently loud underwater sound may not affect an animal if it is at frequencies outside the animal's hearing range. In the NMFS (2016c) final Guidance document, there are five hearing groups: low-frequency (LF) cetaceans (baleen whales), mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales), high-frequency (HF) cetaceans (true porpoises, Kogia, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* and *L. australis*), Phocid pinnipeds (true seals), and Otariid pinnipeds (sea lions and fur seals). All of the above-listed species except Otariid pinnipeds potentially occur in the aquatic analysis area.

There are specific hearing criteria thresholds provided by the NMFS for each functional hearing group. These criteria apply hearing adjustment curves for each animal group known as M-weighting (see table 4.5.2.2-3).

TABLE 4.5.2.2-3

M-Weighted PTS Criteria and Functional Hearing Range for Marine Mammals

Functional Hearing Group	PTS Onset Impulsive	PTS Onset Non-Impulsive	Functional Hearing Range
LF cetaceans (baleen whales)	219 dB_{peak} & 183 dB SEL_{cum}	199 dB SEL_{cum}	7 Hz to 35 kHz
MF cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	230 dB_{peak} & 185 dB SEL_{cum}	198 dB SEL_{cum}	150 Hz to 160 kHz
HF cetaceans (true porpoises, Kogia, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* and *L. australis*)	202 dB_{peak} & 155 dB SEL_{cum}	173 dB SEL_{cum}	275 Hz to 160 kHz
Phocid pinnipeds (underwater) (true seals)	218 dB_{peak} & 185 dB SEL_{cum}	201 dB SEL_{cum}	50 Hz to 86 kHz
Otariid pinnipeds (underwater) (sea lions and fur seals)	232 dB_{peak} & 203 dB SEL_{cum}	219 dB SEL_{cum}	60 Hz to 39 kHz

NMFS has defined the threshold level for Level B harassment at 120 decibels root mean squared (dB_{RMS}) for continuous noise and 160 rms_{90} sound pressure level (SPL) for impulse noise. Within this zone, the sound produced by the Project may approach or exceed ambient sound levels (i.e., threshold of perception or zone of audibility); however, actual perceptibility will be dependent on the hearing thresholds of the species under consideration and the inherent masking effects of ambient sound levels. The Level B harassment threshold was not updated with the July 2016 technical guidance.

Underwater noise from project construction activities could affect fish resources in Coos Bay. State agencies in Washington, Oregon, and California along with federal agencies including the FWS and NMFS have developed interim noise exposure threshold criteria for pile-driving effects on fish (WSDOT 2011; Fisheries Hydroacoustic Working Group 2008; Popper et al. 2006). These threshold criteria are considered levels below which injury effects would not occur to fish from in-water noise. These thresholds should be suitable for all forms of in-water noise. Interim noise exposure threshold criteria for pile driving effects on fish include: 1) a cumulative sound exposure level (SEL_{cum}) of 187 dB re 1 μPa^2 s for fishes more than two grams, 2) a SEL_{cum} of 183 dB relative to 1 square microPascal (re 1 μPa^2) for fishes less than two grams, and 3) a single-strike peak level (SPL_{peak}) of 206 dB re 1 μPa for all sizes of fishes (Fisheries Hydroacoustic Working Group 2008; WSDOT 2011). Generally, the high peak value is associated with potential mortal injury and forms of recoverable injury while the cumulative values are associated with forms of impairment that are likely recoverable forms of injury (Popper et al. 2014). While more recent studies based on additional information have recommended slightly different guidelines (Popper et al. 2014) these have not yet been implemented by the above agencies as new criteria. Piling location relative to water area, substrate piling is driven into, type of piling, and method of pile driving all influence the magnitude of in-water noise level and therefore the likelihood of noise levels injuring marine mammals and fish.

The potential noise levels relative to fish and mammal criteria of sheet pile and post pilings that would be installed at the LNG site out of the water were modeled (Deveau and MacGillvray 2017; O'Neill and MacGillivray 2017b; Wladichuk et al. 2017; Wladichuk et al. 2018). The sheet pile installation modeled were those that would be closest to the water. These sheet piles would be installed behind a 30-foot-wide berm separating the installation from the water. Wladichuk et al. (2018) modeled the installation of 36-inch steel post pilings by impact hammer located 100 feet back from sheet piles and adjacent to the water at the MOF.

The available information on decibel levels from these models were entered in the NMFS impact model for fish (NMFS 2009) for vibratory sheetpile installation to approximate the extent of potential noise effects from a general location in Coos Bay. Model results based on data from Deveau and MacGillvray (2017) indicate essentially no likely affect to fish from sheet piles installed away from the water. If any sheet piles were installed in or near the water edge, some adverse effects on fish that remain near the installation site (table 4.5.2.2-4).

Impact hammer use on steel post piles also was modeled for those near the MOF. Using the criteria noted above, estimated extent of potential injury to fish from these of pile installation are shown in table 4.5.2.2-4. While not directly modeled by Wladichuk et al. (2018), there will be unspecified locations in the bay that will have in-water pilings installed to anchor the navigation channel dredging pipes. Since most of these pilings would be installed with a vibratory hammer, effects on fish would limited in most areas. However, if an impact hammer were used, noise effects on fish in these areas would be limited because of the low number of impacts. Therefore, the extent of noise impact distribution is likely to be absent or limited in most other areas; however, where impact hammer is used, effects could be similar to those shown in table 4.5.2.2-4 if noise-dampening mitigation is not applied.

TABLE 4.5.2.2-4

Modeled Onset of Injury Distances of Unmitigated Metal Pile-Driving Sound Effects on Fish in Coos Bay during Construction

	Distance Threshold (ft) to Onset of Physical Injury to fish		
		Cumulative SEL dB by Fish Size	
Criteria and Hammer Type	**Peak dB**	**Fish ≥ 2 grams**	**Fish < 2 grams**
dB Criteria Threshold	206	187	183
Vibratory Hammer a/	0 ft	380 ft	380 ft
Vibratory Hammer b/	0 ft	<10 ft	< 10 ft
Impact Hammer MOF100-ft set back c/	120 ft	0.5 miles	0.5 miles
Impact Hammer MOF at shore c/	120 ft	1.1 miles	1.1 miles

a/ In water sheet pile noise level values averaged from data in Illinworth and Rodkin (2007). Model estimate from NMFS (2009); assumed 10,000 hammer impacts in 24 hours

b/ Sheet pile 30 feet back from water, peak value from Deveau and MacGillvray (2017). Model estimate from NMFS (2009); assumed 10,000 hammer impacts in 24 hours

c/ Assume 10,000 and 20,000 hammer impacts within 24 hours (Source: Wladichuk et al. 2018)

In addition, there would be 1,150 wood piles and sheet piles constructed at the Trans-Pacific Parkway/U.S. 101 intersection widening. These piles may be installed above or below water level depending on tide level. The methods for wood pile installation are unknown, but sheet piles would be installed by vibratory hammer with an impact hammer being used if necessary. One report measured peak values of 180 dB 10 meters from wood piling when using an impact hammer (Illinworth and Rodking 2007). Data are not available on noise levels from a vibratory hammer on wood, but vibratory hammer noise levels are generally much lower at peak noise production than those from an impact hammer. With the number of pilings to be installed, the frequency of piling contacts would be high. There is some risk of cumulative noise levels associated with wood pile-driving being an issue if peak noise values were near 180 dB. Jordan Cove has indicated that an impact hammer would not be used on sheet piles if they were inundated by high tides; implementation of this commitment would reduce the effects of cumulative and peak noise levels on fish.

Mitigative actions would be taken to reduce the potential effects of noise on fish. The estimates of noise levels that may cause injury to fish (table 4.5.2.2-4) assume that no mitigation (such as a bubble curtain) is in use, and that fish would remain in the area of adverse noise effects during the whole period of installation. Jordan Cove would implement sound attenuation measures in accordance with NMFS guidelines as needed, and fish are mobile and unlikely to remain in areas where cumulative noise levels would result in injury. All in-water pile driving would also occur only during the ODFW in-water approved construction window of October 1 to February 15, which would avoid noise injury to most salmonids.

General equipment used (e.g., trucks, compressors) and construction activity other than pile driving would all have noise levels below any that would affect marine mammals or fish (all less than 90 dB maximum). Noise in air produced by pile driving was modeled by Jordan Cove, and it was found that peak noise within 23 feet for all piles (18- to 72-inch diameter) being driven would be less than 117 dB and maximum of 101 dB at 50 feet, well below levels that would affect fish even if in the water. During pile driving, noise levels in air would decrease to below 90 dB_{RMS} (current in-air behavioral disruption threshold for harbor seals) at approximately 920 feet from the nearest piling rig. The current in-air behavioral disruption threshold for pinnipeds other than harbor seals (e.g., the California sea lion and Steller sea lion) is a less stringent 100 dB_{RMS} (NMFS 2018a). As a result, marine mammals within this distance could experience some behavioral disruption during pile driving.

Marine mammals inside Coos Bay may be affected by underwater noise from pile-driving during construction. The greatest distance at which PTS due to impulsive peak noise may possibly occur is around 250 feet for the harbor porpoise. Outside Coos Bay, the potential for effects on marine mammals from piling is limited to behavioral disturbance due to noise. Vibratory sheet pile driving has the potential to exceed the NMFS interim behavioral disturbance threshold of 120 dB re 1 μPa at distances of up to 1.2 miles (Deveau and MacGillvray, 2017). Impact pipe pile driving has the potential to exceed the NMFS interim behavioral disturbance threshold of 160 dB re 1 μPa at similar distances (O'Neill and MacGillvray 2017).

Jordan Cove would consult with the NMFS to design a monitoring and adaptive management plan including the development of a pinniped safety zone. If sound levels are determined to exceed NMFS Level A regulatory thresholds for marine mammals or guidelines for listed salmonids, sound attenuation measures would be used in accordance with NMFS guidelines. The NMFS has indicated that they may require additional monitoring as well as noise mitigation for the Project, including potentially the use of bubble curtains, sediment curtains, as well as various ongoing monitoring programs. These measures would be included, if required, in the NMFS BO.

Erosion and Runoff from Upland Facilities

Effects on marine resources could occur from the clearing of vegetation at the terminal, erosion and sediment runoff, and potential hazardous substance spills during construction. While no streams are present in the upland portion of the terminal, the removal of current vegetation could modify the character and amount of water runoff into the bay.

Nearshore vegetation clearing could indirectly affect aquatic resources in the bay; however, the amount of nearshore vegetation that would be removed for this Project is small. No planned nearshore disturbance would occur outside of the upland and shoreline that would be excavated and dredged to create the marine slip for the terminal. Jordan Cove would prevent uncontrolled releases of sediment runoff during construction by implementing erosion control and revegetation measures from its ESCP.

During construction of the LNG terminal facilities, stormwater runoff could erode disturbed soils, creating sediment in nearby surface waters, and affect local aquatic resources. Stormwater runoff from the disturbed portions of the site would be managed in accordance with Jordan Cove's ESCP and ODEQ-approved *Storm Water Management Plan* (see section 4.3.2.2). Following appropriate treatment, such as electro-coagulation, chemical flocculation, or filtration, if needed, all construction stormwater from the LNG terminal site would be directed toward Coos Bay.

Additionally, accidental spills of hazardous materials (e.g., equipment fuel, oils, and paints) during construction could have effects on aquatic resources in the bay. Jordan Cove prepared a preliminary SPCC Plan for construction to minimize the potential for accidental releases of hazardous materials.

Hydrostatic Testing

Water would be used for hydrostatic testing of the LNG storage tanks and piping prior to placing them in service (see chapter 2). The source of water would be local untreated potable supply from the CBNBWB. After completion of the test, the water would be discharged by filtration through the ODEQ-approved stormwater system or through the existing industrial wastewater pipeline. Permits would be obtained for all wastewater discharges as required by ODEQ. Water discharges would be treated, if necessary, to comply with discharge permits. If treatment were required, treatment procedures would be developed prior to discharge. The discharge through the existing industrial wastewater discharge pipeline, which connects to the previously existing ocean discharge diffuser location, would be at a rate of about 2.9 mg/d. Given that the water would be used inside the LNG storage tanks, chemicals would not be added, the water would be tested for quality and treated if necessary prior to discharge and would enter the ocean through a diffuser allowing rapid dissipation and mixing, the release of hydrostatic test water would not likely affect the ocean aquatic environment.

Construction Supply Vessel Transit

Much of the supplies needed for construction of the terminal and related facilities may be transported by break bulk ships and barges. These vessels would be similar to those used for typical transport of materials into Coos Bay. Approximately 60 deep-draft commercial cargo ships and 50 barges arrive in Coos Bay per year currently; while the frequency of vessel traffic would increase during the construction period, effects on marine resources would be similar to those that normally occur during commercial vessel traffic. The types of effects would be similar to those described for LNG carrier traffic but likely less due to a reduced number of trips and smaller vessel size. This would include effects of vessel strikes, ship grounding, shoreline erosion and fish stranding from vessel transit in the bay, fuel and oils spills and introduction of nuisance species. See section 4.5.2.1 for details of analysis of LNG transport effects addressing these parameters.

Effects on Aquatic Habitat and Aquatic Species from Operating the Jordan Cove LNG Project

Water Use by LNG Carriers at Berth

Jordan Cove estimates that about 110 to 120 LNG carriers would visit its terminal each year. While at the terminal dock for a period of about 17.5 to 24.5 hours, these LNG carriers would release ballast water while taking on LNG cargo. They also would take in water from the marine slip to cool their engines and would slightly affect the temperature of the water in the slip due to either the release of warm water after engine cooling or contact with the cool hull after taking on LNG cargo. These activities could have effects on aquatic resources in the slip.

Ballast Water

LNG carriers would discharge ballast water into the slip after arriving at the terminal berth and taking on cargo. As explained in section 4.3.2.2, Jordan Cove estimated that an LNG carrier taking on cargo at its berth would discharge about 9.2 million gallons of ballast water into the marine slip during the 17.5 hours it would be hoteled at the terminal. Ships may actually spend 24 hours at the berth so water use may be higher, as noted below. The potential of introduction of nuisance species from vessel transit including ballast water discharge was discussed earlier in section 4.5.2.1. Because the ballast water would have been taken on at sea, it might have slightly higher salinity than the water in Coos Bay that is fed from upstream fresh water sources. The tidal cycling of water in Coos Bay would reduce the effect of more saline seawater from ballast release in the slip on local aquatic resources. We estimate the total slip area to cover about 4.8 mcy (3.7 million m^3) of water. Therefore, the ballast water release would only amount to 1 percent of the entire size of the marine slip. By following Coast Guard and EPA procedures for ballast water, Jordan Cove and the LNG carriers visiting its terminal would probably not introduce exotic non-native organisms from a foreign port into Coos Bay.

Entrainment and Impingement from Vessel Cooling Water Intake

During operation of the terminal, LNG carriers at berth may entrain marine organisms through water taken from the slip to cool engines. Jordan Cove estimates that a 148,000 m^3 steam-powered LNG carrier would take in about 69.7 million gallons (264,000 m^3) of water from the slip for engine cooling while during their 24-hour loading period at the terminal dock. Dual-fuel diesel electric propulsion vessels (160,000 to 170,000 m^3) would take in 20.3 million gallons (76,800 m^3) less than steam-powered vessels over 24 hours.

Currently, no additional screening system other than that already employed on the LNG carriers, is proposed for water intakes. The current screen bar spacing on most LNG carriers is about 24 millimeters (mm; about 1 inch), bar width is 4.5 mm, and the total open area (considering screen open area is about 70 percent of total intake size) of the cooling water intake is about 3.5 to 4.2 m^2 or 36 to 45 square foot intake area. Additional finer mesh screens are located internally on the vessels to prevent larger items from entering the system. These screens would not meet NMFS (1997a) screening criteria for juvenile salmonids. The estimated velocity at the opening of the cooling water intake would range from 1.0 to 4.3 fps (0.30 to 1.32 meters/second), depending on the intake rate of cooling water used and intake area. The NMFS recommends an approach velocity of 0.33 fps for screening systems for salmonids of less than 60 mm, and 0.8 fps for larger juvenile salmonids. These guidelines also include other requirements such as sweeping velocity and type and size of openings that are not present on these screens. The result is likely to be that fish at fry and larger juvenile size salmonids near the intakes may be entrained or impinged during cooling water intake.

In addition, smaller marine and estuarine fish, juvenile stages of crab and shrimp, as well as other zooplankton and eggs and larvae fish could also be entrained. Some estuarine organisms potentially including juvenile salmonids would be removed from Coos Bay with this process during every loading cycle. It is expected that a high portion of juvenile larval stages of fish and invertebrates entrained or impinged would result in mortality. Nevertheless, natural mortality of these early life stages is extremely high. The result would be less than 1 percent of earliest life stages reaching adult size, with natural mortality over 20 to 30 percent per day during earliest growth periods (Comyns pers. comm. 2003). For example, data from an estuarine cooling water intake site determined that intake water larval stage entrainment, had very low natural survival (Marine Research Inc. 2004, as cited in FERC 2005). On a typical LNG carrier, the location of the water intake would be near the inner portion of the slip at depth of about 30 feet, which would likely reduce overall abundance of juvenile salmonids but not necessarily other organisms in the intake area. Salmonids migrating in Coos Bay would more likely be swimming in the main channel, away from the shoreline and the inset slip, reducing their chance of encountering the LNG carrier intakes. Other fish may have more varied distribution relative to the intake location. Therefore, the off-channel artificially created marine slip at the Jordan Cove LNG terminal would probably have a lower presence of juvenile salmonids but more varied overall fish abundance than the rest of Coos Bay.

To make a reasonable estimate of potential loss from cooling water intake, we compared the relative amount of water used by an LNG carrier while at dock at the terminal to the amount of water carried by the tide in Coos Bay past the Project vicinity. There are several assumptions with this method; the three major ones are: (1) organism distribution would be similar in water used to that in the bay as a whole, (2) all organisms entrained would be lost to the system, and (3) no avoidance to entrainment would occur. In addition, the estimate of entrainment loss was compared to what typical natural mortality loss would be for invertebrate and vertebrate life stages that are common in zooplankton as potential fish food sources. This information provides a perspective of how entrainment loss may influence food supply relative to natural conditions. This approach was developed in the Shanks et al. (2010, 2011) documents.

The period at the dock would span approximately two tidal cycles (each tidal cycle takes approximately 12 hours). We used data from Shanks et al. (2010, 2011) to make an average estimate that 106.1 million m3 of water would be passing through Coos Bay in the vicinity of the Jordan Cove terminal during one tidal cycle. This means that conservatively[121] from 0.07 to 0.25 percent of the water passing the marine slip would be taken in for engine cooling while an LNG carrier is at dock at the terminal, based on average tidal exchanges. Theoretically, organisms in this entrained water would be lost to the Coos Bay system and therefore not available as a food source. Based on the assumption that the concentration of various planktonic organisms is homogeneous in the resident water in Coos Bay, only about 0.07 to 0.25 percent of the planktonic population would be affected by each LNG carrier.

The loss of these organisms from entrainment can also be compared to loss from natural mortality in the bay environment by comparing estimated loss from entrainment to that occurring from natural mortality of typical pelagic organisms. This comparison was based on comparing instantaneous natural mortality rate (per day) loss, to loss from potential entrainment assuming all entrained organisms suffer 100 percent mortality. The natural mortality rate for various marine pelagic organisms was obtained from Rumrill (1990) and McGurk (1986). Using these rates, comparisons can be made to potential loss from entrainment to that that would naturally occur on a daily basis for a variety of typical marine organisms (table 4.5.2.2-5).

[121] Values is conservative (likely high) because total cooling water intake/discharge period is about 24 hours while we used the one tidal exchange period, about 12 hours for the estimate. Actual volume of water passing area would be about double, but some portion would be the “same” water.

TABLE 4.5.2.2-5

Comparison of Relative Loss of Larval Invertebrates and Larval Fish from Entrainment to Natural Mortality During Cooling Water Intake for One LNG Vessel Docked at the Jordan Cove Terminal

Mortality Category in Literature Source	Taxa Groups b/	Sample size	Natural Mortality Rate M (daily)(M=ln(S)/-t) c/	Estimated Percent Loss from Entrainment Relative to Daily Loss from Natural Mortality a/	
				Low Intake	**High Intake**
Lowest	Larval Invertebrate 1	14	0.0305	2.4%	8.2%
Lowest	Larval Invertebrate 2	28	0.0161	4.5%	15.5%
Lowest	Larval Fish	29	0.0200	3.6%	12.5%
Average	Larval Invertebrate 1	14	0.1450	0.5%	1.7%
Average	Larval Invertebrate 2	28	0.2470	0.3%	1.0%
Average	Larval Fish	29	0.1969	0.4%	1.3%

a/ Values based on average daily Coos Bay tidal water exchange rate of 106,000,000 m^3, and one LNG carrier water intake of 76,800 m^3 (low) and 264,000 m^3 (high) over 24 hours. Assumes 100% mortality of entrained organisms.
b/ Sources: Invertebrates from Rumrill (1990), and fish from McGurk (1986).
c/ S= Daily Survival, t=days, ln=natural log base e

Average and lowest mortality rates data for larval invertebrates and larval fish from these two sources were similar. Average loss of organisms from entrainment during one LNG carrier loading event would be low, ranging from 0.3 to 1.7 percent of what would occur from natural morality in one day. For the lowest literature mortality rate of larval taxa among those reported, daily entrainment loss would be much higher ranging from 2.4 to 15.5 percent depending on what water volume was used during one vessel loading cycle and which taxa group data are used. These values are conservative estimates when compared to natural mortality that would occur in the Coos Bay system overall because entrainment would not occur daily whereas natural mortality would, not all entrained organisms would suffer mortality, and, as noted, we assumed half the daily water volume passing the loading area.

Because about 110 to 120 LNG carrier trips a year would occur, LNG loading and water intake use would occur on average every 3 days. Therefore, relative fish food organism loss from entrainment annually would be considerably less than that estimated. Overall reduction in food sources for marine predators from entrainment of planktonic organisms appears to be slight, considering numerous factors. On average, water intake would be less than 0.3 percent of the water in Coos Bay passing by the terminal location on a daily tidal cycle, so relatively few organisms would be subject to entrainment assuming similar planktonic organism distribution at the intake. Typical “loss” on average would be about 1.7 percent or less of loss from natural mortality of invertebrate and fish larvae during the day of LNG cargo loading (table 4.5.2.2-5). Even though the number of fish individuals lost is not expected to be large, some mortality would occur. It is expected that the greatest portion of organism and fish that would be entrained would likely be early life stages, as these are unable to avoid entrainment. As noted above, natural mortality is high for these early stages.

We also considered what effect the direct loss of young stages may have on production of older individuals. EPA (2004) examined the effects of entrainment by California power plants on marine fish and shellfish. The document developed natural mortality information by life stage of common marine and estuarine species or groups of species present in the California coastal region. Many of the species groups are common to Coos Bay. This information supplies an additional indication that loss of early life stages because of high natural mortality would not markedly reduce later life stages. Table 4.5.2.2-6 shows the relative survival percent from one life stage to the next up to age 2, and overall percent survival from larval to age 1 and 2, based on the EPA (2004) document. For most taxa, less than 1 percent of larvae would be expected to survive to age 1, as the highest rate of mortality occurs in early life stages. Adult or harvestable populations of a fish species are also affected by many factors (e.g., currents, food, temperature, usable habitat) that are generally independent of numbers or survival of early life stages. Overall, the loss of marine fish and their prey resources from entrainment, relative to numbers in Coos Bay, would be small based on the information discussed.

TABLE 4.5.2.2-6

Selected Survival Values by Life Stage of Marine Species That May Be Entrained or Impinged

	Percent Survival by Life Stages a/				
Taxa Group/Species b/	**Larvae to Juvenile**	**Juvenile to Age 1**	**Age 1 to Age 2**	**Larvae to Age 1**	**Larvae to Age 2**
Anchovies	0.03%	12.00%	49.66%	<0.01%	<0.01%
Longfin Smelt	0.17%	40.01%	51.17%	0.07%	0.03%
Pacific Herring	0.90%	50.01%	62.31%	0.45%	0.28%
Other Forage Fish	0.05%	27.53%	19.79%	0.01%	0.00%
Flounder	0.19%	31.98%	69.56%	0.06%	0.04%
Rockfish	36.79%	36.79%	80.65%	13.53%	10.92%
Cabezon	1.87%	40.01%	26.18%	0.75%	0.20%
Sculpins	2.26%	40.01%	65.70%	0.90%	0.59%
Dungeness Crab	30.12%	30.12%	60.65%	9.07%	5.50%
Commercial Shrimp	4.98%	11.53%	11.53%	0.57%	0.07%
Forage Shrimp	0.31%	41.85%	33.29%	0.13%	0.04%
Average	**7.06%**	**32.90%**	**48.23%**	**2.32%**	**1.607%**
Median	**0.90%**	**36.79%**	**51.17%**	**0.45%**	**0.07%**

a/ Values based on natural mortality rates by life stage.
b/ Groups include multiple species defined in Appendix B1 of EPA (2004).

Loss of juvenile salmonids from entrainment or impingements could also reduce adult returns. Survival from smolt stage is highly variable among salmonid size, species, and year and easily can range from less than one to more than 10 percent. NMFS (2008b) in their assessment of effects of the Coos Bay airport expansions used a value of 4 percent survival for coho salmon smolts to returning adults. Even so, due to the extremely small portion of total water intake relative to the volume of Coos Bay, likely intake locations (30 feet deep, in the back of the isolated slip) likely away from concentrations of juvenile salmonids, the relative portion of juvenile salmonids that would be entrained and suffer direct mortality would be small.

Overall, the extremely small portion of total water intake relative to the volume of Coos Bay per LNG carrier (0.07 to 0.25 percent) suggests that the loss of zooplankton and ichthyoplankton, other marine invertebrates, eggs, larvae, shellfish, and fish including juvenile salmonids due to operation of the Jordan Cove Project would be low in comparison to total available entrainable size organisms in the bay and occurring from natural mortality. Therefore, we conclude that entrainment and impingement from LNG carrier water intakes at the terminal would not have substantial adverse effects on any marine phase of aquatic resources (e.g., the juvenile stage of salmonids) or their food sources.

Water Temperature in the Slip and Bay

LNG carriers at berth at Jordan Cove's terminal have the potential to both warm the temperature of the marine slip while discharging engine cooling water, and to cool the temperature of the marine slip while loading LNG cargo. Moderate to large temperature increases have the potential to reduce fish and invertebrate growth, reproductive success, and if high enough cause direct mortality. Fish of the north Pacific, including those found in Coos Bay, are adapted to cool water conditions and could be adversely affected by sharp increases in water temperature. Coos Bay temperatures historically remain less than 20°C (McAlister and Blanton 1963).

Moffat & Nichol (2018a) developed a temperature plume model for cooling water discharge from the LNG carriers during LNG gas loading. The model assumed that steam turbine vessel and dual-fuel diesel electric vessel would have a cooling water temperature of 2.0°C (3.6°F) and 2.8°C (5.0°F) above ambient at the point of discharge, respectively. Discharge rate would be 11,000 m^3/hour and 3,200 m^3/hour for about 24 hours of loading, for the former and latter vessels, respectively. Moffat & Nichol modeled the extent of the plume to where plume temperature would decrease to 0.3°C (0.6°F) over ambient water temperature. This model was run for varied bay water temperatures. The result was that the maximum distance from the port discharge point where the plume would reach this temperature was 80 feet for the steam turbine vessel and 37 feet for the dual fuel diesel electric vessel. The average water temperature increases for the total slip volume for one day when an LNG carrier is at dock for the vessel using the larger volume (steam turbine vessel) would range from 0.03 to 0.06°F (see section 4.3.2.2). We expect the actual average increase in water temperature in the slip would be less than the higher value estimated due to tidal exchange and the vessel uptake of heat from its surroundings due to the transfer of liquid gas into the vessel at -260°F (-162°C). While marine species would likely have a range of temperature tolerance, salmonids are known to be sensitive to elevated temperatures. The modified water temperature would be well below levels that would be considered lethal in the short term (a few days) for salmonids, which would be over about 24 to 26°C (WDOE 2002). Mortality of juveniles starts to occur at constant exposure to temperatures above 71.6°F (Hicks 2000), with an acute lethal temperature of 78.4°F (Beschta et al. 1987), while optimum temperatures are much lower for salmonids, with preferred ranges generally between 50ºF and 59ºF for rearing juvenile coho salmon (Brett 1952; Reiser and Bjornn 1979; Jobling 1981; Konecki et al. 1995; McCullough 1999; Sullivan et al. 2000; Carter 2008). Juvenile coho salmon are taxed in the temperature range of 60.1ºF to 68.5ºF but are still capable of growing at a reduced rate (Stenhouse et al. 2012). Short-term local temperature increases would remain well below short-term adverse levels for salmonids, and any small changes in temperature including to the area within 80 feet of the discharge port would be easily avoided by fish. Therefore, the cooling water discharge should result in no adverse effect on salmonid resources from temperature changes. Since salmonids are not tolerant of elevated temperatures, they are likely a reasonable indicator that other estuarine species (which may be less sensitive) would also not be adversely affected by small temperature changes. Considering the total volume of water in Coos Bay, in comparison to the small volume of heated water discharged, virtually no change in bay temperature would occur from operation of the LNG Project.

Water Runoff and Spills of Hazardous Materials

After construction of the terminal, about 100 acres would be covered by impervious surfaces (e.g., compacted gravel). There is the potential for stormwater to run off these hard surfaces into the marine slip or bay, carrying sediment or hazardous materials, which may harm aquatic resources. However, before stormwater is discharged, it would be directed to areas for treatment (see section 4.3.2.2). Low oil potential runoff would be treated primarily by filtration, although cartridge filtration may be implemented, as designated in Jordan Cove's *Stormwater Management Plan*. Examples where cartridge filter would be used are paved roads, parking lots, and dense-grated gravel process areas. As mentioned in section 2.1.1.5, Jordan Cove would design and construct a stormwater drainage and collection system for its terminal. Runoff, including potential hazardous materials from the site, would be designed to meet regulatory requirements from both NMFS and ODEQ, and would be managed by following the ODEQ-approved *Storm Water Management Plan*. Stormwater from areas that have no potential for contamination would be allowed to flow into the slip or bay through designed discharge ports. Stormwater collected in areas that are potentially contaminated with oil or grease would be directed to sumps and then processed through an oily water separator before discharge to the industrial wastewater pipeline. Industrial wastewater would be conveyed to the Port's existing ocean outfall, pursuant to the NPDES permit issued by the ODEQ. Stormwater collection and treatment facilities would be designed in consultation with NMFS and the ODEQ.

All areas where LNG may be present would be curbed and graded so that any spill would flow to containment trenches leading to impoundment basins. The two LNG storage tanks would be surrounded by a 65-foot-high barrier. Any spills of hazardous materials would be handled in accordance with Jordan Cove's SPCC Plan (see section 4.3.2.2).

Terminal Lighting

Localized changes in light regime have been shown to affect fish species behavior in a variety of ways (Simenstad et al. 1999; Valdimarsson et al. 1997; Tabor et al. 2004; Nightingale and Simenstad 2001a). Disorientation may cause delays in migration, while avoidance responses may cause diversion of migratory routes into deeper, less protected waters. In some cases, increased light may attract both predators and potential prey species (Simenstad et al. 1999; Valdimarsson et al. 1997; Tabor et al. 2004). Juvenile coho salmon show no response to moderately high light intensity but become inactive in very low light (Hoar et al. 1957). Other fish may respond differently; for example, schools of juvenile chum salmon show marked preference for light, while juvenile sockeye prefer the dark. Depending on their reaction, fish may have migration delayed, be moved into less protected deepwater habitat, or they may become more susceptible to predation, as light can attract predators and increase their ability to see fish. Some adverse modification in fish behavior could occur from the lighting present at the terminal, possibly delaying migration, moving fish to less desirable habitat conditions, or subjecting juvenile fish to greater nighttime predation.

Lighting at the LNG terminal would likely include a mixture of low-power fluorescent lighting and higher intensity security lighting that would primarily be located on shore, in and adjacent to the slip. Lighting used at the LNG terminal would be similar to that already in place at other Coos Bay facilities. The facility would have its highest intensity lighting on shore away from the water, although some lower level lighting would be present near the water. Lighting on the tug dock would be low intensity lighting adequate for safety. No high intensity lighting would be present near the water except possibly during vessel docking. When an LNG carrier is not in the berth, the lighting would be reduced to that required for security and would be focused upon the structures and not be in proximity to the water; therefore, the lighting would not serve as an attractant or deterrent to fish species. When an LNG carrier is at the berth, it would physically block the lighting on the berth from the slip waters and, due to its proximity to the slip wall, would block the fish from getting too close to the lighting on the berth. Lighting used would be similar to that already in place at other Coos Bay facilities.

The location of the facility, set back from the main channel of Coos Bay, would reduce fish encountering any shoreline lighting effects. The reduced lighting levels near the water should reduce any behavioral effects on fish near the terminal. As mentioned above, we have recommended that Jordan Cove develop the details of its final lighting plan in consultations with the FWS, NMFS, and ODFW to minimize potential effects on aquatic resources. The limited height intensity lighting and overall large habitat area available for fish avoidance of these regions, and plans to obtain an approved plan with managing agencies, are anticipated to reduce the potential for adverse effects on local and migratory fish resources.

Maintenance Dredging

Jordan Cove has estimated that maintenance dredging would occur every three to five years with varied amounts removed ranging from 115,000 cy to 160,000 cy each dredging cycle for slip and access channel (see section 4.3.2.2 for details). An additional 27,000 cy would be removed from the navigation channel about every three years. Jordan Cove proposes to place maintenance dredged material at land storage sites APCO Sites 1 and 2 (figure 4.5-2).

Modeling conducted by Jordan Cove and the Port (Moffat & Nichol 2006a) suggests a very narrow range of elevated suspended sediment (greater than 100 mg/l) during low tidal velocity extending out a few hundred feet from where the maintenance dredging area of the slip would occur in Coos Bay using a mechanical (clamshell) dredge. The highest concentration levels would occur at lowest tidal velocity when dispersion of suspended sediment would be the least. Peak value at the lowest modeled tidal velocity—the point of clamshell dredging—is estimated to be 830 mg/l, with decreasing values away from the actual dredging site to about 125 mg/l at 200 m (660 feet) from the site. During typical tidal cycles, turbidity would be up to 75 mg/l out about 0.2 to 0.4 mile from the dredging site. Moderately low values of 25 to 50 mg/l may extend out to about 3.5 miles depending on flow, sediment composition, and equipment used, for brief peak periods (about 2 hours daily). During high current velocity, peak values at the point of dredging would be about 90 mg/l, decreasing to 25 mg/l in 100 m (330 feet). Average daily (24-hour) values outside of the direct area being dredged would remain in the range of seasonal background levels of 25 to 50 mg/l during the ODFW-allowed dredging window. Maintenance dredging of the marine waterway modifications (i.e., the navigation reliably improvement areas) is expected to have similar turbidity effects but could be less if a hydraulic suction dredge is used. The number of days dredging would occur would depend on details of equipment used but would likely range from a few days to about a month of dredging to remove about 142,000 cy every three years (COE 2011). If dredging were to occur at the estimated removal rate of about 7,000 cy per day estimated for hydraulic dredging in Jordan Cove's *Dredged Material Management Plan*, active maintenance dredge would occur over 20 days.

Fish are likely to move from this narrow band of elevated suspended sediments during peak occurrences for short durations during dredging (likely several hours over the largest area affected). Additionally, some benthic organisms (e.g., clams, shrimp, and tubeworms) would be removed during this dredging. Maintenance dredging would occur from October 1 to February 15 during the Coos Bay in-water work window which would avoid major juvenile salmonid presence in the region.

Because all dredged material would be placed on land where runoff is controlled, there would be no effect on the estuary or marine environment from dredged material disposal. However, the final transport method of the dredged material to these sites has not been finalized and may include some bottom disturbance or effects from piping used to transport the discharge material. These are expected to be small areas of potential direct effects from pipeline impacting bottom areas and would not have substantial effects on benthic organisms.

Operational Acoustic Effects

LNG carrier and tugboat operations along the waterway, operational noise at the terminal, and maintenance dredging would generate underwater sounds pressure levels that could elicit responses in aquatic organisms. State agencies in Washington, Oregon, and California along with federal agencies (FWS and NMFS) have developed interim noise exposure threshold criteria for pile-driving effects on fish (WSDOT 2011; Fisheries Hydroacoustic Working Group 2008; Popper et al. 2006). These threshold criteria are described above for pile-driving acoustic effects during construction.

Underwater noise levels are expected to vary by ship type and by vessel length, gross tonnage, vessel speed, and, to some extent, vessel age as older vessels tend to be louder than newer vessels. Based on the general trend for higher underwater noise generated by larger vessels (McKenna et al. 2012), it is possible that some of the LNG carriers could generate more noise if they are larger than the LNG carrier built in 2003 with a 138,028 m^3 capacity reported by Hatch et al. (2008). The vessel in that study produced sound levels (with one standard error) of 182 ± 2 dB re: 1 µPa at 1 meter that attenuated to 160 dB at 35 ± 11 meters and to 120 dB at 16,185 ± 5,359 meters. These vessel noise levels are therefore generally less than threshold levels considered to cause direct harm to fish. Upland operational noise may also travel over water, but is not likely to affect fish, although there may be effects on marine mammals close to the terminal.

Generally, response to changes in noise levels would be behavioral and perceptual, and not physiological in nature, as fish and marine mammals would tend to avoid the area during periods of high noise output. We conclude that operational noise would not have significant adverse effects on aquatic resources.

4.5.2.3 Pacific Connector Pipeline Project

The Pacific Connector pipeline would cross or affect 352 waterbodies: 69 perennial streams, 270 intermittent streams (99 of these are considered ditches), 9 ponds (i.e., all ponds are adjacent to the line and would not be directly crossed), and 4 estuarine channels. Available data indicate that about 71 of these waterbodies are known or assumed to be inhabited by fish. Appendix I, table I-2, lists information on waterbodies crossed or potentially affected and known fish distribution and classification relative to the crossing.

Aquatic Habitat in the Coos Bay Estuary

The pipeline would cross under about 2.3 miles of Coos Bay in two separate crossings. Coos Bay consists of about 14,000 acres of varied intertidal and subtidal substrate habitat conditions including algae beds, eelgrass sites, marsh lands, and mostly unconsolidated substrate. The upper Coos Bay estuarine habitat contains important rearing habitat supplied by estuarine wetlands, algae, and eelgrass beds, which are important conditions for estuarine fish and migratory salmon, as well as commercial oyster beds. The estuarine habitat of the Coos Bay estuary along the pipeline route is in a mix of shallow regions of the Coos Bay near Kentuck Slough and deeper areas under the two navigation channels crossed (see figure 4.5-1). Most of the route and associated work areas are in nearly equal amounts of shallow intertidal and subtidal fine bottom and unconsolidated bottom habitat, with a few regions of mixed seabed of eelgrass, attached algae, tidal marsh and deep navigation channel. The fisheries in these habitats include a mix of anadromous and marine species, as well as shellfish, and are described above in section 4.5.2.1.

Aquatic Habitat in Inland Waterways

The freshwater streams crossed by pipeline route include six major subbasins of rivers in southern Oregon. The aquatic habitat crossed by the pipeline outside of Coos Bay is primarily coldwater streams, but with a few warmwater ponds adjacent to the pipeline. Most stream riparian areas crossed are heavily forested, and are therefore shaded by a mix of conifer and hardwood trees, providing typical salmon and/or trout habitat. Several waterbodies crossed are large (over 100 feet wide), but the majority are small waterbodies with generally no or low flow ,as about 75 percent are intermittent streams. Most of the major streams and many of the minor streams crossed contain salmon and steelhead, some of which are federally listed as threatened fish species.

Fishery Types and Fish Status

Fish species present in the pipeline area can be classified as warmwater, coolwater, coldwater resident, anadromous, and estuarine fish. Freshwater streams with habitat suitable for coldwater resident fish and anadromous fish are the most common along the pipeline route and associated facilities other than in the Coos Bay estuary, while warmwater fish species are typically associated with ponds in southeast Oregon. The status of federally listed fish species and other commercial fish species that are managed under the MSA will be presented in our pending BA and EFH Assessment that will be submitted to the FWS and NMFS. Endangered and threatened species and their respective critical habitat, and other special status species are addressed in section 4.6. The status of other state-listed fish species and fisheries of concern are also discussed in section 4.6. The EFH assessment summary relative to pipeline-related actions is included in appendix I.

Warmwater, Coolwater, and Coldwater Fish

Typical warmwater species in the pipeline area include black (*Pomoxis nigromaculatus*) and white crappie (*Pomoxis annularis*), and brown bullhead (*Ameiurus nebulosus*), which are not native to the region. Warmwater species are present in several lakes near the route and are present at pipeline crossing areas, and are likely in some Klamath Basin streams crossed by the pipeline.

Coolwater fish present in the area affected by the Project include both non-native and native species. Some important non-native species include smallmouth bass (*Micropterus dolomieu*) and yellow perch (*Perca flavescens*), as they are a common sport fish. These fish are often present in lakes, and smallmouth bass may be found in some larger rivers. Other native coolwater species of note include the ESA listed Lost River sucker (*Deltistes luxatus*), ESA listed shortnose (*Chasmistes brevirostris*) and Klamath largescale (*Catostomus snyderi*) suckers, and blue chub (*Gila coerulea*). These latter species occur primarily in the Klamath Basin, in Upper Klamath Lake and its tributaries. Umpqua chub (*Oregonichtyhys kalawatseti*) are a FWS species of concern, as this fish species has declined precipitously in the last decade. The pipeline would cross habitat occupied by Umpqua chub.

Resident coldwater fish species spend their entire lives in fresh water. Various waterbodies crossed by the Pacific Connector pipeline provide year-long habitat for several resident coldwater fish species. Resident cutthroat trout (*O. clarki*), rainbow trout (*O. mykiss*), and redband trout (*O.*

m. gibbsi) are the most common resident coldwater game species along the route. Non-game fish species, some of which migrate between freshwater and marine habitats (e.g., threespine stickleback [*Gasterosteus aculeatus*]), and others that are freshwater residents (e.g., speckled [*Rhinichthys osculus*] and longnose [*R. cataractae*] dace, sculpins, chiselmouth [*Acrocheilus alutaceus*], sucker) also may occur in waterbodies in the pipeline area.

Anadromous Fish

Anadromous fisheries in the pipeline area comprise eight species: Chinook salmon, coho salmon (including two ESA listed coho salmon ESUs), chum salmon, steelhead, coastal cutthroat trout, Pacific lamprey, river lamprey, Pacific eulachon, and green sturgeon (also ESA listed) (see section 4.5.2.1). Section 4.5.2.1 summarizes most of the major runs of anadromous salmon, steelhead, and trout species in the area affected by the Pacific Connector Project and their general timing of life phases.

Marine (Estuarine) Fish

The marine species that may be present along about 2.3 miles of the pipeline route where it would cross under Coos Bay at two locations between about MPs 0.3 and 1.0 and MPS 1.5 and 3.0 are the same as those discussed above for the Coos Bay portion of the waterway for LNG carrier marine traffic to and from the terminal (section 4.5.2.1).

Marine (Estuarine) Shellfish

Major invertebrate taxa present in Coos Bay are described in section 4.5.2.1. Invertebrate groups include pelagic (in the water column), epibenthic (residing on sediment surface), and benthic (residing in the sediment) organisms. Pelagic invertebrates include juvenile and larval stages of many species, such as crab, shrimp, clams, worms (polychaetes) as well as adult and juvenile crustacean zooplankton (e.g., copepods). Epibenthic organisms including harpacticoid copepods, snails, amphipods, mussels, oysters are all present to varying degrees. Benthic organisms include clams and the most abundant polychaetes and amphipods, the latter an important food for juvenile salmonids.

Estuarine Oysters

There are two different types of oysters identified along the pipeline route at the two Coos Bay crossings: 1) commercially grown non-native Pacific oysters; and 2) native Olympia oysters. Neither species can be legally harvested for recreational purposes. Native oyster populations are state-protected to encourage their recovery. Pacific oysters are the private property of their commercial growers.

Four companies lease state lands in Coos Bay to raise Pacific oysters commercially, two of which are near the pipeline crossing. They seed their beds with juvenile oysters (spat) and later harvest adults. These commercial beds are located on the north and east side of Coos Bay from Glasgow Point (north) to Crawford Point (south) in intertidal areas. Another commercial oyster operation is in South Slough. The pipeline route would go directly under one commercial oyster area owned by Clausen Oysters west of Kentuck Slough.

Olympia oysters can be found in the subtidal and intertidal zones of Coos Bay from Haynes Inlet south to Isthmus Slough. Pacific Connector surveyed nearly 7,000 feet of relatively shallow intertidal habitat for Olympia oysters along the previously proposed pipeline route in Haynes Inlet during late June 2011. Olympia oysters were found growing on riprap at the mouth of Haynes Inlet and on substrates within the pipeline right-of-way. Generally, Olympia oysters were found almost exclusively where hard surfaces (e.g., riprap, old oyster or clam shells) are present (Ellis Ecological Services 2011).

Marine Mammals

The marine mammals that may be present along the pipeline route in Haynes Inlet are the same as those discussed for the Coos Bay portion of the waterway for LNG carrier transit to and from the terminal (see section 4.5.2.1), except for large whale species that only inhabit the deep, open ocean. It is possible that killer whales, gray whales, and pinnipeds could be found in Coos Bay. The potentially present marine mammals are protected under the MMPA.

Freshwater Mussels

Limited native freshwater mussels may be present in some streams along the route. Only eight native mussels are present west of the Continental Divide, most of which belong to the genus *Anadonta* (Nedeau et al. 2009). This genus tends to occur more often in lakes and pond and quiet pools but may found in swifter waters in protected areas without current sheer. Another species, the Western pearlshell (*Margaritifer falcate*), while most common in large streams can be found in cold small streams only a few feet wide (Nedeau et al. 2009). The distribution relative to the project crossing for mussel species in not known; however, it is possible that some may be present near crossings, especially in larger, low-gradient streams. Two sensitive species (see appendix I) may be present in streams along the route: California floater mussel (*Anadonta californiensis*) and Western ridged mussel (*Gonidea angulata*). Both species are also addressed in the Forest Service's Biological Evaluation (BE; appendix F of this EIS).

Effects on Aquatic Habitat and Aquatic Species from Construction of the Pacific Connector Gas Pipeline Facilities

The pipeline route would cross under 2.3 miles of estuarine habitat in Coos Bay and cross or pass near an additional 349 waterbodies, of which about 71 are known or presumed to be inhabited by fish. In addition, 4 new stream crossings would occur along the 10 temporary or 15 permanent roads, 2 of which are known to have fish. Existing roads used by the pipeline project for construction would use existing stream crossings although final design may include new or modified structures at some locations (see below), with a total of 47 streams crossed, 5 of which are perennial streams with 1 known to have fish. One new permanent construction road would also cross a known fish-bearing stream (PAR 15.07 crossing an intermittent tributary to Stock Slough).

Pacific Connector proposes to cross under the two Coos Bay estuary crossing locations and three large river crossings (Coos, Rogue, and Klamath Rivers), using HDD methods. At two crossings of the South Umpqua River, Pacific Connector would use a diverted open-cut method at one and a DP method at the other. Pacific Connector proposes to cross Medford Aqueduct using a conventional bore. An additional 24 bore crossings would be used primarily at ditches and canals. All other stream crossings would employ a dry, open-cut method. General stream crossing methods for each of these are described in section 2.4.2.2, and specific crossing methods are listed in appendix I, table I-2. General Project activities potentially affecting aquatic resources include frac-out at estuarine and large river crossings, freshwater in-water construction activities, terrestrial/riparian habitat modification, accidental spills or leaks of hazardous materials, and periodic maintenance of the pipeline.

Right-of-way clearing would occur during the early spring through late fall unless site-specific deviations are proposed. The baring of soil upslope of streams has the potential to contribute sediment and elevated turbidity when near streams, especially if on steep slopes; however, the pipeline route has been selected to minimize steep slopes and unstable areas. Additionally, there is an ECRP which includes implementation of BMPs such as silt fences, water bars, slash filter windrows, and other general procedures. Additionally, an upland erosion control and revegetation plan is in place that identifies where specific actions would be needed to curtail substantial erosion and sediment runoff to streams. Therefore, upland erosion from right-of-way clearing would not contribute substantial new sediment to streams, thus avoiding adverse effects on aquatic systems.

Construction of the Pacific Connector pipeline in-water stream crossings would only occur during ODFW recommended in-water construction windows. This timing would minimize the coincidence of pipeline construction with upstream adult salmonid migration and spawning as well as juvenile outmigration. Resident salmonids, which would be primarily cutthroat and/or rainbow trout, and juvenile coho salmon would be present at pipeline crossings during construction. During construction in the Coos Bay estuary (October 1 through February 15), adult anadromous salmonids, green sturgeon, and possibly eulachon would be present (ODFW 2007b).

The extent of effects on aquatic resources from pipeline construction would depend on the waterbody crossing method, adjacent clearing methods, erosion control, the existing conditions at each crossing location, and the timing of construction. Potential short-term effects that degrade habitat could occur with trenching and laying of the pipe at waterbody crossing sites and sometimes adjacent slope runoff. The installation of the pipeline across a waterbody may result in temporary deposit of a limited amount of sediment in that stream, with associated short-term turbidity affecting aquatic species. Pacific Connector would install erosion control devices during construction to reduce sedimentation and in-stream turbidity at waterbody crossings. Right-of-way clearing would be 75 to 95 feet wide at stream crossings and a permanent 30-foot-wide access route maintained in herbaceous non-forest vegetation. We expect the pipeline right-of-way to be restored and revegetated immediately after pipeline installation. Except for forested areas, vegetation would be expected to re-establish in the area within three years (see section 4.4).

Long-term degradation of habitats can occur if flow or sediment regimes are modified in a manner that results in morphological changes to the bed and banks of the channel. Also, in forested areas, shade would be reduced at waterbody crossings for the time it would take trees to grow after restoration and revegetation. In streams that have very small flows, lack of shade may raise stream water temperatures and reduce LWD supply, which could in turn affect aquatic species. However, streams with low or intermittent flow generally support smaller fish populations and less diverse species composition.

Pacific Connector developed its project-specific ECRP which includes specifications for waterbody crossing techniques and associated sediment and erosion controls to be implemented during waterbody crossings. A detailed description of construction and mitigation measures that Pacific Connector would implement at waterbody crossings is included in section 4.3.

In addition to actual waterbody crossings by the pipeline, several of the project-related construction activities, such as improving existing access roads (EARs), PARs, TARs, and TEWAs within riparian areas, could indirectly affect aquatic resources by increasing erosion and runoff to nearby streams, losing future large wood input to streams, and increasing stream temperatures. The potential effects on fish or their habitat would be minimized by BMPs including the ECRP and procedures in place to eliminate or reduce potential effects on streams.

Fish passage is a potential issue relating to streams crossing by roads that would be used by the project. The final locations of all road-stream crossing and road use levels would not be determined until a construction contractor can assess what final road use would be needed and final designs are developed. However, Pacific Connector, in consultation with ODFW, has developed general plans and designs for methods to be use for road-stream crossings to ensure fish passage is maintained and other effects are minimized (Pacific Connector Gas Pipeline LP 2015). For temporary and permanent roads, designs may include use of existing instream structures, which could include the protection, repair or replacement of these stream-crossing structures. New culverts may be needed in some areas. Fish passage would be ensured for all life stages for any new structure. However, Pacific Connector would not modify the fish passability of existing structures if they use them without needing to replace them. Pacific Connector would submit a fish passage plan to ODFW, and the NMFS or FWS as applicable, and would not construct the crossing until approval is received.

Temporary bridges may be used before culverts are installed. These bridges would span above the ordinary water level and be maintained to stay above water levels during use. All new or temporary crossing structures would meet state fish passage requirements and NMFS fish passage criteria. Any culvert installation would occur during state designated in-water work windows unless otherwise approved by the ODFW, and the NMFS or FWS as applicable on streams with ESA listed fish, and fish passage would be maintained during construction if passage occurred at the crossing prior to construction. If temporary bridges are used, they may be installed outside of the in-water work window if the ODFW and NMFS approve. To provide equipment and material access up and down the construction right-of-way, temporary bridges would be installed outside of the ODFW in-water work window. For flowing waters, efforts would be made to span the water with a temporary bridge from the bank without entering the water. Where bridges cannot safely be installed this way, only equipment needed to install the bridge would be allowed in the stream, minimizing water disturbance. These bridges would have suitable clearance to allow higher flows to pass without inhibition, and any temporary bridges remaining in the fall would be removed before high flows. All installation structures would be approved by the COE, ODSL, ODEQ, ODFW, and, as appropriate, the Forest Service and BLM. Currently, there are no plans to have equipment cross flowing water streams for other purposes. In-water activities would meet state turbidity standards reducing turbidity effects. With procedures in place, disturbance to aquatic systems would be kept to a minimum during periods of greater sensitivity outside of the in-water work window. Riparian disturbance would be kept to that needed for construction. These actions would maintain adequate fish passage and minimize stream disturbance from the use and installation of road-stream crossing structures.

Construction in Estuarine Habitats

During in-water pipeline installation within Coos Bay, fish and other aquatic resources are unlikely to be affected unless a frac-out were to occur. Construction of the pipeline across the Coos Bay estuary would not directly disturb the substrate as crossings utilize HDD crossing methods. The current pipeline route in the bay would be two HDD spans of 0.7 and 1.6 miles with no planned subtidal or intertidal habitat disturbance. Generally, an HDD would avoid direct effects on the bay and associated estuarine resources. However, an HDD requires the use of drilling mud as a lubricant during the process. This fluid is under pressure and there is a possibility of an inadvertent release of drilling mud through a substrata fracture, allowing it to rise to the surface (also referred to as a frac-out).

Drilling mud primarily consists of water mixed with bentonite, which is a naturally occurring clay material. Bentonite by itself is essentially non-toxic (Breteler et al. 1985; Hartman and Martin 1984; Sprague and Logan 1979). However, bentonite can act like a fine particulate sediment in water, which could affect aquatic resources. The dispersal of drilling mud from a frac-out in the bay could interfere with oxygen exchange by clogging the gills of aquatic organisms (EPA 1986). The degree of interference generally increases with water temperature (Horkel and Pearson 1976). Sediments in high concentrations can clog gills, impair vision, make it difficult to feed, and increase the chance of predation. Drilling mud that accumulates on the bay bottom could cover over benthic organisms and estuarine food sources. Most highly mobile aquatic organisms, such as fish, crabs and shrimp, would be able to avoid or move away from the affected area. Local elevation of turbidity could affect fish, including salmonids if present, but with construction occurring during the in-water work window abundance in this area would be low further reducing the likely hood of adverse effects from elevated local turbidity. Other less mobile or immobile organisms, such as echinoderms, clams (i.e., *Macoma* sp.), Pacific oyster, Olympia oyster, and coral/anemone polyps (*Anthoszoa*) (Miller et al. 1990) and other macroinvertebrates, would incur short-term effects from direct mortality if smothered by the drilling mud. However, benthic communities on mud substrates in Coos Bay that were disturbed by more intensive effects from past dredging activities recovered to pre-dredging levels in four weeks (Newell et al. 1998). Some effects may be long term if important habitat elements are affected, such as the effects of turbidity on eelgrass growth (Martin and Tyrrel 2002).

The pipeline route does pass via HDD under commercial Pacific oyster designated areas and native oyster could also be present so there is some risk for oysters should frac-out occur directly in this area. While oyster surveys have not been conducted along the current proposed route, some oysters are likely to be present in the intertidal and shallow subtidal areas where hard surfaces (like Pacific oyster shells) are available. However, typical oyster habitat is not common in the bay because most bottom areas consist of sand and fines.

Attached algae and eelgrass could also be affected by direct burial. Effects would be localized and short term, limited to species in the immediate vicinity of the frac-out, and ameliorated by tidal exchange volume. While tidal exchange would keep much of the bentonite in suspension, because much of the area is shallow and intertidal, depending on timing, some would settle to the bottom, but may be resuspended during tidal change. In these mostly shallow bay areas, accumulation could be contained and removed. Because of the above, effects on benthic organisms from burial under a release of drilling mud are likely to be low.

To prevent a frac-out or address impacts should one occur, Pacific Connector developed its *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations*.[122] As discussed in chapter 2, the contingency plan would be implemented in the case of a frac-out into an estuarine or aquatic environment. These measures include, but are not limited to:

- temporarily halting the HDD, and sealing the source of the leak in the fractured zone;
- contacting agencies and developing a site-specific treatment plan;
- adding higher viscosity drilling fluid or lost circulation material to help seal leaks if required:
- deploying containment structures, if feasible;
- monitoring locations downstream of the HDD to identify areas of drilling mud accumulation;
- in estuary possibly remove muds during low tide if they are exposed; and
- in streams removing the drilling mud from substrate and streambanks, if possible.

The precise amount of drilling lubricant that would escape to water from a frac-out cannot be determined because of the many variables that affect quantity (proximity to water where frac-out occurs, length of time active drilling occurs after a frac-out begins, where in the process and flow rate where it occurs). However, with current designs and contingencies that would be in place at the site of any frac-out, the time period of drilling mud released into a waterbody would likely be short term if it were to occur. The *Drilling Fluid Contingency Plan* includes active monitoring of drilling activity that has procedures in place to detect potential drilling fluid spill such as monitoring sudden drops in drilling fluid pressure that would cause cessation of drilling. If monitoring detected a frac-out, the HDD activity would be immediately stopped. Detailed surveys and plans[123] have been made for each of the HDD crossing sites. Furthermore, the HDD locations are all under a large estuary or major rivers, with large volumes of water and swift flows, where the drilling mud would be diluted. Finally, frac-out most often occurs near the entry and exit locations, which are often landward of the stream channel. Displaced soil and a return flow of the bentonite slurry is another potential source of sediment from HDD crossings. As discussed in chapter 2, the drilling mud returns would be hauled offsite after completion of the HDD crossing and disposed of at an approved disposal facility in accordance with all applicable federal and state regulations. Therefore, we conclude that an inadvertent release of drilling mud from an HDD would have minor, short-term adverse effects on estuarine or aquatic resources.

There could also be oil or fuel leaks from construction equipment. Pacific Connector would implement the measures outlined in its SPCC Plan to avoid or reduce effects from an equipment oil or fuel leak.

Aquatic Nuisance Species in Coos Bay

Invasive species have the potential to modify the food base and induce other ecological modifications in the estuarine area of Coos Bay. Non-indigenous aquatic species (NAS) are aquatic species that degrade aquatic ecosystem function and benefits, in some cases completely altering aquatic systems by displacing native species, degrading water quality, altering trophic

[122] This plan was attached as Appendix 2.H of Resource Report 2, in Pacific Connector's September 2017 application to the FERC.
[123] See Appendix G.2 of Resource Report 2, in Pacific Connector's September 2017 application to the FERC.

dynamics, and restricting beneficial uses (Hanson and Sytsma 2001). Within the Coos Bay estuary, over 67 NAS have been identified (Aquatic Nuisance Species Taskforce 2006). All the invertebrate NAS in the Coos Bay estuary have been introduced by ship fouling or discharge from ballast water of ocean-going vessels.

Pacific Connector identified two NAS that may occur in the Coos Bay estuary: New Zealand mud snails (*Potamopyrgus antipodarum)* and brackish water snail *(Assiminea parasitologica).* Pacific Connector would filter hydrostatic test water and discharge to upland areas through straw to reduce chance of transporting organisms between waterbodies and Pacific Connector proposes to use a treatment of 2 ppm or 2 mg/l of free chlorine residual with a detention time of 30 minutes to treat all non-municipal surface waters that would be used as a water source for hydrostatic testing purposes, and follow ODEQ criteria for this action. Additionally, the applicant did state it would not obtain hydrostatic test water from either Coos Bay or the Coos River, to prevent the spread of NAS from the estuary to inland watersheds.

<u>Construction Across Stream Habitats</u>

Construction of the pipeline would affect 69 perennial stream sites, 270 intermittent stream sites, 9 ponds, and 4 estuary channels (table 4.5.2.3-1; including Coos Bay crossings discussed above). A total of 285 locations would be direct channel crossings, while 67 would be locations where the waterbody is in the right-of-way clearing area. Direct effects on four perennial streams (and Coos River estuarine channel) would be avoided by placing the pipeline beneath them by HDD, DP, or conventional boring. Another 26 intermittent streams would be bored or employ DP technology under the channel.

At one crossing of the South Umpqua River, Pacific Connector would use a diverted open cut. All other waterbody crossings that have flow at the time of construction would be crossed using dry open cut, which is designed to minimize activities directly in flowing water. Of streams that would be crossed using the dry open-cut method, about 29 are known to support anadromous salmon and/or steelhead and another 13 streams are assumed to also have anadromous species. Thirty-four streams crossed are known to support primarily coldwater resident fish, estuarine fish, or important endemic species in the Klamath River Basin. Eighteen additional streams that would be crossed with dry open cut are assumed to support important resident fish. Resident trout are mostly cutthroat trout. In all, about 71 of the waterbodies that would be crossed by, or adjacent to, the pipeline are known or assumed to have fish. Pipeline construction could adversely affect EFH species in up to 55 streams, as well as streams with numerous special status fish species crossings (see section 4.6 for ESA listed species). Our pending EFH assessment and BA will describe effects on those species occupying inland streams, and measures Pacific Connector would implement to avoid, minimize, or mitigate the effects.

In-stream construction could interfere with essential life processes of aquatic species. Most of the waterbodies identified as known, presumed, or classified as being fish bearing would be crossed using isolated or "dry" crossing construction techniques including the flume or dam-and-pump method if water is flowing in the waterbody at the time of construction. At one site on South Umpqua, the diverted open cut method used would require diversion of the flow to one side of the channel at a time. Potential effects of trapping fish from these methods are discussed under Entrainment and Entrapment subsection below.

TABLE 4.5.2.3-1

Number of Waterbodies Crossed or Adjacent to the Pacific Connector Pipeline, by Fish Status Category and Fifth-Field Watershed

					Fish-bearing Streams/channel with:			
Fifth-Field Watershed (Fifth-Field HUC)	**Estuarine**	**Ponds a/**	**Perennial Streams**	**Intermittent Streams**	**Anadromous Species (assumed) b/**	**Resident Species (assumed) b/, c/**	**EFH Species and Habitat Present (assumed) b/**	**ESA Species or Habitat Present (assumed) b/**
Coos County								
Coos Bay Frontal (1710030403)	4	0	5	10	13(1)	4(11)	13(1)	13(1)
North Fork Coquille River (1710030504)	0	0	4	4	3	2(3)	3	3
East Fork Coquille River (1710030503)	0	0	9	5	2(6)	4(3)	2(6)	2(6)
Middle Fork Coquille River (1710030501)	0	0	3	6	1	0(2)	0(1)	0(1)
Douglas County								
Middle Fork Coquille River (1710030501)	0	0	4	6	0	3	0	0
Olalla Creek-Lookingglass Cr (1710030212)	0	0	4	15	2(2)	2(2)	2(3)	2(3)
Myrtle Creek (1710030210)	0	0	7	7	2(1)	2(1)	3(2)	3(2)
Clark Branch-South Umpqua River (1710030211)	0	0	7	15	4	4	4	4
Days Cr. South Umpqua River (1710030205)	0	3	6	10	4	6	4	4
Upper Cow Creek (1710030206)	0	0	4	6	0	0	0	0
Jackson County								
Upper Cow Creek (1710030206	0	0	0	1	0	0	0	0
Trail Creek (1710030706)	0	1	2	5	3	2	3	3
Rogue River-Shady Cove (1710030707)	0	0	4	14	1(1)	2	1(1)	1(1)
Big Butte Creek (1710030704)	0	0	3	7	2	2	2	2
Little Butte Creek (1710030708)	0	1	5	48	3(1)	6	2(2)	2(2)
Klamath County								
Spencer Creek (1801020601)	0	0	0	7	0	2	0	0
Klamath R-John C Boyle (1801020602)	0	0	0	3	0	0	0	0
Lake Ewauna-Upper Klamath (1801020412)	0	1	1	39	1	1	0	1
Mills Creek-Lost River (1801020409)	0	3	1	62	0	1	0	1
TOTAL	4	**9**	**69**	**270**	**41(11)**	**43(23)**	**36(16)**	**41(16)**

a/ None directly crossed but in ROW adjacent to direct pipeline locations.
b/ Known and assumed, possible or likely (value in parentheses) crossings or pipeline proximity with indicated fish category designation.
c/ Includes primarily coldwater trout, but also estuarine species in Coos Bay and lower Coos system, and endemic species in the Klamath Basin.

Timing of Construction

The degree of effects on aquatic resources associated with construction activities would depend on the timing of in-water construction. Construction during periods of sensitive fish activity (i.e., spawning, juvenile and adult rearing, and migration) can have a greater effect on fish than construction during other periods. Pacific Connector would cross fish-bearing waterways during the in-water work windows specified by the ODFW in consultation with the NMFS within the range of anadromous fish, and with the FWS as appropriate.

The timing restrictions would prevent construction during periods of sensitive fish use and would typically allow construction only in periods of lower flow rates in streams. In general, construction of the pipeline would be timed to miss periods of major juvenile or adult anadromous salmonid migrations in freshwater based on allowed fishery construction windows, typically July 1 to mid-September for most streams, and some other dates for specific waterbodies. These are tentative dates and timing restrictions would be subject to change by the ODFW. Any modifications to the allowable construction windows would be dictated by stream and fish migration conditions in the year of construction, and would be stated as conditions of state water crossing permits.

Sedimentation and Turbidity Resulting from Pipeline Installation Across Freshwater Streams and Effects on Aquatic Resources

Pipeline crossings of surface waterbodies would cause some downstream turbidity and sedimentation. The type of crossing and stream sediment characteristics can affect turbidity and suspended sediment in streams. Nearly all streams (88 percent) would be crossed using the dry open-cut method (flume and dam-and-pump) (table 4.5.2.3-2). Both “dry” techniques produce much less sediment in the water than alternative “wet” open cut methods (Reid and Anderson 1999; Reid et al. 2002; Reid et al. 2004). While several factors affect the effectiveness of dry construction methods, dry open-cut construction across waterbodies, if properly installed and maintained during construction and restoration, would produce minor levels of sediment and turbidity. Pacific Connector would minimize effects on surface waters and aquatic resources by implementing the waterbody crossing and erosion and sediment control measures as described in its project-specific ECRP, which would reduce the risk of sediment releases during construction.

TABLE 4.5.2.3-2

Proposed Waterbody Crossing Methods for All Waterbody Crossings, by Subbasins and Fifth-Field Watersheds

Subbasins and Fifth-Field Watersheds	Number of Waterbodies Crossed, by Construction Method						
	HDD or Direct Pipe	Bore	Diverted Open-Cut	Dry Open-Cut	Dry Open Cut (Bedrock) b/	Total Crossed	Adjacent Not Crossed a/
Coos Subbasin							
Coos Bay-Frontal Pacific Ocean	3			10		13	6
Coquille Subbasin							
North Fork Coquille River				7		7	1
East Fork Coquille River				9	4	13	1
Middle Fork Coquille River				15	1	16	3
South Umpqua Subbasin							
Olalla Creek-Lookingglass Creek				13	5	18	1
Clark Branch-South Umpqua River	2			8	3	13	9
Myrtle Creek				11	3	14	
Days Creek-South Umpqua River			1	9	5	15	4
Upper Cow Creek				7	1	8	3
Upper Rogue Subbasin							
Trail Creek				4	2	6	2
Shady Cove-Rogue River	1			8	2	11	7
Big Butte Creek		1		2	5	8	2
Little Butte Creek				44	5	49	5
Upper Klamath Subbasin							
Spencer Creek				6		6	1
J.C. Boyle Reservoir-Klamath River				3		3	
Lost Subbasin							
Lake Ewauna-Klamath River	1	6		18		25	16
Mills Creek-Lost River		20		39	1	60	6
TOTAL	**7**	**27**	**1**	**213**	**37**	**285**	**67**

a/ Waterbodies within the construction right-of-way that would not be crossed.
b/ Dry open-cut streams with bedrock streambeds which may require special construction techniques to ensure pipeline design depth including rock hammering, drilling and hammering, or blasting. The need for blasting would be determined by the contractor and would only be initiated after ODFW blasting permits are obtained. These streams are in addition to regular dry open-cut streams.

Duration of crossing can ultimately influence periods of downstream turbidity and suspended sediment elevation to aquatic resources. If channels are dry during construction, small streams (channel width less than 10 feet) are projected to be crossed in less than 24 hours, and intermediate streams (channel width 10 to 100 feet) usually in less than 48 hours. Reid et al. (2004) examined stream crossing data from 46 crossings (23 dam and pump, 12 flumed, and 11 open cut) over a range of stream types across Canada and the U.S. from streams that were mostly less than 10 meters wide. Reid et al. (2004) noted that, in flowing streams they monitored, instream work averaged 38 and 64 hours for dam-and-pump and flumed crossings, respectively. However, the times noted for crossings include all activities that occur, which influence when active suspended sediment may occur, but do not indicate the actual periods when increased suspended sediment development would occur, which is mostly influenced by periods of active instream installation or removal of flow diversions for dry open-cut methods. Additionally, failure of flow sealing and other instream structures at upstream diversions structures can occur from a variety of malfunctions such as pump failure, dam and flume failure, poor dam seal and others. Reid et al. (2004) noted seal failures of monitored diverted open cut crossing in 1 of 23 dam-and-pump projects and 5 of 12 flumed projects. Should these occur, suspended sediment would be relatively elevated over those without failure, but immediate repair work could reduce magnitude and duration of elevated suspended sediment.

Increased sediment loads associated with high turbidity can have effects on fish behavior and physiological processes (e.g., blood chemistry, gill trauma, immune system resistance), and can result in mortality. Salmonids (e.g., trout and salmon) are the most common, abundant, and important species in Project streams and often the most sensitive of common freshwater fish species to elevated suspended sediment. Approximately 27 percent all streams crossed contain salmonids that could be affected if TSS levels are elevated. Salmonids exposed to moderate to high levels of suspended sediment for extended periods could be adversely affected. At high levels, turbidity and suspended sediment directly affects survival and growth of salmonids and other species and interferes with gill function (reviewed and compiled by Bash et al. 2001). Turbidity can also reduce aquatic plant cover (over the long term) by limiting photosynthesis (Goldsborough and Kemp 1988), as well as adversely affecting fish vision, which is a requisite for social interactions (Berg and Northcote 1985), feeding (Vogel and Beauchamp 1999; Gregory and Northcote 1993), and predator avoidance (Meager et al. 2006; Miner and Stein 1996).

Sediment stirred into the water column can be redeposited on downstream substrates, which could bury aquatic macroinvertebrates (an important food source for salmonids, and other fish in estuarine areas). Additionally, downstream fine particle sedimentation could affect spawning substrate habitat, spawning activities, eggs, larvae, and juvenile fish survival, as well as benthic community diversity and health (reviewed and compiled by Bash et al. 2001).

Some studies related specifically to pipeline stream crossing have found varied effects from sediment. For example, rapid recolonization of benthic organisms has been documented on 30 pipeline projects post-construction (Gartman 1984). One long-term study (construction through three years post-construction) of multiple pipeline crossings of a coldwater streams found no measurable effect on fish or benthic resources or their habitat within two months to three years after construction (Blais and Simpson 1997). Reid et al. (2008) found similar conditions for benthic resources ranging from no effect on reductions in abundance or diversity for periods of less than a year, all for wet open-cut crossings, which is not likely representative of most dry crossings.

Dry open-cut construction methods may have the potential to alter fish abundance over the short term. Reid et al. (2002) found that fish abundance downstream of dam-and-pump or flumed crossings reduced immediately after construction in two of four sampled sites, but concluded these reductions were likely not the result of sediment. Additionally, one year after construction, Reid et al. (2002) found no difference in fish abundance below these two sites from preconstruction levels.

Newcombe and Jensen (1996) compiled research from many sources that demonstrates effects on anadromous and resident salmonids by various levels of suspended sediment concentration and exposure duration. They used this information to develop models that estimated the severity of these effects based on sediment concentration and exposure duration.

Output from the model provides severity-of-ill-effects (SEV) scores that are summarized below. Values range from 0 to 14, where an SEV of 0 indicates no effects, an SEV between 1 and 3 indicates behavioral effects, an SEV from 4 to 8 indicates sublethal effects, and an SEV from 9 through 14 indicates lethal and paralethal effects (see Table 1 in Newcombe and Jensen 1996).

1) <u>Behavioral Effects SEV scores</u>
   - 1 = Alarm reaction
   - 2 = Abandonment of cover
   - 3 = Avoidance response

2) <u>Sublethal Effects SEV scores</u>
   - 4 = Short-term reduction in feeding rates and/or feeding success
   - 5 = Minor physiological stress (increase coughing rate and/or increased respiration rate)
   - 6 = Moderate physiological stress
   - 7 = Moderate habitat degradation; impaired homing
   - 8 = Major physiological stress; long term reduction in feeding rate- feeding success; poor condition

3) <u>Lethal and Paralethal Effects SEV scores</u>
   - 9 = Reduced growth rate and/or delayed hatching and/or reduced fish density
   - 10 = 0 to 20 percent mortality and/or increased predation and/or moderate to severe habitat degradation
   - 11= >20 to 40 percent mortality (SEV scores exceeding 11 predict increased mortality rates)

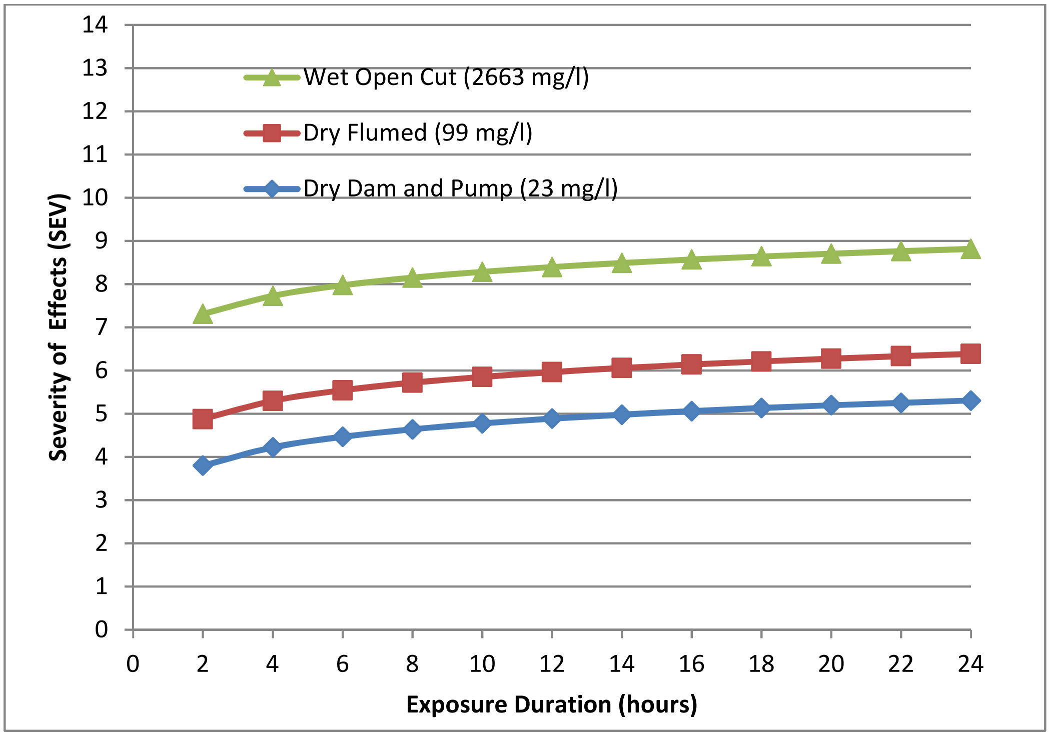
Newcombe and Jensen (1996) developed varied models for this assessment method. The one most relevant for this study is Model 1, which is used to estimate effects on both juvenile and adult salmonids and is based on 171 different study results.

Because of the uncertainty of both available site-specific information and the accuracy of models when applied to varied locations, two approaches were taken to estimate the concentration of suspended sediment and its effect on aquatic resources. One method used literature values from other stream pipeline studies concerning concentrations and durations of the activity to estimate reasonable approximations of likely sediment concentrations and effects on fish. The other was a detailed approach using models to predict sediment concentrations at Project stream pipeline-crossing sites based on known and assumed values, as presented in Pacific Connector’s Resource Report 3.

Literature-Based Assessment of Sediment Effects

Application of the Newcombe and Jensen (1996) model to a collection of stream pipeline crossing locations supplies an approximation of what the likely range of effects may be to fish resources (primarily salmonid). The Reid et al. (2004) data are the most complete set of literature information available on likely ranges of suspended sediment that may occur from various crossing methods and likely in-stream construction duration. Reid et al. (2004) measured suspended sediment downstream from 12 flumed pipeline crossings and 23 dam-and-pump crossings (dry open-cut or isolated pipeline construction crossings) and 11 wet open-cut construction crossings. He noted that average suspended sediment concentrations near these 11 “wet cut” crossing sites were 2,663 mg/l, whereas values were much lower at “dry crossing” sites, which averaged 99 mg/l (12 sites) and 23 mg/l (23 sites) for flumed and dam-and-pump sites, respectively. Using the mean sediment concentration values from Reid et al. (2004) and the Newcombe and Jensen (1996) sensitivity Model 1, the effects on salmonid resources can be approximated (see figure 4.5-4).

While crossing times for construction may be in the range of less than one day to four days for dry crossings, actual periods of elevated sediment would occur primarily during periods of installation and removal of isolation structures. Therefore, time of elevated sediment for any one crossing would only be a few hours, which is why the range of duration in the figure 4.5-4 is limited to 24 hours which would more than cover the period of likely elevated sediment resulting from crossing under normal crossing conditions.



Note: Based on the Newcombe and Jensen (1996) effects model based on typical suspended sediment concentrations levels (data from Reid et al. 2004) by crossing type.

Figure 4.5-4. Effects of Pipeline Stream Crossing Suspended Sediment Concentrations on Salmonids

Based on the estimate of likely average conditions of construction at a crossing assuming the average of the Reid et al. (2004) suspended sediment values, SEVs for dam-and-pump crossings would be most likely in the range of 4 to 5, which could include short-term reduced feeding rate or minor physiological stress. Flumed crossing sites would on average have slightly greater effects, with SEVs mostly in the range of 5 to 6, which could result in minor to moderate physiological stress. If some failure occurred in crossing methods, short-term concentrations and duration would be greater with SEV values similar to those of wet open-cuts, likely in the range of SEV 8, implying adverse factors such as long-term reduction in feeding success and major physiological stress, with wet open cut crossing time closer to 14 hours (Reid et al. 2004). All levels of effects would remain sublethal even with some short-term failure in crossing methods, based on the literature concentration and duration values.

Active monitoring of pipeline crossing construction of mostly coldwater fish streams in New Hampshire found similar SEV level results to those shown above. Trettel et al. (2002) monitored suspended sediment levels within 50 to 150 meters (160 to 500 feet) downstream of the active pipeline crossing constructions sites and used information from 75 perennial streams consisting 71 dry dam-and-pump or flumed crossings and 4 open-cut wet sites to estimate SEV levels. They found that the average SEV of the dry crossings was 6.5 with no measurable difference between types of dry crossing, while the four wet crossings averaged an SEV of 7.4. The SEV level of 6 corresponds to moderate stress while SEV 7 suggests the lowest level where some habitat effects would occur. They found that about one-third of the dry crossings equaled or exceeded this SEV level (7) of potential adverse habitat effects. Additionally, 99 percent of all crossings were less than the designated paralethal or lethal range (SEV of 9 or above). The biggest factor affecting elevated SEV levels was the portion of fines in the sediment at the crossing. These results suggest a very low probability of any direct fish mortality from construction, with local crossing area effects consisting of mostly sublethal effects (e.g., physiological stress, short-term reduction of feeding), and limited habitat degradation.

The distance downstream effects could occur is dependent on many factors (e.g., substrate composition, velocity, flow, channel width). Ritter (1984) estimated that for a minor perennial stream (likely average only half a foot deep, and less than 20 feet wide), suspended sediment concentrations may be near background levels in the range of 60 meters (200 feet) to 150 meters (500 feet) downstream during open-cut crossings. These stream sizes would be most typical of crossings along the pipeline route. Reid et al. (2002) found that below four separate dam-and-pump crossings, mean suspended sediment was less than 20 mg/l within 30 meters (100 feet) downstream. However, at another crossing where some high suspended sediment concentrations occurred from leakage, values 340 meters (1,100 feet) downstream were reduced to 20 percent of those at 45 meters (150 feet) downstream. Low concentrations during construction of crossings appear to be more common when BMPs are closely followed. For example, according to Pacific Connector, a Williams Northwest pipeline completed in Washington State had only one state turbidity standard exceeded out of 67 waterbodies crossings. Pacific Connector estimated the changes of suspended sediment concentrations based on the Ritter (1984) model downstream of 13 Project subwatersheds using estimates of substrate sediment composition and other physical conditions at the crossing sites (e.g., width, depth, and flow).

Based on the Reid et al. (2004) average values, effects on salmonids would be low, other than when sealing failure events occur at the planned dry crossings; the effects would likely range from short-term behavioral to short-term sublethal effects, likely lasting a few hours or days depending on severity. Trettel et al. (2002) monitoring suggests adverse effects may be somewhat greater but still sublethal, with occasional local habitat degradation.

Model Estimates of Effects of Suspended Sediment

Pacific Connector incorporated site data, regional data, and available literature-based models to provide an estimate of both suspended sediment level and extent of effects on aquatic resources from pipeline stream crossing construction based on their estimates of sediment concentration and exposure duration. The parameters used in this model assessment are variable and are based on a combination of data. Thus, the results may be considered an approximation, rather than the exact suspended sediment levels that would be observed.

The method for approximating the concentration of suspended sediment at the specific crossing sites and the distance downstream that various concentrations travel relies on the use of two separate models and empirical suspended sediment value comparisons from typical crossing sites for each crossing method. The first is a regression model that estimates the concentration at or near the representative installation area (Reid et al. 2004) (see above) based on selected physical stream conditions. The second model estimates the distance various concentrations of suspended sediment travel downstream (Ritter 1984) based on selected physical site data.

The Reid et al. (2004) model uses site-specific physical parameters at representative crossing to predict sediment concentrations from a wet open-cut crossing at each stream reach in each watershed crossed by the Project. The basic stream reach data were obtained from the ODFW Aquatic Inventories Project. These data were not specifically from a proposed crossing site in a watershed but were considered to be representative of physical conditions of streams crossed in each watershed. Since all crossings would be dry cut, these model estimates were adjusted downward to equal predicted dry cut crossing values based on the average relationship between wet cut and dry cut methods in the Reid et al. (2004) article. Mean suspended sediment concentrations generated during dry open-cut construction for dry fluming construction were 3.7 percent of the wet open-cut concentrations and 0.85 percent of the wet open-cut concentrations for dam-and-pump construction. Pacific Connector assumed in their model that if sealing of the site from stream flow failed during construction, the average suspended sediments levels at the crossing would be equal to wet cut crossing values.

All parameters used in this model (flow, stream width, velocity, percent silt and clay), except for median sediment size (this had a regressed value based on percent fines for each stream reach), were taken from subbasin stream measurements report in ODFW's Aquatic Inventory database from fifth-field watersheds. This information was used to estimate what sediment concentrations would be for a wet open cut at the stream specific set of data.

The model by Ritter (1984) for small stream crossings was used to predict change in concentrations downstream of crossings based on stream characteristics (e.g., flow, depth, roughness). The details of how this model operates are provided in a revision to Pacific Connector's Resource Report 3.[124]

Estimates were made for 9 to 99 stream crossings per fifth-field watershed (average 51 per fifth-field watershed) for which sufficient data were available to conduct the analysis. These crossings were representative of the Project regions and ranges of stream width/gradient that would have normal dry open-cut crossings. Streams not modeled included the Upper Klamath River (except Spence Creek) and Lost River subbasins crossings, other HDD or boring sites, and bedrock stream crossings that would have low sediment during crossings. Due to the dynamic nature of sediment movement in streams, however, some bedrock crossings may have other substrate at the time of crossing.

The resulting estimates of potential suspended sediment concentrations (without major crossing area sealing failures) indicate that suspended sediment concentrations would remain low in most project regions (table 4.5.2.3-3) (See appendix I, tables I-10, I-11, and I-12 for details by watershed). These estimates are based on the average range of suspended sediment concentrations by watershed during low flows, the period when in-stream construction would occur. Estimates of suspended sediment concentrations produced during pipeline construction under summer low-flow conditions may be highest for the waterbodies crossed in the Coos Bay-Frontal Pacific Ocean fifth-field watershed, followed by crossings in the North Fork Coquille River and Myrtle Creek fifth-field watershed,

[124] Attachment FERC-PCGP-RR3-10 submitted to the FERC in a supplemental filing on May 4, 2018.

which is the result of assumed high fines concentrations at the crossings. For flumed crossings, suspended average watershed values ranged from 27 to 153 mg/l, with values even lower for dam and pump crossings, ranging from 7 to 35 mg/l among the 14 watersheds. Exposures to suspended sediment concentrations from any crossing method would decrease to background levels from about 0.6 to 19 kilometers downstream, among the 14 watersheds (table 4.5.2.3-3).

TABLE 4.5.2.3-3

Estimates of Total Suspended Sediment Concentrations (TSS) Generated during In-stream Construction and Estimated Downstream Distance to Attenuate to Ambient TSS in Fish-bearing Watersheds that Would Be Crossed by the Pipeline

	Average Estimates for Streams Sampled in Watershed a/			
Subbasin and Fifth-Field Watersheds	**Wet Open–Cut TSS (mg/l) at 50 m**	**Fluming TSS (mg/l) at 50 m**	**Dam & Pump TSS (mg/l) at 50 m**	**Distance (m) for TSS (Clay Fraction) to Equal Ambient(TSS = 2 mg/l)**
Coos				
Coos Bay-Frontal Pacific Ocean	4,102	153	35	595
Coquille				
North Fork Coquille River	2,923	109	25	1,840
East Fork Coquille River	2,783	104	24	1,744
Middle Fork Coquille River	2,576	96	22	2,072
South Umpqua				
Olalla Creek-Lookingglass Creek	2,425	90	21	1,780
Clark Branch-South Umpqua River	1,951	73	17	2,407
Myrtle Creek	3,436	128	29	1,708
Days Creek-South Umpqua River	727	27	6	633
Upper Cow Creek	1,996	74	17	7,315
Upper Rogue Subbasin				
Trail Creek	804	30	7	18,591
Shady Cove-Rogue River	712	27	6	16,534
Big Butte Creek	1,112	41	9	10,563
Little Butte Creek	1,198	45	10	11,439
Upper Rogue Subbasin				
Spencer Creek	850	32	7	15,577

a/ Stream-specific values are provided in Appendix X of the APDBA. Nearly all watersheds with at least 12 streams each, usually with multiple reaches per stream.
m – meter; mg/l – milligram per liter; TSS – total suspended solids (sediment)

If there is a failure of isolation structures during either type of dry open-cut construction, it is assumed that the suspended sediment generated during the failure would be similar to suspended sediment generated during wet open-cut construction. Suspended sediment concentrations assumed to occur during failure of isolation structures could be substantial. For the watersheds with highest concentrations, waterbodies in the Coos Bay-Frontal Pacific Ocean, Myrtle Creek, and North Fork Coquille River fifth-field watersheds, modeled suspended sediment assuming average wet open-cut values might be as high as 4,102 mg/l (Coos Bay -Frontal). Other watersheds could be as low as 712 mg/l (Shady Cove-Rogue River) 50 meters (164 feet) downstream from construction (table 4.5.2.3-3). However, each of these watershed values is based on the average of single point estimates from multiple streams but without consideration of how precise the model value is or how the variability of input parameters may affect the model output.

As noted above, Newcombe and Jensen (1996) developed models that estimate severity of effects on fish (primarily salmonids) based on the suspended sediment concentration and the amount of exposure time (i.e., assumed in-water peak disturbance period length) for various fish life stages. Model 1 (effects on juvenile and adult salmonids) was used for the analysis because those are the primary life stages and species of concern that may be present at locations and time of construction. The model requires estimates of both suspended sediment and the duration that values would occur in the stream.

While the actual full process of flumed or dam and pump crossing construction may last more than a day, elevated concentrations would likely peak over a two- to six-hour period, depending on stream width and construction methods with smaller streams taking less time. The number of dry open-cut crossings by stream size category for all watersheds assessed (two Lost River subbasins watersheds not included) is shown in table 4.5.2.3-4 (the number by watershed is given in appendix I, table I-10). Most crossings were of very small (less than 10-foot-wide) streams. Duration time ranged from two hours to six hours. To assess the potential sediment effects if major problems occurred with sealing during installation, a period of six hours duration was applied to sediment concentration estimates developed for wet open-cut crossing values. These times were used to estimate the duration of elevated sediment levels and used in the Model 1 of effects discussed above.

TABLE 4.5.2.3-4

Number of Streams Within Four Width Classed that Would be Crossed by Dry-Open Cuts and Estimated Duration (a/) of In-Stream Generating Actions

	Number by Width Class and Duration b/				
Category	**≤ 10 ft 2 hours**	**>10 ft to ≤25 ft 4 hours**	**> 25 to ≤50ft 5 hours**	**> 50 ft 6 hours**	**Total**
Number	121	47	17	4	189
Percent	64%	25%	9%	2%	100%

a/ Worst-case estimate as many of the smaller streams would be dry during construction.
b/ Total Dam and Pump and Flumed crossing for all watersheds except those in the Lost River subbasin.

Where flumed crossings are used, the magnitude of maximum average watershed severity of sediment effects for juvenile and adult salmonids for most stream crossing (i.e., smallest stream, less than 10 feet wide crossed) would be at most SEV 5 (minor physiological effect) in some of the 14 watersheds. This effect level would occur within 30 meters of stream crossings in six of the watersheds and not in the others. The lowest level of sublethal effect (SEV=4) (short-term reduction of feeding success) would occur in all watersheds to a distance average of about 800 meters below crossing (see appendix I, table I-11). With the longer duration of elevated sediment, severity of effects would be slightly greater for small stream crossings (i.e., 10-25 feet wide), with SEV 5 (minor physiological stress) occurring in about half of the watersheds at an average distance of about 100 meters below the crossings, while lowest sublethal effects (SEV 4) would occur in all watersheds and extend an averaged about 1,800 meters downstream. Except for two watersheds, effect levels on larger streams would be SEV 5 or less. This level would extend on average 180 meters for streams 25 to 50 feet wide (medium), and 280 meters for greater than 50-foot-wide (large) streams. SEV 4 would extend on average about 2,120 and 2,380 meters in the watersheds for the medium and large stream crossings, respectively. While the model results suggest some potential behavioral effect (SEV 1-3) may occur farther downstream in any stream crossing, the sediment concentration that could generate these effects is near background suspended sediment levels (e.g., 2 mg/l), so these effects would be similar to existing stream conditions.

Dam and pump crossings typically have lower suspended sediment generation so almost none of the crossings on the smallest streams (a majority of streams less than 10 feet wide in table 4.5.2.3-4)[125] would have suspended sediment levels reaching any sublethal SEV levels for any watershed, and the few that do would extend less than 50 meters. For the small stream crossing (10-25 feet wide), about half (8 of 14) the watersheds would have some areas reaching the lowest sublethal level (SEV 4), with most of these having sediment effects reduced to potentially only behavioral effects in less than 100 meters from the crossing. For the limited number (up to 21 crossings) of remaining medium and large stream crossings (table 4.5.2.3-4), if dam-and-pump crossings were used, a few watersheds would have no modeled sublethal effects, while the remaining 8 watersheds and up to 13 crossing would be at the lowest sublethal level (SEV 4) (appendix I, table I-11). In these crossings, severity levels would decrease to less than sublethal levels typically in less than about 200 meters of the pipeline crossings.

If the selected dry open-cut method has a failure in sealing, the in-stream construction area sediment levels would be higher than estimated for the crossing type. As noted earlier, if that occurred, then potential wet open-cut suspended sediment concentrations would be assumed. The severity effects model estimate of this assumed elevated sediment level would occur for about six hours (see above). Based on model results, the highest sublethal model effect of SEV 8 (major physiological stress, long-term reduction in feeding rate) would occur within at most 50 meters downstream of the crossing in any watershed, with about half (8 of 14) the watersheds having lesser sublethal effects (i.e., SEV 7 or lower). For most watersheds, if this crossing type occurs, severity levels of SEV 7 (moderate habitat degradation, homing effects) would extend downstream below the crossing between 500 and 2,000 meters (average about 1,000 meters; see appendix I, table I-11). Levels of SEV 6 or less would diminish in distance downstream of these areas as sediment settles. The minimal sublethal effects SEV 4 would still occur mostly from about 5 to 9 kilometers (average about 6.5 kilometers) downstream among the watersheds, over a 6-hour period. No watershed is modeled to have levels reaching the lethal or paralethal range (SEV >9) at any distance below crossings. In the unlikely event that dry crossing methods fail completely and wet open-cut methods must be implemented to complete the crossing, if suspended sediment conditions are high, the longer duration of elevated levels could result in the potential for severity levels to be higher (e.g., SEV 9, reduced fish density) over a limited stream area.

Overall, these effects would be short term, all less than a day as modeled. Some lower levels of effect would occur due to lower suspended sediment concentrations sporadically occurring during the actual crossing activity, and some resuspension of settled sediment with most lasting less than two or three days (Reid et al. 2004). As noted above for value estimates of suspended sediment, the SEV estimates should be considered approximate because the range of accuracy and variability of the input parameters is not directly included in the model estimates. However, the results are reasonable considering that typical dry crossing methods have relatively low concentrations of

[125] Number of streams that would definitely be crossed by dam-and-pump or flumed crossings will be determined during construction, but dam and pump is more often used on smaller streams.

suspended sediment (Reid et al. 2004) of short duration, likely less than 24 hours (Harper and Trettel 2002).

Sediment may also be contributed to fish streams from pipeline crossings of upstream feeder tributary streams. There were some 22 stream crossings of intermittent stream channels that could result in unlikely (due to lack of flow during crossing) sublethal effects (all SEV 4) to the downstream fish stream, and another seven tributary crossing of perennial streams that could result in sublethal effects (SEV 4 or 5) extending into downstream fish streams from these crossings (appendix I, table I-12).

The South Umpqua River diverted open-cut crossing would also result in some increase in suspended sediment. While not directly modeled, the coarse sediment at this crossing area would limit fine sediment distribution downstream of this crossing, likely less than 150 feet, based on model estimates of sediment transport distance, and would likely be less than levels that cause minor physiological stress (SEV 5). Elevated sediment and effects would be mostly reduced within a day of crossing activity termination.

No open-cut or dry-cut crossings would occur when any known adult salmonid resource, including spring Chinook salmon, would be spawning near a crossing during the designated approved construction window. Therefore, direct effects on spawning would be unlikely. Overall, the potential effect of suspended sediment on spawning activities of spring Chinook salmon would be restricted to the South Umpqua River diverted open-cut crossing, which would be limited in its downstream distribution as noted above.

Summary of Suspended Sediment Effects

While the modeled results supply a reasonable estimate of likely level of effects on primarily salmonid fish resources, the models rely on multiple input parameters (e.g., substrate composition and size distribution of fines, median substrate size (d_{50}), and water velocity at each stream) that are specific to fish streams in the watershed but not to specific crossing locations. Therefore, overall summary assessment of effects considered both literature results from other pipeline crossings and the modeled results of Project streams. For both modeled and literature-based assessments, effects would be mostly short term (less than 1 to 4 days) and remain at a near to moderate distance from the crossing location (downstream distance a few hundred feet based on literature, and a few hundred to a few thousand feet based on models).

Overall model results are based on regional watershed averages, but site-specific conditions may vary from these averages. However, the literature-based values of typical project-wide effects provide comparable results, suggesting more specific model estimated effects are reasonable. The results for either method is that crossings would cause at least some short-term adverse effects, primarily avoidance, short-term feeding reduction, and likely minor to moderate stress, but unlikely any direct effects on growth, fish density, or survival. No long-term adverse effects are expected unless some major failure occurred during construction. However, if failure occurred under certain conditions, some marked effects could be expected such as reduced fish density of salmonids in a limited stream area.

Sediment releases would affect primarily short-term stream habitat conditions. Sediment from stream crossings could affect spawning habitat below crossings as Project-generated sediment could increase gravel embeddedness downstream, although elevated fall and winter flows following crossing would likely flush fines from any local spawning sites. Habitat quality, including fish food sources, would be temporarily decreased downstream (e.g., visibility, flushed and covered benthic organisms, reduced fish movement) with overall habitat suitability (Anderson et al. 1996) temporarily decreasing, though not necessarily to levels that would cause moderate habitat degradation (SEV 7).

The Project could result in short-term adverse effects on estuarine and freshwater critical habitat for the Oregon Coast ESU of coho salmon. Short-term effects on critical habitat within the estuarine analysis area would include effects on food and rearing habitat as a result of dredging the access channel, marine waterway modifications, and the slip. Dredging in proximity to the Coos Bay shipping channel would decrease water quality and affect cover (e.g., aquatic vegetation and eelgrass).

Because of the linear nature of the Pacific Connector Project, the number of stream crossings and ultimately total area of stream habitat and individual streams that would be affected in any watershed would be extremely small. There would be 249 actual dry open cut stream channel crossings (table 4.5.2.3-2) in 231 miles of pipeline route over 17 fifth-field watersheds (watersheds with no crossing not included). Since almost no individual stream would have more than one crossing, effects on each stream would be limited to the crossing location. As an example of the relative portion of streams that may be affected in the short term by stream crossings, we examined the potential stream area affected in the four fifth-field watersheds of the Coquille subbasin, a route area with a high number of stream crossings. Those four watersheds have 3,093 miles of stream (Ecotrust 2015). The Project would cross 37 stream channels by dry open cut crossings in that length. Assuming the area affected from sediment to be 1,000 feet per stream crossing, about 0.2 percent of all stream length in this subbasin would have some short-term effect from sediment during construction. Overall cumulative effects would be unsubstantial based on the dispersed distribution of crossings and magnitude of effects at each and lengths of stream channel potentially affected.

Inadvertent Release of Drilling Mud from HDDs and DPs

Pacific Connector proposes to use the HDD method to cross under the Coos, Rogue, and Klamath Rivers. Generally, an HDD would avoid direct effects on a river and its associated aquatic resources. However, as discussed above for the Coos Bay crossing, an HDD requires the use of drilling mud (bentonite) as a lubricant which may leak (also referred to as a frac-out). This fluid is under pressure and there is a possibility of an inadvertent release of drilling mud through a substrata fracture, allowing it to rise to the surface.

As noted above, this release of drilling muds could interfere with various life activities for fish and benthic organisms. Drilling mud that accumulates on the stream bottom could cover over food sources and fish eggs. The majority of highly mobile aquatic organisms, such as fish, would be able to avoid or move away from the affected area while less mobile organisms could incur direct mortality if smothered by the drilling mud. These effects would be localized and short term, limited to species in the immediate vicinity of the frac-out, and ameliorated by river volume.

The effects of an in-stream frac-out on spawning habitat, eggs, and juvenile survival depend on the timing of the release. If spawning habitat is nearby, redds could be affected near a frac-out (Reid and Anderson 1999). During establishment of the spawning bed, the female as part of the normal preparation behavior would likely clean out a minor addition of sediment. However, a heavy sediment load dispersing downstream could settle into spawning beds and clog interstitial spaces, reducing the amount of available spawning habitat, which could be a limiting factor in areas of already reduced habitat. When redds are active, eggs could be buried, disrupting the normal exchange of gases and metabolic wastes between the egg and water (Anderson 1996). The effects of sediment intrusion into the redd on larval survival are more severe during the earlier embryonic stages than following development of the circulatory system of larvae, possible because of a higher efficiency in oxygen uptake by the older fish (Shaw and Maga 1943; Wicket 1954). Clogging of interstitial spaces also reduces cover and food availability for juvenile salmonids (Cordone and Kelley 1961). Benthic organisms could also be affected by burial. However, bentonite is more likely to stay in suspension and less likely to immediately settle than common bottom sediment so, in flowing water effects on benthic organisms from burial under a release of drilling mud are likely to be low and unsubstantial. As discussed earlier, Pacific Connector developed a Contingency Plan that includes measures to reduce effects should frac-outs occur.

DP technology would be used to cross the South Umpqua River at MP 71.3. Like HDD, DP crossings use a bentonite lubricant that theoretically could have an inadvertent return to the surface where it could enter the water contributing to suspended sediment levels. Because the excavated hole is continuously supported and the risk of hydraulic fracture is low, the DP alignment can be designed much shallower than is typical for HDD. Because of the limited amount of lubricant used and relatively low pressure of this construction, the chance of any inadvertent return occurring is remote. Therefore, the chance of accidental contribution of increased suspended sediment to this crossing is unlikely and adverse effects on fish and aquatic organisms at this crossing are likely to be unsubstantial.

Overall drilling mud releases to any waterbody would be short term and diluted from large river water volumes and swift flows. Additionally, frac-out most often occurs near entry and exit points, which may be out of the stream channel. Also, as noted for the HDD crossing in Coos Bay, Pacific Connector has conducted detailed crossing plans for each site and has contingency plans in place should it occur.

Streambank Erosion and Stream Bed Stability

The clearing and grading of vegetation during construction could increase erosion along streambanks, resulting in sedimentation and higher turbidity levels in the waterbodies crossed. Alteration of the natural drainage ways or compaction of soils by heavy equipment near streambanks during construction may accelerate erosion of the banks, runoff, and the transportation of sediments into waterbodies. Erosion, sedimentation, and higher turbidity levels related to the Project could affect aquatic resources, as discussed above. Effects on aquatic organisms due to erosion would depend on sediment loads, stream velocity, turbulence, streambank composition, and sediment particle size.

The rootwad network of trees adjacent to stream supplies bank stability. Those within 25 feet of the stream are considered most important at providing the root source aiding in bank stability (WDNR 1997). To aid in maintaining this bank stability, Pacific Connector would cut most trees near the bank (right-of-way width of 75 to 95 feet at the crossing), except those in the trench line, at ground level leaving the root systems in place helping to maintain short-term bank stability. Roots would be removed over the trench line or from any steam banks that would need to be cut down or graded to accomplish the pipeline crossing. To minimize these effects, Pacific Connector would use temporary equipment bridges, mats, and pads to support equipment that must cross the waterbody (perennial, intermittent, and ephemeral if water is present) or work in saturated soils adjacent to the waterbody. Pacific Connector would also install sediment barriers, such as silt fence and straw/hay bales, across the right-of-way at the edge of waterbodies throughout construction except for short periods when the removal of these sediment barriers is necessary to dig the trench, install the pipe, and restore the right-of way.

Pacific Connector proposes several measures to reduce the risk of erosion, bank failure, bed scour, and channel migration both from initial field evaluations and planned future actions. These are discussed in detail in section 4.3. The ECRP would be followed to help mitigate potential for bank and bed erosion, which would include not using riprap to stabilize streambanks. Immediately after installation of a waterbody crossing, the contours of the streambed, shoreline, and streambanks would be restored to preconstruction configurations (i.e., contour/elevations) to restore the physical integrity/condition of these features and to minimize the loss of stream complexity. Additional erosion control measures would include the installation of erosion control fabric (such as jute or excelsior) on streambanks at the time of recontouring. Stream banks would be restored to original contours, and selected site-appropriate riparian vegetation plantings would occur.

Pacific Connector has conducted a scour and channel migration analysis that identified channels with high risk of potential scour or migration, and pipe exposure. The channel migration and scour analysis rated crossings as to their risk of pipe exposure. Based on this analysis, Pacific Connector proposes to implement site-specific crossing methods at 11 waterbody crossings to reduce the risk of pipe exposure and reduce changes in stream channel habitat at potential areas of risk. Additionally, Pacific Connector has conducted an initial assessment of crossing conditions of all streams suitable for analysis based on the FWS risk matrix (GeoEngineers 2017d, 2018a, and 2018b). This assessment was intended to determine where stream crossings may pose significant risk to increase streambank erosion and streambed instability. GeoEngineers, using a combination of field and GIS data, rated the 173 pipeline stream crossings based on the matrix. Streams were lumped into categories based on their relative risk of project actions at that site affecting the stream and the sensitivity of the stream crossing to be affected crossing actions. The ratings help determine what kinds of BMPs would be most appropriate for each stream category depending on how the stream crossing were ultimately rated for project actions and stream conditions at that site based on the risk category the crossing fell into. Stream crossings that are unstable can ultimately adversely affect aquatic resources from such factors as loss of local habitat and addition of sediment to downstream habitat; these effects would last as long as it takes the crossings to stabilize.

Relatively few of the streams were considered to have marked potential for bank instability. Most streams were determined to be adequately protected with standard BMPs. Some streams would require additional specific BMPs to protect the stream channel and bank conditions (GeoEngineers 2017d, 2018b, and 2018c). Seven stream crossings were considered to need site-specific crossing measures to reduce the risk. Additionally, the BLM and Forest Service made recommendations for crossing designs on eight perennial stream crossing on their lands (see section 4.3). Most of these were the same crossing that Pacific Connector had concluded needed site-specific crossing BMPs. These recommended crossing plans were adopted by Pacific Connector for these crossings.

Proper substrate restoration would also be used maintain stream geomorphic and habitat conditions. Substrate characteristics and physical habitat features would be determined through pre-construction surveys, and the upper 1 foot of existing substrate would be replaced with clean cobble or gravel (not derived from crushed gravel), or a combination of both, or in some cases matching existing substrate during reconstruction after pipe installation. Many of these actions would be determined prior to construction based on results of the pre-construction survey (see below) and determined by a qualified EI specifically trained to determine proper restoration actions to implement based on river channel processes or a suitably trained professional. On non-federal lands, this person would have the authority to select appropriate additional BMP construction methods, bank stability actions, and revegetation types and methods to help reduce the risk of instability of the crossing and potential for future erosion (GeoEngineers 2017d and 2018a). Additional oversight would occur on federal land.

A pre-construction survey would be conducted by a technically qualified team of Pacific Connector on all stream crossings to confirm and clarify conditions developed in the aforementioned matrix analysis. This would include surveys of sites currently not accessible due to property ownership issues. Following these surveys, if significant changes were to occur to parameters of the risk matrix for a crossing, changes would be made to risk level and appropriate final methods of crossing and BMPs made at each stream crossing. Following the final surveys, special additional BMPs, as described in GeoEngineers (2017d and 2018a), would be implemented depending on individual site conditions and may include such actions as changes in bank material and bank angle modifications, specific substrate composition used, plants used on the bank, artificial stabilizing bank material, rootwad enhancement, type of bed and bank restoration structure and various other actions. As described in section 4.3, additional specific post-construction monitoring at various intervals over a 10-year period would occur and corrective actions taken if bank or bed issues are encountered. Additionally, as discussed below, Pacific Connector would supplement lost existing LWD and sources of local LWD in nearly all streams to various degrees, which should help stabilize bed, bank and habitat conditions. These actions are expected to reduce the chance of modification of stream habitat from erosion to occur from the result of the crossing actions to be unsubstantial in most areas.

Construction of New TARs, New PARs, EARs, and TEWAs

Construction of all of these facilities has the potential to contribute sediment to streams occupied by fish and influence benthic food organisms as discussed above concerning the effect of added sediment to streams. Section 4.3 addresses the sediment runoff that would occur from numerous TARs, PARs, EARs, and TEWAs that would be constructed or rebuilt along the route.

Within the range of coho salmon along the route, two new road crossings (PARs) would be built, and seven existing road crossing on EARs would also be improved. Road crossings are areas of potentially the highest relative contribution of sediment to streams. An additional five new roads (PARs and TARs) and an additional 15 EAR segments have the potential to contribute sediment to streams because they are within 200 feet of streams in this area. Sediment contribution to streams is affected by many factors (cover, slope, substrate) but typically decreases exponentially in distance from the road to the stream. Most potential sediment runoff to a stream channel from roads would occur within 100 feet of a stream, but some sediment, about 10 percent, can be contributed from roads between 100 and 200 feet, with contribution beyond 200 feet considered to be non-existent (Dube et al. 2004). Most road segments outside of this distance would have minimal potential for sediment delivery to streams. TEWAs near streams are common along the route. While some additional roads would be built or modified in other Project areas, these areas have limited fish streams along the route, and some additional sediment from these roads would have limited potential to affect fish or their habitat.

As discussed in section 4.3, multiple actions would be implemented to reduce potential sediment quantity entering fish streams. These would include such actions as graveling new road surfaces, restoring all TARs to preconstruction conditions, following land-managing agencies' engineering design and road management standards, and installing BMPs according to the ECRP for all related construction actions, which may include silt fence/straw bales, sediment barriers, temporary slope breakers, or prefabricated construction mats to prevent rutting/compaction.

While some additional sediment to streams may occur, implementation of the *Transportation Management Plan*, ECRP, BMPs, and maintenance procedures would minimize the amount of sediment entering streams, especially fish-bearing streams, reducing the potential for adverse effects on fish and their habitat from sediment runoff.

Crossing Unstable Slopes

Slope failure near the waterbody during pipeline operation could result in soil and sedimentation falling into the waterbody. Pacific Connector evaluated all likely unstable areas during selection of the proposed pipeline route and moved the route as necessary to areas considered to have low risk. Field reconnaissance to assess potential risk based on initial assessment of moderate or high risk was done along the proposed pipeline route, and the final assessment determined only two crossings, located near Steinnon Creek between MPs 24BR and 25BR, were considered to have moderate risk along the pipeline crossing area. The risks to the pipeline at these sites were not considered hazardous enough to require additional rerouting or mitigation. The final assessment considered protective measures that would be adequate to reduce this risk. The known landslide risk areas have thus been all but eliminated from the route (see section 4.1).

Resuspension of Potentially Contaminated Sediments

Elevated heavy metals in water and sediment can have adverse effects on aquatic organisms. Fish and other aquatic organisms are sensitive to mercury levels even at very low concentrations. Because of concerns about hazardous waste from historic mining activities near the crossing of the East Fork Cow Creek (approximately MPs 109 to 110), Pacific Connector evaluated the currently proposed route in the area for mercury-contaminated soils and stream sediment. Examination of the underlying rock type (volcanic) of the proposed route indicates it is unlikely to contain elevated mercury in the bedrock (GeoEngineers 2009a). Broeker (2010) examined this route and sampled soil and stream samples near the proposed stream crossings. Of the three crossing measurements, one value (0.29 milligram per kilogram [mg/kg]) exceeded the ODEQ Level II screening value for freshwater (0.2 mg/kg). The other two were less than the freshwater value but two of the three were equal to or exceeded the bioaccumulation value of 0.07 mg/kg. The six soils samples were considered low in mercury, although they were slightly higher than the ambient background levels. Two intermittent stream channels occur up slope in this region that theoretically could carry sediment and related mercury downslope. However, Broeker (2010) concluded that these intermittent streams would stop on upslope benches and not reach the stream. He concluded upslope delivery to streams was not likely unless erosion was not controlled. Special erosion control provisions, in addition to what usually are implemented, were agreed to by Pacific Connector for this region to reduce possibly elevated mercury levels reaching the stream (Pacific Connector 2013).

Additionally, while levels of mercury in the East Fork Cow Creek are sometimes over ODEQ Level II screening levels, little sediment would be disturbed or suspended from the crossing activity since the crossing would be done in the dry. The pipeline route had been moved about 2,500 feet to avoid areas where elevated mercury levels were measured, so soil is unlikely to have concentrations of naturally occurring mercury exceeding those measured. With adjacent upland disturbance following the standard ECRP and supplemental erosion control actions, additional site-specific ground cover actions would be taken at this crossing, and upslope potential sediment entry into the stream would be controlled and minimized. Overall, adverse effects on fish from mercury would not occur from Pacific Connector Pipeline Project actions.

Vegetation and Habitat Removal and Modification

Sections 4.4 and 4.5.1 list the acres of riparian habitat that would be directly affected by all construction-related activities. Much of this habitat is in forested areas, where stream shading and organic input are most prominent. The analyses conducted for considering effects on riparian vegetation present within a one site-potential tree height buffer on either side of a waterbody on both federal and non-federal lands. This area is within one site potential tree height of the stream, the area near streams with the greatest potential effects on stream. Federal lands have additional areas called Riparian Reserves, which are different than the riparian areas shown here. The analyses here do not consider effects on Riparian Reserves because those effects would be limited to certain federal lands; the analyses provided below consider effects on all lands, hence the analysis of effects on Riparian Zones rather than to Riparian Reserves. Table 4.5.2.3-5 lists riparian areas disturbed by construction and the 30-foot-wide maintenance corridor adjacent to perennial and intermittent waterbodies crossed by the pipeline. Tables listing these cleared areas by watershed are presented in appendix I, tables I-8 and I-9. Removal or alterations in other habitats (e.g., clearcut/regenerating forest, shrub and grasslands, and wetlands) would also contribute to effects on aquatic resources, but to a lesser degree because riparian influence (e.g., shade, organic input, sediment and nutrient filtration) on stream conditions would be less.

TABLE 4.5.2.3-5

Total Terrestrial Habitat (acres) Affected/Removed (a/) by Construction and within the 30-Foot-Wide Maintained Operation Corridor Riparian Zones (One Site-Potential Tree Height Wide) Adjacent to Perennial and Intermittent Waterbodies Crossed/Near the Pacific Connector Pipeline Project

	Forest Habitat b/					Other Habitat b/						
Landowner	**Late Successional Old Growth Forest**	**Mid-Seral Forest**	**Forest Regenerating**	**Clearcut, Forest**	**Forest Total**	**Forested Wetland**	**Nonforested Wetland**	**Nonforested Habitat Unaltered**	**Agriculture**	**Altered Habitat**	**Other Total**	**Total Riparian Area Affected (acres)**
Construction												
BLM-Coos Bay District	7	4	10	0	21	0	<1	0	0	4	4	25
BLM-Roseburg District	1	2	<1	<1	4	0	<1	0	0	<1	<1	4
BLM-Medford District	12	1	0	0	13	0	0	6	0	<1	6	19
BLM-Lakeview District	1	0	0	0	1	0	0	<1	0	0	<1	1
Forest Service-Umpqua National Forest	2	4	2	0	8	0	<1	0	0	3	3	12
Forest Service-Rogue River-Siskiyou National Forest	1	0	1	0	2	0	0	<1	0	0	<1	2
Forest Service-Fremont-Winema National Forest	2	0	2	0	4	0	<1	<1	0	<1	<1	4
Federal Subtotal	**25**	**12**	**16**	**<1**	**53**	**0**	**<1**	**6**	**0**	**7**	**14**	**67**
Non-Federal Subtotal	**15**	**57**	**32**	**8**	**112**	**<1**	**38**	**78**	**14**	**13**	**144**	**257**
Overall Total	**40**	**69**	**48**	**8**	**165**	**<1**	**39**	**84**	**14**	**20**	**158**	**323**
30-foot wide corridor												
BLM-Coos Bay District	2	1	2	0	5	0	<1	0	0	1	1	6
BLM-Roseburg District	0	1	<1	<1	1	0	0	0	0	<1	<1	1
BLM-Medford District	3	<1	0	0	3	0	0	2	0	<1	2	5
BLM-Lakeview District	0	0	0	0	0	0	0	0	0	0	0	<1
Forest Service-Umpqua National Forest	1	1	1	0	2	0	<1	0	0	<1	<1	2
Forest Service-Rogue River-Siskiyou National Forest	0	<1	<1	0	1	0	0	<1	0	0	<1	1
Forest Service-Fremont-Winema National Forest	1	<1	<1	0	1	0	<1	0	0	<1	<1	1
Federal Subtotal	**7**	**3**	**4**	**<1**	**13**	**0**	**<1**	**2**	**0**	**1**	**3**	**17**
Non-Federal Subtotal	**4**	**14**	**8**	**2**	**28**	**0**	**7**	**16**	**3**	**2**	**28**	**56**
Overall Total	**11**	**17**	**12**	**2**	**41**	**0**	**7**	**18**	**3**	**3**	**31**	**73**

Note: Rows/columns may not sum correctly due to rounding.

a/ Project components considered in calculation of habitat "Removed:" Pipeline project construction right-of-way, temporary extra work areas, aboveground facilities, and permanent and temporary access roads (PAR, TAR).

b/ Habitat Types within Riparian Zones generally categorized as: Late Successional (Mature) or Old Growth Forest (coniferous, deciduous, mixed ≥80 years old); Mid-Seral Forests (coniferous, deciduous, mixed ≥40 but ≤80 years old); Regenerating Forest (coniferous, deciduous, mixed ≥5 but ≤40 years old); Clearcut Forests; Forested and Nonforested Wetland, Unaltered Nonforested Habitat (grasslands, sagebrush, shrublands), Agriculture and Altered Habitats (urban, industrial, residential, roads, utility corridors, quarries).

Effects on waterbodies and resident and anadromous fish due to removal of riparian vegetation and maintenance within the construction and operation corridor adjacent to but not crossed by the pipeline Project would be similar to effects on riparian vegetation for streams crossed by the pipeline:

- loss of riparian vegetation along the banks, reducing shade and potentially increasing water temperatures;
- decreased LWD recruitment in streams and on adjacent uplands, although current conditions of LWD in fifth-field watersheds crossed by the pipeline project are generally undesirable;
- removal of an important source of terrestrial food for aquatic organisms; and
- potentially increase in mass slope failures and/or erosion due to surface runoff adjacent to waterbodies that could increase sediment in the waterbody.

Pacific Connector would minimize effects on riparian vegetation by narrowing the width of its standard construction right-of-way at waterbody crossings, and by maintaining a setback between waterbody banks and TEWAs in forested areas. A riparian strip at least 25 feet wide on private lands, including widths ranging from 50 to 100 feet on fish-bearing streams as designated for Oregon State Riparian Management Areas, and 100 feet wide on federally managed lands, as measured from the edge of the waterbody, would be permanently revegetated. Pacific Connector would plant native tree and shrub species along all fish-bearing streams. Within a 30-foot-wide corridor centered on the pipeline, plants would be kept less than 15 feet high. Overall, about 84 acres (23 percent) of former riparian habitat cleared by pipeline construction would be maintained long term in an herbaceous state. The management of vegetation including the riparian areas is presented in detail in section 4.4. Restricting the low-growth vegetation area to a small portion of the total right-of-way clearing would allow much of the ecological function of the riparian conditions relative to fish needs (e.g., shade, future LW, and organic input) to more quickly return. This would limit the overall long-term effects of loss of riparian habitat to a small portion of each stream crossed, reducing future negative effects on fish resources. This would limit the overall long-term impacts of loss of riparian habitat, primarily as a result of LWD reduction, to a small portion of each stream crossed, reducing future negative effects on aquatic resources.

Water Temperature

The effects of water temperature on salmonid life stages have been extensively reviewed by McCullough (1999) and others. Maximum water temperatures ranging from 71.6 to 75.2°F (22 to 24°C) limit distribution of many salmonid species. For spring Chinook salmon, for example, the optimum temperature for growth is 60.1°F (15.6°C) and higher temperatures during summer could reduce growth and lead to increased mortality rates (McCullough 1999). Vegetative cover that provides shade, especially during summer, is one factor that regulates water temperature (WDNR 1997). If sufficient loss of shade occurs, temperatures in streams are known to increase. Increasing stream temperatures can result in reduced fish production and spawning success, and, if high enough, reduced fish survival also, especially for important northwest salmon and trout species found in many Project streams. The current Oregon state water quality temperature standards, which are addressed in section 4.3 of this EIS, include provisions to limit anthropogenic increases in stream temperature especially in salmon- and trout-bearing streams. Construction of the pipeline across waterbodies would necessitate removal of trees and riparian shrubs at the crossing locations that, if extensive enough along any single waterbody, may influence these stream temperatures. Pacific Connector has proposed to mitigate potential temperature increases on waterbodies through riparian plantings. This would include, as mitigation for loss of riparian shade vegetation, replanting the equivalent of 1:1 ratio for construction or 2:1 for permanent riparian vegetation loss with the goal to restore shade along the affected or nearby stream channels in the same watershed (GeoEngineers 2017f). Plantings would incorporate recommendations by the Forest Service and BLM for their lands in Riparian Reserve areas. The lengths of planting areas on streambanks would be determined prior to construction. Plantings are preferred to be continuous and not small parcels. Final plant species and spacing would follow those in the ECRP, which includes specific recommendations by the Forest Service and BLM, unless differently recommended by the landowner.

Temperature modeling was done by the BLM and Forest Service for some of the streams that would be crossed (NSR 2015a, 2015b, 2015c). During the low-flow conditions of 2013, modeled 7-day maximum stream temperatures just below in the three East Fork Cow Creek crossings showed potential increases of 1.0°F to 5.1°F (NSR 2015b). Wetted width on these channels was less than 5 feet, with the smallest channel and lowest flow having the highest temperature increase. The model also tended to overestimate the known temperature, so the results may be elevated, and the 2015 analysis of this creek showed larger temperature increases than those reported in NSR (2009) of similar locations primarily due to much lower flows during 2013. Again, these were very small streams (0.02 to 0.12 cubic foot per second) that also had a natural downstream decrease in temperature below the modeled areas likely from natural groundwater inflow. Steinnon Creek, a small 6-foot-wide stream, was also modeled to have a 7-day maximum stream temperature increase of 0.4°F assuming right-of-way clearing results in zero percent shade, also under the low flow conditions (0.22 cubic foot per second) of summer 2015 (NSR 2015c). Two other modeled creeks (Middle Creek and Big Creek tributary) had estimated increases of 0.1 and 1.1°F in 7-day maximum stream temperature (NSR 2015b). As with other streams, size affected relative change with Middle Creek having a flow of 1.62 cubic feet per second (12 feet wide) and Big Creek tributary 0.08 cubic feet per second (5 feet wide).

The results of the stream temperature model discussed above are likely conservative estimates based on other literature studies and modeling estimates. For example, Pacific Connector modeled 15 streams along the route (GeoEngineers 2017f), where the average temperature increase was modeled at 0.03°F, and the maximum increase among the streams was 0.3°F, with the highest value occurring at one of the smallest streams (table 4.3.2.2-9).

Other studies have noted lower temperature results in similar conditions as well. Two eastern U.S. studies looking at effects of right-of-way clearing in forested areas on stream temperature found no noticeable changes (Brown et al. 2002; Blais and Simpson 1997). More locally (i.e., in the north Oregon Cascades) a study of existing transmission line clearing found no significant downstream temperature changes from the clearings (Tetra Tech 2013). Modeled worst-case temperature conditions changes for this study estimated about 1.1°F (median of about 0.4°F) in the modeled maximum and maximum daily mean temperature across the assumed future clearing of the modeled 22 streams, for an estimated 150-foot-wide clearing (Tetra Tech 2013). The right-of-way width for these studies' crossings was much larger than what is proposed for the Pacific Connector Pipeline Project (i.e., 150 feet wide). Based on the literature studies noted above and project-specific models, estimated stream temperature changes that would result from right-of-way clearing are expected to be minor (see sections of 4.3.2.2 and 4.3.4.2).

These results demonstrate the effects that low-flow conditions, most common in very small channels, have on changes in water temperatures; as noted by Brown and Kygier (1970), given the same solar input, stream temperature is inversely proportional to flow. Observations of these streams also suggest that LWD and low-growing willows, huckleberries, and other brush species can provide effective shade for small, narrow channels. Blann et al. (2002) noted that riparian grasses and forbs supply as much shade as wooded buffers for streams less than 8 feet (2.5 meters) wide. In many cases after completion of pipeline crossing construction, low-growing grasses and brush within and outside of the immediate crossing construction area could minimize shade loss, resulting in lower temperature increases than modeled under zero percent shade.

Models addressing the temperature effect of adding shade from riparian revegetation plantings and other actions is that water temperature would be comparable to the existing condition and remain below ODEQ thresholds on the East Fork Cow Creek. Additionally, any temperature increases in small streams would likely be masked by the assimilative capacity of larger streams at the stream network scale (NSR 2009, 2014) (see section 4.3.2.2).

Over the whole pipeline project region, plantings and regrowth in riparian areas, as suggested by these modeling results, would help moderate potential temperature increases in the short term (a few years). Much of the riparian area would be allowed to regrow from plantings with herbaceous plants (only 10 feet wide would be maintained without some growth) and conifer and other trees (all but 30-foot width). On small streams and, to a lesser extent on larger streams, even 10- to 15-foot-high trees would supply substantial shade, reducing solar heating effects on streams. Additionally, many small streams have intermittent flow (about 80 percent of stream crossings are intermittent) and most would not have flow during periods of greatest temperature, with few of these having fish populations. Thus, the slight effects of solar heating from clearing would gradually be reduced or eliminated over time, based on the model, most between 5 and 10 years, with most areas of potentially higher increases absent flow or fish populations.

As discussed in section 4.3.2.2, potential cumulative watershed temperature increases from Project riparian clearing would be unlikely. GeoEngineers (2017f) provided an estimate the likely relative change in cumulative watershed heat input to streams from Project clearing at stream crossings. While actual total watershed stream temperature changes were not predicted, a relative measure can be approximated through an estimate of increased heat budget from clearing. In the example they provided for the South Umpqua subbasin, the thermal load from the Project due to initial construction clearing in these watersheds was about 16.5 million kcal/day, or about 0.032 percent. The relative unmitigated (i.e., no supplemental riparian plantings) change in heat load to these watershed streams relative to existing uncleared conditions would be an increase of only 0.004 percent once vegetation grows back outside of the 30-foot permanently maintained right-of-way clearing. The regrowth to achieve these levels would be expected to occur within 10 years in the Coos and Coquille subbasins and 20 years in others along the route. Considering the very small portion of total watershed riparian stream cover removed and low estimates of thermal increase, streamside clearing would not result in any measurable cumulative watershed-level changes in water temperature.

Based on available information, we conclude that any changes in water temperature, related to 75- to 95-foot-wide right-of-way vegetation clearing at waterbody crossings, are likely to be very small and undetectable through measurements, except for possibly the very smallest perennial streams and occasional intermittent flowing streams that may have flow during a hot period. Small streams with the greatest potential for measurable temperature increase also often contain limited numbers of fish because small headwater streams are often not fish-bearing or, if fish are present, their small size and often high gradient limit the stream's suitability as fish habitat. Any temperature changes that may occur would gradually be reduced or eliminated over time as most riparian vegetation, from plantings, natural vegetation growth, and size increases would increase stream shading.

Large Woody Debris

One effect on fisheries that would result from forest clearing at pipeline crossings and construction of the pipeline right-of-way within the riparian zone adjacent to but not crossing streams, TEWAS, and PARs, and TARs is the reduction of LWD in streams and on adjacent uplands (Harmon et al. 1986; Sedell et al. 1988). Large logs provide in-stream channel structures (i.e., pools and riffles), which are critical to salmon spawning and rearing. As the size of individual logs or accumulations of logs increases, the size and stability of pools that are created also increase (Beschta 1983). Riparian forests that undergo harvesting of large trees take on secondary-growth characteristics and contribute lower quantities of large wood than unmanaged, old-growth forests (Bisson et al. 1987). However, sufficiently wide, carefully managed riparian buffers that retain a full complement of ages, sizes, and species of native trees and vegetation can ensure adequate recruitment of LWD to streams (Bisson et al. 1987; Murphy and Koski 1989; Morman 1993).

Pacific Connector has proposed to mitigate for effects on waterbodies by installing LWD at agency- and landowner-approved and appropriate areas within the construction right-of-way across certain waterbodies. The use of LWD as a mitigation measure for effects associated with in-stream construction has been documented as an effective means of creating in-stream habitat heterogeneity, reducing streambank erosion, reducing sediment mobilization (Bethel and Neal 2003), and enhancing local fish abundance (Scarborough and Robertson 2002). Placement of LWD on the streambanks and in the streams, can provide slight shade and increase bank stability, while vegetation is maturing following construction. Additionally, placement of LWD in streams or keyed into streambanks can provide habitat for benthic invertebrates and important food source for salmonids, and increase habitat for forage species with the creation of pools and enhancement of the salmonid rearing potential of an area (Cederholm et al. 1997; Slaney et al. 1997).

To mitigate for short-term losses of LWD from riparian clearing and in-stream removal of wood during construction, Pacific Connector has developed a *Large Woody Debris Plan* which includes a proposal to install 733 pieces of LWD over several fifth-field watersheds along the pipeline route where the two ESA-listed coho salmon ESUs are present. Sizes would be based on those recommended by the current ODF and ODFW (1995) protocol for piece size by streambank full width category. The plan includes placing from one to four pieces of LWD per stream crossed in the stream or on the bank, depending on forest conditions, stream flow, and landowner approval. This number of pieces, if no other LWD were present in the stream reach affected by clearing, would be near the range of what is considered "desirable" by ODFW (Foster et al. 2001) for forested streams. Foster et al. (2001) noted that more than 20 LWD pieces/100 meters of stream length (i.e., 4.6 pieces/75 feet of right-of-way clearing) with more than 3 "key" pieces/100 meters (i.e., 0.7 "key" pieces/75 feet right-of-way clearing) is considered "desirable" in forested streams in Oregon. Bilby and Ward (1991) found LWD density in old-growth forest streams in southeast Washington to have a similar range. Based on their LWD regression model estimates using channel width,[126] LWD values in old-growth forest would be expected to range from about 1 to 7 pieces per 75 feet of stream channel length for streams ranging from about 50 to 10 feet wide. The sizes of LWD pieces to be installed are based on ODF and ODFW (1995) guidelines for sizes of LWD pieces to be present in streams to meet habitat needs for specific stream sizes and number of streams crossed. These final numbers would be developed as part of Pacific Connector's Mitigation Plan, which may have some modification prior to construction. Some long-term loss of local stream habitat would remain even with the LWD mitigation due to reduced future sources of LWD from the right-of-way.

Specific streams for LWD installation have been identified by Pacific Connector; however, the specific locations within the streams would be determined through discussion with ODFW, NMFS, and other agencies as appropriate, and in consideration of the BMPs outlined in the *Stream Crossing Risk Analysis Addendum* (GeoEngineers 2018a). The size of LWD installed would follow ODF and ODFW (1995) suggested guidelines for size of LWD based on stream size. Depending on private landholder approval, some pieces may be installed at various times and locations, but in general, LWD would be placed at waterbody crossings during the last phases of pipeline construction and right-of-way restoration. Pacific Connector has proposed that, if for some reason not all pieces proposed are installed, they would be donated to local water conservation groups for installation locally.

Long-term losses of LWD input would largely be mitigated through riparian replanting of conifers in the right-of-way, although some limited long-term reduction would remain from the absence of trees in the 30-foot-wide maintenance corridor and relatively smaller sizes of regrown trees in the remaining 45 to 65 feet of the right-of-way.

The NMFS, upon review of this proposed LWD plan, determined that the applicant's proposed number of LWD pieces, location, and methods of their proposed installation is not adequate to meet the loss of supply of LWD from riparian forest habitat related to right-of-way riparian clearing. However, we conclude that the proposed plan is consistent with ODF and ODFW protocols. Further, we note that the contribution of LWD to a stream from the 75- to 100-foot area cleared on both sides of a stream for construction represents an insignificant source for any stream other than extremely short headwater reaches.

Fish Passage

Waterbody crossings using the dry crossing methods, either flume or dam–and-pump, may result in some fish being trapped in streams. Flumes and dams would be completely installed and functioning before any in-stream trenching disturbance occurs. Up to about 250 stream crossings would be dry open cut, although most of these would be dry during crossing as they are intermittent streams (tables 4.5.2.3-1 and 4.5.2.3-2). Construction across a waterbody would take up to 4 days using dry open-cut methods, but less for small and intermediate streams. At one crossing of the South Umpqua River, a diverted open-cut crossing (only crossing of this type) would be used. This is similar to a dry open cut in that all in channel construction would be done in the "dry" but would require diversion of the flow to one side of the channel at a time. This method could take

[126] Model: Log10 frequency of LWD = -1.12 log10 of Channel Width (m) +0.46

about 14 days to complete. Because one channel would be open during the entire crossing, no passage of fish would be impeded, and no fish removal would be required.

For typical crossings, once streamflow is diverted through the flume pipe, but before pipeline trenching begins, fish trapped in any water remaining in the work area between the dams would be removed and released using the methods in Pacific Connector's *Fish Salvage Plan*.[127] Pacific Connector would use seining[128] as the primary method to salvage fish but would also use electrofishing if all fish cannot be removed by seining. All methods of capture and holding have risks of stress, injury, or mortality of fish and fish inadvertently left in the construction crossing area may die.

Tribal governments have expressed concern that the currently proposed fish salvage methods would not adequately capture and protect lamprey, which is an important resource to tribal communities (see section 4.11). Adult Pacific lamprey are expected to be captured during the proposed salvaging; however, the currently proposed salvage methods (which were developed primarily for salmonids) may not be effective for salvaging lamprey ammocete larvae, which may remain in dewatered sediments. Electrofishing procedures to sample Pacific lamprey larvae have been recommended by the FWS (see Appendix A in FWS 2010a) and the Coquille Tribe has indicated that they can provide Pacific Connector with additional measures that would be effective at salvaging lamprey. Pacific Connector has indicated that it would contract with either the ODFW or a qualified consultant to salvage fish; however, because the salvage methods currently proposed may not be effective at collecting all lamprey life stages, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary, for review and written approval by the Director of OEP, its final *Fish Salvage Plan*, that addresses methods suitable to collect and salvage all lamprey life stages, to the extent practical, together with documentation that the final *Fish Salvage Plan* was developed in consultations with interested Tribes, ODFW, FWS and NMFS. The revised *Fish Salvage Plan* should also incorporate the applicable measures of the Handling Guidelines for Klamath Basin Suckers.**

Because the flume would maintain streamflow, some fish may move upstream through the flume. With the dam-and-pump method, the fish would not be able to move upstream or downstream through the work area until the dams have been removed. Flumes and dams would be removed as soon as possible following backfilling of the trench. Based on information from average stream crossing times (Reid et al. 2004) estimated durations when complete or partial blockage may occur for fluming would range from 36 to 92 hours, and for dam-and-pump, the range is from 20 to 56 hours.

<u>Aquatic Nuisance Species</u>

Currently, there are 180 reported NAS in Oregon, of which 134 are documented in the USGS hydrologic basins crossed by the Pacific Connector pipeline (USGS 2005). Some of the major potential aquatic invasive species are mussels, including the zebra and quagga mussels (*Dreissena polymorpha*, and *Dreissena rostriformis bugenisis*), and New Zealand mud snail (*Potamopyrgus antipodarumis*) as well as Cyanobacteria (blue-green algae), and freshwater mold (Saprolegnia). Invasive species can have multiple adverse effects when introduced to their non-native

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[127] See Appendix F.3 of RR3 , which was included in Pacific Connector's application to the FERC.

[128] A fine meshed net pulled through the water to capture fish.

environment. The most common effect is competition with native species for habitat and resources, often with the reduction or elimination of the native species. They also may cause effects on human uses of the water. For example, zebra mussels have been found to multiply to such vast numbers that they effectively block water intakes, such as drinking water supplies. Additionally, invasive species may crossbreed with native stocks of organisms indirectly causing the reduction of viable native pure species. Some invasives may directly kill other native species that have no natural defenses against them. Pacific Connector's *Hydrostatic Test Plan*[129] includes measures that would prevent the spread of invasive species from one water basin to another. These plans would also be used for equipment used between waterbodies.

The procedures are outlined in Attachment C to the *Hydrostatic Test Plan*. Additional supplemental invasive species protective actions for cleaning of equipment used among water bodies was developed by ODFW specifically for this project and have been incorporated by Pacific Connector in their *Hydrostatic Test Plan*. Some items in the *Hydrostatic Test Plan* that would aid in ensuring invasive aquatic species are not transported between streams, including preventing the spread of quagga and zebra mussels, New Zealand mudsnail, and aquatic plant invasion, are:

- Clean all aquatic plants, animals, and mud from vehicles, boats, motors or trailers and discarding the debris in the trash. Rinsing, scrubbing, or pressure washing should occur away from storm drains, ditches, or waterways.
- Drain live wells, bilge, and all internal compartments.
- Dry equipment including boats between uses, if possible (leaving compartments open and sponging out standing water).
- Scrub or pressure wash life jackets, waders, boats, landing nets, and other gear that comes in contact with the water.
- Clean and sanitize as needed which may include heated power wash before moving establishing sanitizing areas away from areas where it may enter surface water including use of bleach solution and run through portable pumps for 10 minutes
- Inspect everything for signs of aquatic invasive species before launching and before leaving.

Blasting

Blasting in stream channels can have adverse effects on fish, especially for fish with swim bladders. Explosives detonated near water produces shock waves that can be lethal to fish, eggs, and larvae by rupturing swim bladders and addling egg sacs (British Columbia Ministry of Transportation 2000). Explosives detonated underground produce two modes of seismic wave (Alaska Department of Fish and Game 1991). Shock waves propagated from ground to water are less lethal to fish than those in-water explosions since some energy is reflected or lost at the ground-water interface (Alaska Department of Fish and Game 1991). Peak overpressures as low as 7.2 pounds per square inch (psi) produced by blasting on a gravel/boulder beach caused 40 percent mortality in coho smolts and other studies revealed 50 percent mortality in smolts with peak overpressures ranging from 19.3 to 21.0 psi (Alaska Department of Fish and Game 1991).

The best way to reduce or eliminate effects on fish is to keep fish out of regions where pressure waves are harmful. The Alaska Department of Fish and Game (1991) reported that a pressure change

[129] See Appendix V.2 of Resource Report 3, which was included in Pacific Connector's application to the FERC.

of 2.7 psi is the level for which no fish mortality occurs and is from 1.7 to 4.5 psi below any level where mortality would be expected. Based on normal charges used in trenching (about 1 to 2 pounds at 8-millisecond delay) the zone of the above pressure wave would extend 34 to 49 feet, depending on substrate near the charge (Alaska Department of Fish and Game 1991). Typically, the dry area (where fish could not be) would be at least 25 feet wide during construction. If blasting were to occur with only a 25-foot-wide dry working space buffer between the blast and the stream, the potentially hazardous pressure wave (i.e., greater than 2.7 psi) would extend no more than an additional 25 feet. Likely, the effects would be felt over a much smaller distance as this distance estimate is based on a very conductive energy transfer substrate, which is unlikely to occur at most crossings. Pacific Connector developed a *Blasting Plan* that outlined measures to reduce effects on resources. Prior to any blasting, proper permits would be obtained and agencies notified as required by permits. Blasting may occur in uplands adjacent to streams or in dry streambeds, and Pacific Connector does not anticipate conducting any in-water blasting. Pacific Connector would attempt to minimize shock waves from blasting that may affect aquatic resources by the types of explosives selected, the size of charges, and the sequences of firing. Currently, about 37 crossings have known bedrock, some of which may require blasting (table 4.5.2.3-2). Fish would be removed from the crossing area, in accordance with Pacific Connector's *Fish Salvage Plan*. Where blasting would occur near a crossing, fish would be excluded an additional 25 feet upstream and downstream from the crossing area by use of barrier nets. In addition, bubble/air curtains may be used to disrupt shock waves, depending on input from state agencies during the state permitting process.

Hydrostatic Testing

After the pipeline is installed, Pacific Connector would fill it with water under pressure to test it (see section 2.4.2.1). Total water used for hydrostatic testing would be about 64 million gallons. Pacific Connector would obtain its hydrostatic test water from commercial or municipal sources or surface water rights owners to lakes, impoundments, and streams from possibly 17 different locations. About half of the water would be from impoundments or lakes, and the rest may come from up to nine streams, including Coos River, East and Middle Fork Coquille Rivers, Olalla Creek, South Umpqua River, Rogue River, Lost River, and Klamath River. Pacific Connector estimates it would withdraw just over 39 million gallons from 12 source locations within six construction spreads along the length of the pipeline route. Pacific Connector would obtain all necessary appropriations and withdrawal permits, including from the OWRD, prior to use. All the streams identified as potential test water sources include anadromous salmonids or resident trout. About 3,084 potential discharge locations for the test water have been identified. During the test, it may be necessary to discharge water at each of the sites; however, discharges would be minimized and water would be conserved as much as practical by cascading water between test sections when feasible (pumping from one segment to the next).

Potential effects on aquatic resources associated with hydrostatic testing include entrainment of organisms including fish, reduced downstream flows, erosion and scouring at release points, and the transfer of aquatic nuisance species through the test water from one water basin to another. Estimates of potential water intake amounts from streams indicate flows below intake would be reduced by less than 10 percent of instantaneous flow based on typical monthly flows (cfs) during the month of withdrawal for all but one potential locations, where it would about 35 percent during withdrawal (duration about 6 to 11 days at each potential location) (Ambrose 2018; table 4.5.2.3-6). Final selection of intake rates and sites would be reviewed by ODFW and OWRD prior to testing, so that potential effects on fish habitat from flow reductions would be unlikely. Pacific Connector has developed a *Hydrostatic Test Plan* to minimize effects from hydrostatic testing on resources. This plan is discussed in more detail in section 4.3.2.2 of this EIS.

TABLE 4.5.2.3-6

Hydrostatic Testing Water Requirements and Flow Impacts on Water Sources

Alignment Location	**Pump Rate (gpm)**	**Pump Rate (cfs)**	**Total Estimated Volume Needs (gallons)**	**Water Source Name**	**Water Source MP Inter-section (MP)**	**Water Source Basin Area (sq miles)**	**Reference Gage**	**Reference Gage Basin Area (sq. miles)**	**Estimated Time of Use (month)**	**50% Exceedance Flow for Reference Gage (cfs)**	**50% Exceedance Flow for Water Source (cfs)**	**Adjusted Flow Based on Hydrostatic Test Water Use (cfs)**	**Estimated Flow Reduction Duration (days)**	**% Flow Reduction**
Spread 1	300	0.67	2,800,000	Coos River a/	11.08	400	StreamStats	n/a	October	n/a	131	130.3	6.5	0.51%
Spread 1	300	0.67	2,800,000	EF Coquille River	29.64	101	StreamStats	n/a	October	n/a	27.4	26.7	6.5	2.44%
Spread 2	300	0.67	2,500,000	EF Coquille River a/	29.64	101	StreamStats	n/a	October	n/a	27.4	26.7	5.8	2.44%
Spread 2	300	0.67	2,500,000	MF Coquille River	50.28	17.5	StreamStats	n/a	October	n/a	1.91	1.2	5.8	35.06%
Spread 3	300	0.67	4,000,000	Olalla Creek	58.79	68	StreamStats	n/a	June/July	n/a	9.25	8.6	9.3	7.24%
Spread 3	300	0.67	4,000,000	S. Umpqua River	71.25	1410	StreamStats	n/a	June/July	n/a	642	641.3	9.3	0.10%
Spread 4	300	0.67	2,800,000	S. Umpqua River a/	71.25	1410	StreamStats	n/a	July/Aug	n/a	268	267.3	6.5	0.25%
Spread 4	300	0.67	2,800,000	S. Umpqua River	94.70	571	StreamStats	n/a	July/Aug	n/a	137	136.3	6.5	0.49%
Spread 5a	300	0.67	2,500,000	S. Umpqua River a/	94.70	571	StreamStats	n/a	Sept	n/a	87	86.3	5.8	0.77%
Spread 5b	300	0.67	2,800,000	Rogue River a/	122.80	1090	StreamStats	n/a	Sept	n/a	1330	1329.3	6.5	0.05%
Spread 7	300	0.67	4,800,000	Klamath River a/	199.20		USGS 11509500	3920	February	1175	1175	1174.3	11.1	0.06%
Spread 7	300	0.67	4,800,000	Lost River	212.00	1350	StreamStats	n/a	February	n/a	88	87.3	11.1	0.76%

a/ Primary Water Source; all others are a Secondary Water Source.

*Klamath River Flow Estimate Based on Mean of February Monthly Means (2000-2017) at USGS Gage 11509500

Source: Table 1 in Attachment F, Hydrostatic Test Water Withdrawal Hydrologic Assessment, to Pacific Connector's updated *Hydrostatic Test Plan* submitted to the FERC November 8, 2018.

To prevent the entrainment of most aquatic species, the pumps and intake hoses for hydrostatic test water removal would be screened, in accordance with NMFS screening criteria. To ensure water withdrawal does not cause downstream water level issues (ramping rate), Pacific Connector would submit their withdrawal plans to ODFW for review prior hydrostatic testing. To prevent the transfer of organisms from one water basin to another, Pacific Connector would try to return hydrostatic test water to its basin of origin. However, given the linear nature of the pipeline and the need to cascade test water from one section to another, such a return may not always be possible. Therefore, Pacific Connector would treat the test water after withdrawal (most likely with chlorine) to prevent the spread of invasive species and pathogens. To prevent erosion or scour at discharge locations, the hydrostatic test water would be discharged at low head into energy dissipating devices and dewatering structures in uplands at least 150 feet from streams. Volume and flow rates would be controlled to prevent overland flows directly to waterbodies. Specific hydrostatic discharge sites have been reviewed and approved by BLM and Forest Service on their lands to minimize runoff and avoid effects on beneficial uses.

The hydrostatic testing would remove water from several different waterbodies along the pipeline route. The NMFS has indicated that to insure fish and aquatic habitats are adequately protected during these withdrawals that no more than 10 percent of existing flow at the time of withdrawal be removed during hydrostatic testing. Therefore, **we recommend that**:

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary, for review and written approval by the Director of OEP, a revised *Hydrostatic Test Plan* that requires that any water withdrawal from a flowing stream does not exceed an instantaneous flow reduction of more than 10 percent of stream flow.**

<u>Hyporheic Exchange</u>

Mixing of shallow groundwater and surface water in streams is a form of hyporheic exchange and can affect important physical factors such as temperature, dissolved oxygen, and chemical composition of streams that may influence aquatic habitat. As discussed in section 4.3, an assessment was made of likely crossing areas that may affect this exchange rate (GeoEngineers 2017g) and actions taken to reduce potential effects of these crossings. Fifteen stream crossings were categorized as having a “high” sensitivity, which would suggest a high likelihood of a functioning hyporheic zone, mostly associated with larger waterbodies with greater floodplain widths and instream morphologic features. As discussed in section 4.3, however, there are several site-specific crossing construction plans and BMPs in place to help reduce the chance of there being functional effects on this exchange, such as returning natural material to trenched areas and installing trench plugs adjacent to wetlands and waterbodies, all of which would help return natural hyporheic exchange rates after construction is complete. It is anticipated that substantial alterations in these water exchanges would not occur and not affect aquatic habitat in streams crossed.

<u>Fuel and Chemical Spills</u>

For any large construction project, there is the potential for spills of fuel or other hazardous liquids from storage containers, equipment working in or near streams, and fuel transfers. Any spill of fuel or other hazardous liquid that reaches a waterbody would be detrimental to water quality. The chemicals released during spills could have acute, direct effects on fish, or could have indirect effects such as altered behavior, changes in physiological processes, or changes in food sources. Fish could also be killed if a large volume of hazardous liquid is spilled into a waterbody. Ingestion of large numbers of contaminated fish could affect primary and secondary fish predators in the food chain.

To minimize the potential for spills, Pacific Connector has developed an SPCC Plan. Pacific Connector's implementation of this SPCC Plan would minimize the potential for and the effect of any spill near surface waters. The SPCC Plan would be updated with site-specific information prior to construction. Specific measures in this plan include prohibiting liquid transfer, vehicle and equipment washing, and refueling within 100 feet of waterbodies and specific steps to be followed to control, contain, and clean up any spill that occurs. The SPCC Plan is further described in section 4.3.2.2. Pacific Connector's implementation of this SPCC Plan would minimize the potential for and the effect of any spill near surface water on aquatic resources.

Benthic and Sessile Organisms

Benthic and sessile organisms including benthic invertebrates and freshwater mussels would be affected by most of the same factors noted primarily for fish discussed above. This would include effects from elevated turbidity and suspended sediments, release of drilling muds, herbicide application, blasting, fuel and chemical spills, and habitat modification. Mayflies, caddisflies, and stoneflies prefer large substrate particles in riffles and are adversely affected by fine sediment deposited in interparticle spaces (Cordone and Kelley 1961; Waters 1995; Harrison et al. 2007). Fish and benthic macroinvertebrate abundance downstream of pipeline construction sites have been reported short-term reductions following construction-generated suspended sediment (Reid and Anderson 1999). Reid et al. (2008) summarized the results of nine wet open-cut pipeline stream crossing studies and noted all measured effects on downstream stream invertebrate population abundance or diversity (six of nine studies) were less than a year in duration with three studies having no measured effects on invertebrate abundance. Since the proposed action does not include wet open cuts, effects on benthic invertebrates would be limited. Risk of adverse effect on relatively sessile species, such as mollusks, could extend downstream from construction sites if degradation of water quality affects downstream habitats. However, because they are relatively immobile, the trenched crossing would have the greatest effect and would directly kill many at the trenching site because most would be unable to actively move from the area. In the case of many aquatic invertebrates, including insect larvae, these areas would be rapidly (weeks/months) recolonized from upstream drift and new egg deposition from adults. In some cases, for longer-lived organism, such as mussels, recolonization would take longer as they are immobile and most take years to grow to full size. The largest effect on most benthic and sessile organisms would be directly at the crossing location and the effect would be short term. In the case of mussels, local affects may be long term. However, the overall area affected for any given stream would be small so adverse effects on local populations would be slight.

Effects on Aquatic Habitat and Aquatic Species from Operation of the Pacific Connector Gas Pipeline Project

Once installed, maintenance of the pipeline would include activities such as aerial inspections, gas flow monitoring, and visual inspection of surrounding vegetation for signs of leaks, and integrity management, which includes smart pigging[130] to investigate the interior surface of the pipe for any signs of stress cracking, pitting, and other anomalies. All the maintenance activities would be outlined in the *Operations and Maintenance Plan* that would be prepared according to operating

[130] A pig is a remotely operated pipe inspection and cleaning tool.

regulations in USDOT 49 CFR Subpart L, Part 192 and would be completed prior to going in-service. The *Stream Crossing Risk Analysis Addendum* (GeoEngineers 2018a) outlines the measures that will be contained in the final stream crossing monitoring plan. These general maintenance activities would require only surface activities and usage of the existing right-of-way, such as insertion of the pig at one of the pig launching facilities.

Potential estuarine or stream channel disturbance would occur if an integrity issue with the pipeline occurred. If this happened, the pipeline would likely be unearthed (except non-trenched crossings like HDD, which may be rebored) within the right-of-way and repair work done in-water. Within stream sites, repair work could require isolated flow from the section of pipe that is to be exposed. Typically, repairs would be made to the pipe within the right-of-way (within the trench) or, depending on the site-specific conditions and nature of the repair needed, a reroute around the affected section may be considered. Effects would be similar to those discussed above for initial installation except on a much smaller scale, because they would only involve one crossing compared to many streams and, in the case of the estuary, likely just a portion of whole route would be disturbed not the whole 0.7- or 1.6-mile HDD sections, or possibly just rebored without having to disturb the estuary bottom. However, should repairs be needed out of the standard stream crossing window (i.e., during periods of fish spawning or egg incubation) there would be additional adverse effects on key fish resources at the specific site. The actions would include similar BMPs and mitigation. Any future repairs would require additional permit approval from appropriate state and federal agencies, which would determine the acceptable parameters of these actions. Such pipeline integrity-based in-water projects are very infrequent.

Vegetation maintenance would be limited adjacent to waterbodies to allow a riparian strip to permanently revegetate with native plant species across the entire right-of-way. To facilitate periodic pipeline corrosion/leak surveys, a corridor centered on the pipeline and up to 10 feet wide would be maintained in an herbaceous state. In addition, trees that are within 15 feet of the pipeline and have roots that could compromise the integrity of the pipeline coating would be selectively cut and removed from the permanent right-of-way.

Herbicide Application

Pacific Connector would not use herbicides for routine vegetation maintenance; however, Pacific Connector would implement an *Integrated Pest Management Plan*[131] that addresses control of noxious weeds. The plan was developed in consultation with the ODA, BLM, and the Forest Service. The plan would include the selective use of herbicides where necessary to control noxious weeds by limited application from the ground, where allowed by landowners. Pacific Connector would only use agency-approved herbicides authorized in current planning documents to control noxious weeds where infestations occur in the right-of-way after construction and during operation. Herbicides would not be applied by aerial or broadcast spraying. Noxious weeds would be removed only by manual methods in the riparian zones, which is defined as one site potential tree height, and within federal lands Riparian Reserves that are defined as being greater than 150 feet in most areas along the route, and greater than 100 feet in other areas.

Herbicides can have toxic or other adverse effects on fish and other aquatic organisms. In general, most effects on aquatic systems occur from direct spray of herbicides, and possibly drift when herbicides are sprayed, and leaching through soils and groundwater (Tu et al. 2001). Pacific

[131] Appendix N of Pacific Connector's POD.

Connector would not directly spray, or otherwise apply, herbicides in waterbodies or in riparian zones. The risk of drift would be avoided by selectively applying herbicides from the ground. The five types of potential herbicides that could be used have various levels of toxicity to aquatic organisms. However, the restriction to selective applications outside of riparian zones would greatly reduce the potential of adverse effects on fish by keeping herbicides outside of riparian zones and preventing herbicides from reaching streams.

4.5.2.4 Environmental Consequences on Federal Lands

The Pacific Connector Pipeline Project would have some effect on 41 waterbodies and associated riparian areas in the approximately 77 miles of federal lands that would be crossed by the pipeline. The effects on federal lands in designated land use categories (e.g., Riparian Reserve, ACS, Key Watersheds) from the proposed action are addressed fully in section 4.7 and appendix F, and effects on special status species are discussed in section 4.6 and the BE (appendix F). Watersheds crossed on federal lands and characteristics of those watersheds are discussed in section 4.7 and appendix F. Aquatic species present on federal lands would be similar to those discussed in section 4.5.2.3, except no marine and estuarine fish and shellfish are present in the waterbodies crossed on federal lands. Aquatic species found on federal lands would be mostly the same as those on non-federal lands with freshwater habitat. Commercial and recreational fisheries of importance in waterbodies crossed include primarily anadromous salmon and steelhead and resident trout. Specials status species present in some stream segments crossed include federally listed Oregon coastal coho salmon and Southern Oregon/Northern California coastal coho salmon ESU. EFH habitat is also present along the route for coho and Chinook salmon stocks. Other state and federal fish species of special status are discussed in section 4.6. Aquatic habitats that would be affected by the pipeline on federal lands are primarily coldwater and anadromous streams, with a few warmwater ponds adjacent to the construction areas. Much of the stream riparian areas crossed on BLM and NFS lands is heavily forested and shaded by coniferous trees in the Coast Range and mixed conifer-hardwood forest in the Klamath Mountains.

TABLE 4.5.2.4-1

Number of Streams Crossed by the Pacific Connector Pipeline Route on Federal Lands by Fish Status Category within Each Fifth-Field Watershed Coinciding with the Pacific Connector Project

Fifth Field Watershed (Fifth Field HUC)	Federal Land Agency	Perennial Streams	Intermittent Streams	Fish-bearing Streams with (a/): Anadromous Species (assumed) b/	Fish-bearing Streams with (a/): Resident Species (assumed) a/, b/	EFH Species and Habitat Present (assumed) a/	ESA Species or Habitat Present (assumed) a/
Coos County							
Coos Bay Frontal-Pacific Ocean	BLM Coos Bay Dist.	0	0	0	0	0	0
North Fork Coquille River (1710030504)	BLM Coos Bay Dist.	3	1	2	1(1)	2	2
East Fork Coquille River (1710030503)	BLM Coos Bay Dist.	0	2	0	0	0	0
Middle Fork Coquille River (1710030501)	BLM Coos Bay Dist.	1	6	(1)	(2)	(1)	(1)

TABLE 4.5.2.4-1 (continued)

Number of Streams Crossed by the Pacific Connector Pipeline Route on Federal Lands by Fish Status Category within Each Fifth-Field Watershed Coinciding with the Pacific Connector Project

Fifth Field Watershed (Fifth Field HUC)	Federal Land Agency	Perennial Streams	Intermittent Streams	Fish-bearing Streams with (a/): Anadromous Species (assumed) b/	Fish-bearing Streams with (a/): Resident Species (assumed) a/, b/	EFH Species and Habitat Present (assumed) a/	ESA Species or Habitat Present (assumed) a/
Middle Fork Coquille River (1710030501)	BLM Roseburg District	0	0	0	0	0	0
Douglas County							
Middle Fork Coquille River (1710030501)	BLM Roseburg Dist.	1	0	0	(1)	0	0
Days Creek-South Umpqua (1710030205)	BLM Coos Bay Dist.	0	0	0	0	0	0
Upper Cow Creek (1710030206)	Forest Service Umpqua NF	3	4	0	(3)	0	0
Jackson County							
Upper Cow Creek (1710030206)	Forest Service Umpqua NF	0	1	0	0	0	0
Trail Creek (1710030501)	Forest Service Umpqua NF	0	0	0	0	0	0
Trail Creek (1710030501)	BLM Medford Dist.	1	0	1	1	1	1
Shady Cove-Rogue River (1710030707)	BLM Medford Dist.	0	3	0	0	0	0
Big Butte Creek (1710030704)	BLM Medford Dist.	2	0	0	0	0	0
Little Butte Creek (1710030708)	BLM Medford Dist.	0	6	0	1	0	0
Little Butte Creek (1710030708)	Forest Service Rogue River NF	1	1	0	2	0	0
Klamath County							
Spencer Creek (1801020601)	Forest Service Winema NF	1	2	0	1	0	0
Spencer Creek (1801020601)	BLM Lakeview NF	0	2	0	(2)	0	0
TOTAL		**13**	**28**	**3(1)**	**6(9)**	**3(1)**	**3(1)**

a/ Known and assumed (value in parentheses) crossings by the pipeline with indicated fish category designation
b/ Trout
Note: Based on Pacific Connector's analysis, numbers may differ from federal agency analysis of streams, in some watersheds.

The general effects on aquatic resources, and mitigation for those effects, would be similar on federal lands to those discussed above in section 4.5.2.3 for the entire pipeline. Crossing techniques for most waterbodies would include dry-open cut methods. Thirteen perennial and 28 intermittent streams would be directly crossed by the pipeline construction on federal lands (table 4.5.2.4-1). Of these streams, 4 are known or assumed to contain anadromous fish, and 15 known or assumed to contain resident fish species. ESA species and EFH habitat for salmon may be present in up to 4 stream disturbance areas (table 4.5.2.4-1).

Riparian Reserve Areas

Riparian Reserve is a land use allocation specific to BLM and NFS lands. BLM and Forest Service management objectives include protection of aquatic resources and ESA-listed fish species in streams on both BLM RMP and Forest Service-managed lands. One difference between BLM and Forest Service management of these areas is the width of streamside riparian buffer. The details of these two plans are described in section 4.7 and appendix F. This allocation was developed in conjunction with the ACS (NFS) and Riparian Reserve that are incorporated into each of the BLM and Forest Service LMPs for management of areas associated with streams, lakes, and potentially unstable areas. The ACS was developed as part of the NWFP *Standards and Guidelines* to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within NFS lands (Forest Service and BLM 1994b) for a variety of species. In 2016, the BLM signed a ROD that approved the Northwestern and Coastal Oregon RMP and the Southwestern Oregon RMP and adopted a similar strategy for riparian areas. The Forest Service system for managing primarily stream riparian areas includes components of the ACS are Riparian Reserves and Key Watersheds (see section 4.7 and appendix F). Riparian Reserves are intended to serve as corridors in the matrix and enable the Forest Service to manage these land allocations to maintain and restore riparian structures and functions of these unique and important features. The BLM also has Riparian Reserve under its current management plan. As described in section 4.7 and appendix F, Riparian Reserve has unique sets of guidance that are applicable wherever these occur, although these differ now between the two agency plans. The Forest Service ACS places an emphasis on efforts to maintain and restore aquatic and riparian habitat that is necessary to support anadromous salmonids. The nine objectives listed for the ACS include maintaining and restoring aquatic systems, floodplains, wetlands, upslope habitats, and riparian zones in general to support invertebrate and vertebrate species dependent on those habitats. The description of these nine objectives and how they would be maintained under the proposed actions is presented fully in section 4.7 and appendix F. The BLM's Riparian Reserve land use allocation has associated Management Direction and Management Objectives but does not include Key Watersheds.

The Pacific Connector pipeline would cross Riparian Reserve areas of both NFS and BLM lands along the route. Project effects on Riparian Reserve resulting from all construction activities (e.g., pipeline right-of-way, TEWAs, permanent and temporary access roads) are discussed in section 4.7 and appendix F.

Key Watersheds on NFS Lands

Key watersheds on NFS land, as designated by the NWFP (Forest Service and BLM 1994a), provide high water quality and are crucial to at-risk fish species and stocks. They are the highest priority for watershed restoration. Tier 1 Key Watersheds consist primarily of watersheds directly contributing to anadromous salmonid, bull trout, and resident fish species conservation. Tier 2 watersheds do not necessarily contain at-risk fish stocks but are important sources of high quality water (Forest Service and BLM 1994a). The Key Watersheds include three Tier 1 (Days Creek – South Umpqua River [formerly named South Umpqua River], North and South Forks Little Butte, Spencer Creek) and one Tier 2 (Clover Creek) watershed. Potential effects on these Key Watersheds and actions that would be taken by the Project to ensure Key Watershed functions are maintained are discussed in section 4.7 and appendix F.

Measures That Would Mitigate Effects on Aquatic Resources on Federal Lands

Pacific Connector would develop project design, construction, and operation measures to avoid or minimize effects on aquatic resources to the extent practicable. To compensate for unavoidable effects along streams from loss of upslope and riparian vegetation and LWD input that do not meet the objectives of the ACS, Pacific Connector has developed a *Large Woody Debris Plan* and supplemental riparian plantings efforts to help maintain the functions of the system after construction. Actions that would be taken on NFS lands to help meet ACS objectives on those lands are included in chapter 2. No similar actions have been developed in BLM plans. These additional actions and mitigation measures agreed to for NFS lands are summarized in table 2.1.5-1. The effects of implementation of these measures on meeting the ACS and Riparian Reserve management objectives and management direction are discussed in section 4.7 and appendix F.

To ensure that the Pacific Connector Pipeline Project is consistent with the objectives of the ACS on NFS lands, which would in turn aid fish populations on federal land, Pacific Connector would develop a variety of enhancements (at the direction of the Forest Service): (1) donate LWD to agencies/conservation groups to perform in-stream restoration projects; and/or (2) relocate large boulders greater than 24 inches in diameter for use as fish habitat structures. As part of Project development, the BLM and Forest Service have also developed site-specific stream crossing plans for perennial streams on their lands that include specific riparian plantings and other actions to aid at maintaining stream and riparian functions. To mitigate for Project actions that, even with site-specific actions, may impede maintaining ACS and Riparian Reserve management objectives and direction on each watershed (e.g., pipeline crossing LWD placement and riparian vegetation plantings), Pacific Connector would fund the following types of projects that would be implemented on Forest Service areas not directly affected by Project activity:

- add LWD to several miles of streams outside of the area that would be affected by the Project;
- restore degraded riparian habitats through off-site revegetation projects;
- conduct off-site fish passage projects at road crossings;
- improve stream road crossings and replace or stabilize culverts that may contribute sediment from fill failure to streams;
- conduct pre-commercial thinning projects where feasible to improve riparian habitats;
- install fences in allotments to improve riparian habitats;
- decommission roads and waterbody features (e.g., culverts, crossings, bridges) identified by the Forest Service that are no longer needed for resource management to provide numerous benefits including lower road density, minimization of channel extensions, minimization of sedimentation, improvement of fish passage through culvert removal, and reduction of riparian habitat fragmentation;
- close roads that are not in use, which would reduce sediment runoff to streams; and
- stormproof roads (such as adding water bars, ditch cleaning, culvert bypass) to also reduce fine sediment to streams and reduce the risk of road blow out, which could contribute heavy sediment loads to streams.

The list of mitigation measures noted above is not all that would be in place on NFS lands (see table 2.1.5-1) but identifies some of the major efforts that would be undertaken to reduce and mitigate impacts from the proposed action on aquatic resources. Following Project construction, habitat and ecosystem function would be restored in place as much as possible. However, although mitigation actions would restore habitat and have long-term benefits to wetlands, estuarine ecosystems, and habitat for salmonids in general, there would be effects on some non-target species. The goal of additional mitigation would be to restore habitat with similar ecological function for the remaining effects on aquatic resources to ensure project actions meet the ACS and RMS objectives and direction at multiple scales. These actions would reduce effects on fish resources on Forest Service federal lands by reducing factors known to be harmful or limiting to fish species including elevated suspended sediment and sediment in the stream channel, which affects fish production and survival; loss of LWD in streams, which reduces habitat quality; loss of future riparian LWD and other vegetation supplying input of organic matter; and loss or restriction of fish movement (passage) in streams. Specific sites and actions for the mitigation measures were identified through meetings with the Forest Service. These are provided in the *Mitigation Plan for Federal Lands* included in appendix F of this EIS. The details of these mitigation actions and how they relate to ensuring the ACS and RMS is being met is discussed in section 4.7 and appendix F.

4.5.2.5 Conclusion

Constructing and operating the Project would have both short-term effects on fish and invertebrate individuals as well as short- and long-term effects on aquatic habitat. Individual fish and shellfish as well as their food sources would be directly lost as a result of Project construction, the initial and maintenance dredging, decreased water quality, and entrainment from vessel water intake. Habitat modifications would also reduce local important habitat areas including rearing, spawning, and cover areas (e.g., aquatic vegetation, eelgrass). Short-term effects from the pipeline would also include direct local reduction in food sources primarily from bottom disturbance resulting from stream crossings and short-term elevated turbidity; elevated turbidity would also cause short-term sublethal stress to fish and invertebrate stream organisms and movement blockages over limited specific stream locations and time, while limited reduction of riparian vegetation and trees would have limited short- and long-term reduction in stream habitat components. However, the distribution of adverse effects would be limited to areas near the Project (e.g., at the LNG facilities and near and downstream of pipeline stream crossings), and BMPs and impact avoidance measures implemented during construction as well as mitigative actions implemented following construction would limit long-term adverse effects. As a result, we conclude that the Project would not significantly affect fish and aquatic invertebrates.

4.6 THREATENED, ENDANGERED, AND OTHER SPECIAL STATUS SPECIES

This section analyzes the effects of the Project on special status species. In addition to species listed as threatened or endangered under the federal ESA[133] and Oregon ESA[134], agencies and organizations such as the FWS, BLM, Forest Service, ODA, and ODFW maintain lists of species that are considered special concern, sensitive, rare, or are otherwise offered protections under agency planning documents. These species are broadly defined in this assessment as "special status species."[135] Although the term "special status species" is used differently by various agencies, for the purposes of this assessment, the term "special status species" includes:

- species that are listed or proposed for listing by the federal government as endangered or threatened, or are candidates for listing;
- species that are identified by the BLM or Forest Service as "sensitive species" or "strategic species";
- species listed by the State of Oregon as endangered, threatened, or are candidates for listing; and
- species identified by federal or state agencies as rare or protected by federal or state planning documents (e.g., Standards and Guidelines in resource management plans such as "Survey and Manage" species identified in the NWFP).

Using data from the Oregon Biodiversity Information Center (ORBIC),[136] FWS, NMFS, discussions with Forest Service and BLM specialists, and information reviews of published and unpublished information, the applicants prepared lists of threatened, endangered, proposed,

[133] Federal agencies are required by Section 7 of the ESA (Title 19 U.S.C. Part 1536[c]), as amended (1978, 1979, and 1982), to ensure that any actions authorized, funded, or carried out by the agency do not jeopardize the continued existence of a federally listed endangered or threatened species, or result in the destruction or adverse modification of designated critical habitat of a federally listed species. The action agency (e.g., the FERC) is required to consult with the FWS and/or the NMFS to determine whether federally listed endangered or threatened species or designated critical habitat are found in the vicinity of the Project, and to determine the proposed action's potential effects on those species or critical habitats. For actions involving major construction activities with the potential to affect listed species or designated critical habitat, the federal agency must submit its BA to the FWS and/or NMFS and, if it is determined that the action may adversely affect a listed species, the federal agency must submit a request for formal consultation to comply with Section 7 of the ESA. In response, the FWS and/or NMFS would issue a BO as to whether or not the federal action would likely jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Jordan Cove and Pacific Connector filed an applicant-prepared draft BA (APDBA) in December 2017, and a revised APDBA in September 2018. We are reviewing the revised APDBA and will prepare a BA and EFH Assessment, which will be submitted to the FWS and NMFS.

[134] Oregon has its own ESA that requires state agencies to protect and promote the recovery of state-listed threatened and endangered species. At the state level, consultation is conducted with the ODA for state listed plant species and the ODFW for fish and wildlife species. However, state regulations pertaining to the protection of botanical resources are limited to ORS 564 and OAR Chapter 603, Division 73. Oregon regulations regarding state endangered and threatened plants only apply on non-federal public lands (e.g., state, county, city, etc. lands).

[135] The term "special status species" is also used by the BLM, but in a narrower agency-specific definition than in this assessment. BLM "special status species" include species listed as threatened or endangered under the ESA, species that are proposed for listing under the ESA, species that are candidates for listing under the ESA, and species designated by the BLM as "sensitive" under criteria in BLM Manual 6840. The Forest Service uses similar designations. For the Forest Service, "Survey and Manage" are managed under specific criteria provided in the Northwest Forest Plan rather than the agency "special status species" programs. Several species are designated as both "special status species" for the Forest Service and "Survey and Manage species." Those species are noted in the assessment and are analyzed here under criteria for both programs.

[136] Formerly known as the Oregon Natural Heritage Information Center (ORNHIC).

candidate, and special status species that potentially occur near the proposed Project, as described in the following sections. Species that were initially considered but were dropped from further consideration due to a lack of habitat or because they were not detected during targeted field surveys are listed in tables I-3, I-4, and I-5 in appendix I.

4.6.1 Federally Listed Threatened and Endangered Species

Table 4.6.1-1 lists the federally endangered, threatened, and proposed species that potentially occur in the Project area and are discussed below. Additional species (beyond those listed in table 4.6.1-1) are federally listed in Oregon (i.e., the Canada lynx, bull trout Klamath River DPS, yellow-billed cuckoo Western DPS, streaked horned lark, and slender Orcutt grass); however, these species are not known or expected to occur within the Project area and are not discussed further in this document (Canada lynx: Verts and Carraway 1998, McKelvey et al. 2000, ORBIC 2006b; bull trout Klamath River DPS: FWS 1998a, 2002a, ORBIC 2006b; yellow-billed cuckoo: FWS 2013b; streaked horned lark: FWS 2017b; SBS 2008a, 2012, 2013, 2014, 2017a; and slender Orcutt grass: ORBIC 2017b, FWS 2006b). In addition, the North American wolverine occurs in Oregon and has been proposed for listing as threatened under ESA; wolverines have been occasionally documented in Oregon, most recently in the Wallowa-Whitman National Forest in Northeast Oregon during 2011-2012 (Magoun et al. 2013), but no evidence for a reproducing, self-sustaining population has been found in the state. There appears to be an extremely remote chance of a wolverine dispersing into southwest Oregon, but that is not foreseeable during the construction of the proposed action, and as a result, the North American wolverine is not discussed further in this document. The Eastern DPS of the Steller sea lion, which occurs on the west coast of the U.S. and within the Project area, was delisted on December 4, 2013 (78 FR 66139), and thus is not discussed in this section.

Table 4.6.1-1 lists all potentially affected federally listed and proposed species, indicates the portion of the Project area where they may occur, and provides our preliminary determination of effect.

TABLE 4.6.1-1

Federally Listed and Proposed Species Potentially Occurring in the Project Area

Species	Federal Status	State Status	Portion of the Project Area Where Species May Occur	Effect of Proposed Project on Species, Critical Habitat a/
Mammals				
gray wolf *Canis lupus*	Endangered	Delisted	Pacific Connector pipeline	NLAA
Pacific fisbher (West Coast DPS b/) *Pekania pennanti*	Proposed Threatened	Sensitive	Pacific Connector pipeline	NJ/LAA c/
Pacific marten (Coastal DPS b/) *Martes caurina*	Proposed Threatened	Sensitive	Jordan Cove terminal, navigation reliability improvements dredge area	NJ/NLAA c/
lue whale *Balaenoptera musculus*	Endangered	Endangered	LNG carrier transit in the waterway	NLAA
fin whale *Balaenoptera physalus*	Endangered	Endangered	LNG carrier transit in the waterway	NLAA
killer whale –Eastern North Pacific Southern Resident stock *Orcinus orca*	Endangered – Critical Habitat	No listing	LNG carrier transit in the waterway	NLAA, NE
humpback whale *Megaptera novaeangliae*	Endangered	Endangered	LNG carrier transit in the waterway	NLAA
Sei whale *Balaenoptera borealis*	Endangered	Endangered	LNG carrier transit in the waterway	NLAA

TABLE 4.6.1-1 (continued)

Federally Listed and Proposed Species Potentially Occurring in the Project Area

Species	Federal Status	State Status	Portion of the Project Area Where Species May Occur	Effect of Proposed Project on Species, Critical Habitat a/
sperm whale *Physeter macrocephalus*	Endangered	Endangered	LNG carrier transit in the waterway	NLAA
North Pacific right whale *Eubalaena glacialis*	Endangered – Critical Habitat	Endangered	LNG carrier transit in the waterway	NLAA, NE
gray whale (Western North Pacific Stock) *Eschrichtius robustus*	Endangered	No listing	LNG carrier transit in the waterway, navigation reliability improvements dredge area	NLAA
Birds				
short-tailed albatross *Phoebastria albatraus*	Endangered	Endangered	LNG carrier transit in the waterway	NLAA
Western snowy plover *Charadrius alexandrinus nivosus*	Threatened – Critical Habitat	Threatened	Jordan Cove terminal, navigation reliability improvements dredge area	NLAA, NLAA
marbled murrelet *Brachyrampus marmoratus*	Threatened – Critical Habitat	Threatened	LNG carrier transit in the waterway Jordan Cove terminal, navigation reliability improvements dredge area Pacific Connector pipeline	LAA, LAA
Northern spotted owl *Strix occidentalis caurina*	Threatened – Critical Habitat	Threatened	Jordan Cove terminal Pacific Connector pipeline	LAA, LAA
Fishes				
North American green sturgeon (Southern DPS) *Acipenser medirostris*	Threatened – Critical Habitat	Sensitive Critical	LNG carrier transit in the waterway Jordan Cove terminal	LAA, LAA
Coho salmon (South OR/North CA Coast ESU) *Oncorhynchus kisutch*	Threatened – Critical Habitat	Sensitive	LNG carrier transit in the waterway Pacific Connector pipeline	LAA, LAA
Eulachon (Southern DPS) *Thaleichthys pacificus*	Threatened– Critical Habitat	No listing	LNG carrier transit in the waterway Jordan Cove terminal Pacific Connector pipeline	LAA, NE
Coho salmon (Oregon Coast ESU) *Oncorhynchus kisutch*	Threatened – Critical Habitat	Sensitive	LNG carrier transit in the waterway Jordan Cove terminal Pacific Connector pipeline	LAA, LAA
Lost River sucker *Deltistes luxatus*	Endangered – Critical Habitat	Endangered	Pacific Connector pipeline	LAA, NLAA
shortnose sucker *Chasmistes brevirostris*	Endangered – Critical Habitat	Endangered	Pacific Connector pipeline	LAA, NLAA
Amphibians and Reptiles				
green turtle *Chelonia mydas*	Threatened – Critical Habitat	Endangered	LNG carrier transit in the waterway	NLAA, NE
leatherback turtle *Dermochelys coriacea*	Endangered – Critical Habitat	Endangered	LNG carrier transit in the waterway	NLAA, NLAA
Olive Ridley turtle *Lepidochelys olivacea*	Threatened	Threatened	LNG carrier transit in the waterway	NLAA
loggerhead turtle *Caretta caretta*	Endangered	Threatened	LNG carrier transit in the waterway	NLAA
Oregon spotted frog *Rana pretiosa*	Threatened –Critical Habitat	Sensitive Critical	Pacific Connector pipeline	NLAA, NLAA
Invertebrates				
vernal pool fairy shrimp *Branchinecta lynchi*	Threatened – Critical Habitat	No listing	Pacific Connector pipeline	LAA, NLAA

TABLE 4.6.1-1 (continued)

Federally Listed and Proposed Species Potentially Occurring in the Project Area

Species	Federal Status	State Status	Portion of the Project Area Where Species May Occur	Effect of Proposed Project on Species, Critical Habitat a/
Plants				
Applegate's milk-vetch *Astragalus applegatei*	Endangered	Endangered	Pacific Connector pipeline	LAA
Gentner's fritillary *Fritillaria gentneri*	Endangered	Endangered	Pacific Connector pipeline	LAA
Western lily *Lillium occidentale*	Endangered	Endangered	Jordan Cove terminal Pacific Connector pipeline	NLAA
large-flowered woolly meadowfoam *Limnanthes pumila* ssp. *grandiflora*	Endangered – Critical Habitat	Endangered	Pacific Connector pipeline	NLAA, NLAA
Cook's lomatium *Lomatium cookii*	Endangered – Critical Habitat	Endangered	Pacific Connector pipeline	NLAA, NE
Kincaid's lupine *Lupinus suphureus* var. *kincaidii*	Threatened –Critical Habitat	Threatened	Pacific Connector pipeline	LAA, NE
rough popcornflower *Plagiobothrys hirtus*	Endangered	Endangered	Pacific Connector pipeline	NLAA

a/ Effects Key:
NLAA = Not likely to adversely affect, LAA = Likely to adversely affect, NE = No effect, NJ = not likely to jeopardize the continued existence for proposed species
b/ DPS=Distinct Population Segment
c/ This represents a provisional effect determination for this ESA proposed species. This provisional effect determination would apply if the species becomes listed prior to the completion of consultaion on the Project.

4.6.1.1 Mammals

Gray Wolf (Federal Endangered Species, State Delisted)

The federal ESA in Oregon protects gray wolves west of highways 395-78-95 (ODFW 2017e). Gray wolves were delisted from the Oregon ESA in 2015 (ODFW 2017f). Wolves are habitat generalists that only require the presence of ungulate prey and absence of excessive human-caused mortality (FWS 2013c). Wolf pack territory size is a function of prey density and can range from 25 to 1,500 square miles (FWS 2013c). Both male and female wolves disperse, sometimes greater than 600 miles (FWS 2013c).

A radio-collared male (i.e., OR7) dispersing from a pack in northeastern Oregon has been documented in southwestern Oregon and northern California since 2011, including near the Project in Jackson, Douglas, and Klamath Counties (ODFW 2013b). In 2014, a female joined the male, and they produced their first litter that year consisting of three pups (ODFW 2014e). This was the first evidence of wolves breeding in the Oregon Cascades since the early twentieth century (ODFW 2014d). The den was located within the Rogue River National Forest, between Crater Lake and Mount McLoughlin (Young 2014), approximately 6 miles from the pipeline route. Additional pups were born in 2015, 2016, and 2017 (ODFW 2018b). The Area of Known Wolf Activity (AKWA) initially mapped by ODFW for OR7 in 2014 (ODFW 2014c) is crossed by the pipeline route. The AKWA for OR7 and the Rogue Pack has shifted in size and shape since 2014. As currently mapped, it is less than 5 miles from the pipeline route in Jackson and Klamath Counties.

A second AKWA (Keno) was established in southwest Oregon in 2014 with limited evidence that three wolves inhabited an area approximately 280 square miles. ODFW recently removed the AKWA designation for the Keno wolves and is designating it as no longer active, but possibly used as a corridor for wolves moving between Oregon and California (ODFW 2018b). Approximately 2.48 miles of the pipeline route would pass through this area.

Three other radio-collared wolves dispersed from northeastern Oregon to southwest Oregon. One single male wolf (OR25) dispersed in 2015 and established an AKWA spanning northern Klamath County with portions in adjacent Jackson County and Lake County. A radio-collared female wolf (OR28) dispersed in late 2015 and was joined by a collared male (OR3) to establish the Silver Lake AKWA which coincides with the Silver Lake Wildlife Management Unit in western Lake County. The pair produced one pup in 2016 but the male was killed in 2016 (ODFW 2017g).

Given the occurrence of gray wolves in the areas affected by the Project, potential direct and indirect effects from construction and operation of the pipeline include the following:

- Construction-related noise. Construction would produce noise. Wolves appear most vulnerable to human disturbance in and around denning and rendezvous sites. No active denning sites are known within 1 mile of the pipeline.
- Locally concentrated human activities. Available evidence has shown that wolves subjected to increased vehicular traffic will avoid roads and will move pups if disturbed during denning. Wolves disturbed during winter indicated a physiological stress response to snowmobile stimuli.
- Increased risk of collision with construction vehicles along Project area roadways. Vehicles have killed a small number of wolves; overall, 80 percent of all wolf mortalities in the Northern Rocky Mountain population (which includes wolves in the Project area) are caused by humans but only 3 percent are due to accidental human interactions including vehicle collisions and capture mortality (FWS 2012a).
- Wildland fire as an indirect effect associated with increased human presence. The possibility of ignition in conifer and sagebrush/grass fuel types could range from low to extreme depending on weather conditions and patterns, current fire risk rating, moisture conditions, and fuel loadings. There is some possibility of human-caused fire, whether related to pipeline activities or to Project-induced increase of human presence in the area.
- Habitat alteration. Construction would remove forested habitat that might be used by some species that are preyed upon by wolves. However, corridors created within forested habitats are used for movement and foraging by big game species, which are prey for wolves.

Below is a determination of effects summary for this species and critical habitat. More details will be provided in the pending BA.

The Project **may affect** the gray wolf because:

- dispersing and resident wolves have been documented recently near the Project area;
- the OR7 wolf family den was near the pipeline route in 2014;
- construction noise could disturb wolves if present near the pipeline; and
- increased human presence associated with construction activities could affect wolf behavior and movements, including the chance of collisions with vehicles.

However, the Project is **not likely to adversely affect** the gray wolf because:

- the OR-7 den within the Rogue River National Forest is at least 6 miles from the pipeline;
- Project-related noises are not likely to be substantially different from noises produced by existing recreation and logging activities that wolves have been shown to tolerate;
- during pipeline construction, trash would be removed daily, and roadside carrion is expected to be present as an existing condition, and not substantially increased by the Project; and
- following construction, the restored and revegetated pipeline corridor is likely to increase habitat diversity and forage used by ungulates such as deer (Brusnyk and Westworth 1985; Forman 1995), which are prey for gray wolves.

No critical habitat has been designated or proposed for the gray wolf.

Pacific Marten-Coastal DPS (Federal Proposed Threatened Species, State Sensitive Species)

On October 9, 2018, the FWS proposed to list the coastal DPS of Pacific marten *(Martes caurina)* as a threatened species under the ESA (83 FR 150576). Should the rule for this species be finalized as proposed, it would be protected under ESA. The most current information for this species is provided in an updated species status assessment report, and provides a comprehensive account of the species, its life history needs, and stressors to the overall viability and extinction risk for the coastal marten (FWS 2018a). The coastal marten is a mammal in the weasel family and is native to forests of coastal Oregon and coastal California. They occur primarily in older forests, although there is one remnant population occupying the coastal dune forest of central Oregon. Coastal marten historically ranged throughout coastal Oregon and coastal northern California but have not recently been detected throughout much of the historical range, despite extensive surveys. The species exists in four small populations and is absent from the northern and southern ends of its historical range. In Oregon, there are two identified isolated small extent population areas: Central Coastal and Southern Coastal. The Jordan Cove LNG Project falls within the southern portion of the Central Coastal population area and the Pacific Connector pipeline crosses its historical range.

The Central Coastal Oregon population centers on the coastal forest of the Oregon Dunes National Recreation Area (ODNRA) and is managed by the Siuslaw National Forest. Most of this area comprises coastal forest that is less than 70 years old, and consists of shore pine and transitional shore pine/Douglas–fir–hemlock forests within the ODNRA. These forests grow on nutrient-poor sandy soils, dominated by young stands of shore pine and Sitka spruce. The dense understory is dominated by willow (*Salix hookeri*), Pacific waxmyrtle (*Myrica californica*), and berry-producing ericaceous shrubs such as evergreen huckleberry (*Vaccinium ovatum*) and salal (G*aultheria shallon*). These shore pine forests have a variable tree overstory; however, the common denominator with this habitat and older forest habitats is the presence of dense, spatially extensive ericaceous shrub understories and diverse and abundant prey. Coastal martens have a generalist diet that changes seasonally with prey availability. Overall, their diet is dominated by mammals (primarily voles in Central Coastal population area), but birds, insects, and fruits are seasonally important.

Reports by Zielinski et al. (2001) and Moriarty et al. (2016) noted a relatively high incidence of road kills in the last 30 years (i.e., 17) and it was assumed that animals were abundant. Linnell et al. (2018) used recent surveys to refine the extent of the Central Coastal population size of fewer than 87 adults divided into two subpopulations; however, there is no information at this time on long–term trends in population size. The 2018 species status assessment further divides this population into two subpopulations of approximately 30 adults each, separated by the Umpqua River, a relatively large barrier to movement and dispersal. Martens in this population occur in the highest densities reported for any North American marten subspecies (1.13 per square kilometer; Linnell et al. 2018). The Southern Coastal population area in Oregon is located over 40 miles to the south and would not be affected by the Project.

The 2018 species status assessment identifies various factors (stressors) that are directly and indirectly affecting what the coastal marten needs for long-term viability. These include loss of habitat due to wildfire, timber harvest, and vegetation management. Trapping, collisions with vehicles, and rodenticides are all impacting marten individuals, and the threat of disease carries the risk of further reducing populations. Changes in vegetation composition and distribution have also made coastal martens more susceptible to predation from larger carnivores. These threats are expected to be exacerbated by the species' small and isolated populations. Linnell et al. (2018) suggest that small population size, consistent annual human-caused mortality (primarily trapping and road kills), and isolation indicate this coastal marten population is likely to remain vulnerable to extirpation.

Section 4.4 describes five forested and two woodland vegetation types that may be suitable habitat for marten and would be affected by the construction and operation of the Jordan Cove LNG Project. The vegetation types are shown on figures 4.4-1a and 4.4-1b. Table 4.4.1.5-1 estimates that approximately 76 acres and 62 acres of forested and woodland vegetation would be cleared for the LNG facilities and temporary construction areas, respectively.

Given that the Project falls within the southern portion of the Central Coastal population area and the occurrence of marten habitat within the area of the proposed Project footprint, potential direct and indirect effects from construction and operation of the Project include the following:

- <u>Construction-related noise.</u> Construction would produce noise; and martens appear most vulnerable to human disturbance in and around denning and resting habitat. No active denning sites are currently known in the vicinity of the Project site.
- <u>Locally concentrated human activities.</u> Available evidence has shown that martens are subject to road kills and increased vehicular traffic has the potential to increased vehicle collision mortality.
- <u>Habitat alteration</u>. Construction would remove forested habitat that might be used by martens or species that are preyed upon by martens, or otherwise increase fragmentation within suitable habitat. However, much of the forested portions within the Jordan Cove Project boundaries are already in a disturbed state.
- <u>Wildland fire as an indirect effect associated with increased human presence</u>. The possibility of ignition in conifer and sagebrush/grass fuel types could range from low to extreme depending on weather conditions and patterns, current fire risk rating, moisture conditions, and fuel loadings. There is some possibility of human-caused fire, whether related to construction activities or to Project-induced increase of human presence in the area.

Below is a determination of effects summary for Pacific marten- coastal DPS. At this time, no critical habitat has been proposed or designated for this species. More details will be provided should this species become listed as threatened under ESA, including potential exceptions and/or any designation of critical habitat.

The Project **will not jeopardize the continued existence** of the Pacific marten- coastal DPS; however, in the event that Pacific marten- coastal DPS becomes listed prior to completion of the Project, a provisional effect determination is provided.

The Project **may affect** the Pacific marten- coastal DPS because:

- marten historically used the entire Oregon coastal region;
- the southern portion of the Central Coast population area overlaps with the Jordan Cove LNG Project;
- the Project would remove suitable habitat for the coastal DPS population; and
- increased human presence associated with construction activities could affect marten behavior and movements, including the chance of collisions with vehicles.

However, the Project is **not likely to adversely affect** Pacific marten-coastal DPS because:

- there is a relatively low potential for the coastal DPS individuals to occur based on historical accounts and the current low estimated number of individuals south of the Umpqua River;
- project-related noises are not likely to be substantially different from noises produced by existing recreation and logging activities that martens have been shown to tolerate;
- during Project construction, trash would be removed daily to reduce the potential for predator species; and
- construction-related vehicles and equipment would operate at slower speeds, and therefore not substantially increase the potential for vehicle collisions.

Pacific Fisher-West Coast DPS (Federal Proposed Threatened Species, State Sensitive-Critical Species)

The FWS proposed to list the West Coast DPS of the Pacific fisher as threatened under the ESA on October 7, 2014 (79 FR 60419). In April 2016, the FWS determined that the fisher does not warrant listing under the ESA (81 FR 22710). However, on September 21, 2018, the decision to deny the fisher protected status was rescinded and the comment period for the proposed rule to list the West Coast DPS of the fisher was reopened (84 FR 644). The FWS is scheduled to issue a new finding by March 22, 2019.

Fishers occur in the northern coniferous and mixed forests of Canada and the northern United States (69 FR 18770). The West Coast DPS includes fishers in Washington, Oregon, and California. In Oregon, this species is currently known to occur in Curry, Douglas, Jackson, Josephine, and Klamath Counties (Aubry and Lewis 2003; Aubry pers. comm. 2007 as cited in FWS 2014b). Currently, there are two documented populations of fisher in southern Oregon, one in the northern Siskiyou Mountains and one in the southern Cascade Range, that were believed to be genetically isolated from each other (FWS 2014b). However, recent research shows that the two populations are not genetically isolated (Barry et al. 2018).

Fisher habitat consists of mature, closed canopy coniferous and mixed conifer and hardwood forests at low to middle elevations, including riparian corridors with continuous canopies, and large stands with low levels of fragmentation and a high percentage of dead and downed timber (ODFW 2019; FWS 2016a). Fishers prefer large tracts of contiguous interior forest and typically avoid thinned or open forests, including areas where there is substancial human disturbance. A variety of large conifer tree species are used for denning and resting, including Douglas-fir, white fir, incense cedar, red fir, sugar pine, western white pine, ponderosa pine and lodgepole pine (Aubry and Raley 2006; Cummins et al. 2018). In the southern Oregon Cascades, average home range sizes for females were approximately 9.7 square miles and between 24 square miles for males during the non-breeding season and 57 square miles for males during the breeding season, based on locations of radio telemetered study animals (Aubry and Raley 2006).

Loss and fragmentation of habitat due to timber harvest and thinning, roads, urban development, recreation, and wildfire are the main reasons for the decline of the fisher in the west (FWS 2018b). Habitat loss, modification, and fragmentation continue to occur as a result of forest management practices and stand replacing wildfire, and appear to pose a substantial threat to fishers (FWS 2012b). In addition to removing forage, rest, and den sites, fragmentation can increase predation risk, impede movements, and affect prey species composition, abundance, and availability (FWS 2012b). Fragmentation can also increase energetic costs to fishers, which may result in nutritional stress that can reduce animal condition, ultimately affecting survival, reproduction, and recruitment (Lofroth et al. 2010). Additionally, linear infrastructure such as roads, power lines, and pipelines can also affect fisher populations and their habitat (FWS 2016a). As well as being sources of mortality from vehicle collision, these linear infrastructure features can result in permanent removal or alteration of potential fisher habitat and can disrupt movement patterns (FWS 2016a). However, linear infrastructure is considered to be a low-level impact to fishers currently and in the future (FWS 2016a).

Recent telemetry studies in the southern Oregon Cascades identified fisher home ranges that overlap with the Project on the Winema National Forest (Cummins 2018). Location databases show one observation within 1 mile and one observation within 1 to 3 miles of the Project on the Winema National Forest. These observations, together with the availability of suitable habitat within the pipeline ROW, indicate that there is potential for fishers to be present within the analysis area.

Section 4.5 discusses the various wildlife habitat types (from Johnson and O'Neil 2001) crossed by the Project. Late successional and old-growth forest within five forest and woodland habitat types crossed by the pipeline may provide habitat for the fisher. These habitat types include Westside Lowland Conifer-Hardwood Forest, Montane Mixed Conifer Forest, Southwest Oregon Mixed Conifer-Hardwood Forest, Westside Riparian-Wetlands, and Eastside Riparian-Wetlands. Table 4.5.1.2-5 estimates that approximately 657.9 acres of these habitat types would be cleared for the construction of the pipeline.

Given the potential for occurrence of fishers in the areas affected by the Project, potential direct and indirect effects from construction and operation of the pipeline include the following:

- <u>Construction-related noise.</u> Construction would produce noise. Fishers are vulnerable to human disturbance and fishers have been documented within 1 mile of the pipeline.

- Locally concentrated human activities. Construction activities could affect fishers by disturbing animals. Fishers are sensitive to disturbance and avoid areas used by humans (CBD 2000).
- Increased risk of collision with construction vehicles along Project area roadways. Human-caused mortality from vehicle collisions are listed as one of the threats to fisher populations (FWS 2018b).
- Habitat alteration and fragmentation. Construction would remove forested habitat and would modify habitat, particularly by removing large trees, snags, and large woody debris that are used for fisher den and rest sites. The cleared ROW could also fragment habitat, which is detrimental to fishers because they prefer large areas of contiguous, unfragmented forest (CBD 2000).
- Wildland fire as an indirect effect associated with increased human presence. The possibility of ignition in conifer, hardwood, and sagebrush/grass fuel types could range from low to extreme depending on weather conditions and patterns, current fire risk rating, moisture conditions, and fuel loadings. There is some possibility of human-caused fire, whether related to pipeline activities or to Project-induced increase of human presence in the area.

Below is a determination of effects summary for Pacific fisher-West Coast DPS. At this time, no critical habitat has been proposed or designated for this species. More details will be provided should this species become listed as threatened under the ESA, including potential exceptions and/or any designation of critical habitat.

The Project **will not jeopardize the continued existence** of the Pacific fisher-West Coast DPS; however, in the event that Pacific fisher-West Coast DPS becomes listed prior to completion of the Project, a provisional effect determination is provided.

The Project **may affect** the fisher because:

- fishers have the potential to occur in the fisher analysis area;
- suitable habitat is available within the fisher analysis area and would be impacted by the pipeline;
- construction noise could disturb fishers if present near the pipeline; and
- increased human presence associated with construction activities could affect fisher behavior and movements, including the chance of collisions with vehicles.

The following determination is warranted to receive a conference opinion of **may affect, likely to adversely affect** because:

- Recent telemetry studies in the southern Oregon Cascades identified fisher home ranges that overlap with the Project;
- 657.9 acres of suitable LSOG habitat, including snags, would be removed due to pipeline construction.
- Snags and large trees that could serve as fisher dens would be removed during pipeline construction.

Whales

Eight species of federally listed whales potentially occur off the coast of Oregon, including the blue, fin, southern resident killer, humpback, sei, north Pacific right, gray (Western North Pacific Stock) and sperm whales. All these whale species are federally protected under the MMPA. These species tend to feed during the summer in the northern latitudes and migrate to the tropical southern latitudes in the winter for breeding. However, whales could be encountered off the coast of Oregon throughout the year. Two killer whales were documented near the Project area in May 2017 during marine mammal surveys for the Project, although these were likely transient killer whales not belonging to the southern resident DPS (AECOM 2017). Gray whales have been reported in Coos Bay only on an occasional basis. Project effects on whales would be associated with LNG and construction supply vessel transits in the waterway inbound and outbound from the Jordan Cove terminal, as well as construction activities such as dredging and pile driving. Potential direct effects of the Project could include injury and/or mortality due to ship-strikes, injury or behavioral disturbance due to noise from vessels and construction activities, and potential adverse effects from a ship fuel spill. Spills could indirectly affect whales by harming or contaminating forage species. Additional details on whale densities and potential for ship strikes will be provided in the pending BA.

Below is a determination of effects summary for whales and critical habitat. More details will be provided in the pending BA.

The Project **may affect** federally listed whales because:

- federally listed whales may occur within the aquatic analysis areas (Figure 4.5-1 in section 4.5; includes the Coos Bay estuary and marine environment out approximately 12 nautical miles to the outer continental shelf) during construction and operation of the proposed action;
- vibratory sheet pile driving has the potential to exceed the NMFS interim behavioral disturbance threshold of 120 decibel (dB) re 1 microPascal (μPa) at distances of up to 1.2 miles (Deveau and MacGillvray 2017) and impact pipe pile driving has the potential to exceed the NMFS interim behavioral disturbance threshold of 160 dB re 1 μPa at 1.1 miles (O'Neill and MacGillvray 2017); and
- the proposed action would increase shipping traffic (LNG carriers) within the aquatic analysis areas.

However, the Project is **not likely to adversely affect** federally listed whales for the following reasons:

- ship strikes on whales off the Oregon coast are thought to be infrequent based on the Rockwood et al. (2018) assessment of potential whale/vessel collision mortalities for blue, humpback, and fin whales of less than 1 percent, and therefore thought to be discountable;
- 120 LNG carrier trips per year to the LNG terminal are expected to increase the potential in ship strikes to whales over known frequencies of incidents; however, Jordan Cove would provide a ship strike avoidance measures package to LNG carrier operators transporting cargo from the LNG terminal that would consist of multiple measures to avoid striking marine mammals;

- FERC does not have authority over the LNG carrier; however, the independent carrier operators would be required to follow all Coast Guard requirements regarding the operation of LNG carriers, including vessel speeds;
- noise from LNG carriers, dredgers, tugs, and other support vessels could result in behavioral disturbance to listed whales and effects of ship noise on whales could exceed NMFS interim noise exposure criteria for Level B single non-pulse noise (NMFS 2016c, 2017b, 2018c), but LNG carrier noise would not exceed existing background ship noise levels and would not cause injury;
- whales inside Coos Bay in the vicinity of the Jordan Cove LNG Project may be affected by noise from piling during construction, and the use of an impact hammer has impulsive peak source levels that are high enough to cause permantent threshold shift (PTS) (an indicator of hearing damage) in these species; however, listed whales are unlikely to occur within Coos Bay during pile driving (October 1 to February 15), and Jordan Cove has indicated that these activities would be monitored and halted if a whale was detected in the area around the sound source;
- given vessel design, on-board spill kits, safety records, and implementation of Coast Guard recommendations, it is not likely that there would be a major ship spill of hazardous materials that may adversely affect water quality or aquatic species; and
- the relative population density of whales within the marine analysis area[137] would be low enough so that Project-related effects of LNG carrier transit in the waterway would be discountable.

No critical habitat has been designated or proposed for blue, fin, humpback, sei, or sperm whales.

The Project would have **no effect** on designated critical habitat units (CHUs) for the Eastern Northern Pacific Southern Resident stock of killer whales because:

- none of the designated CHUs occur within the marine analysis area off the Oregon coast.

The Project would have **no effect** on designated critical habitat for the North Pacific right whale because:

- none of the designated critical habitat occurs within the marine analysis area off the Oregon coast.

As described above, listed whales inside Coos Bay near the Jordan Cove LNG Project may be affected by noise from pile driving during construction, and the use of an impact hammer has impulsive peak source levels that are high enough to cause PTS (an indicator of hearing damage) in these species. Therefore, **we recommend that:**

- **<u>Prior to construction,</u> Jordan Cove should file with the Secretary, for review and written approval by the Director of OEP, a *Marine Mammal Monitoring Plan* that identifies how the presence of listed whales will be determined during construction,**

[137] Whale density estimates were based on habitat specific densities for blue whales, fin whales, and humpback whales (Becker et al. 2012; Calambokidis et al. 2015). Quantified comparable estimates for other species were not available, but the existing data were examined to qualitatively determine the level of risk to these species. These data sources and analyses are further described in the Applicant Prepared Draft Biological Assessment, filed with the FERC September 14, 2018.

and measures Jordan Cove will take to minimize potential noise effects on whales and other marine mammals, and ensure compliance with NMFS underwater noise criteria for the protection of listed whales.

4.6.1.2 Birds

Short-tailed Albatross (Federal Endangered Species, No State Status)

The short-tailed albatross was listed as endangered throughout its range in the United States on July 31, 2000 (FWS 2000a). In the North Pacific, the coastal habitat for the short-tailed albatross is in high-productivity areas with expansive deep water beyond the continental shelf. Short-tailed albatross rarely occur closer to the coast, but have been documented to occur off the Oregon coast near Coos Bay (in 1961, 2000, and 2001; National Audubon Society 2013). Because the closest breeding population of short-tailed albatross is within the Hawaiian Islands, the Project should not affect recovery criteria for the species. The short-tailed albatross could potentially be encountered within the LNG carrier transit route; however, short-tailed albatross are expected to avoid LNG marine traffic. Below is a determination of effects summary for the short-tailed albatross and critical habitat. More details will be provided in our pending BA.

The Project **may affect** short-tailed albatross because:

- short-tailed albatross may occur within the marine analysis area during operation of the proposed action; and
- the proposed action would increase shipping traffic (LNG carriers) within the marine analysis area.

However, the Project is **not likely to adversely affect** short-tailed albatross for the following reasons:

- other species of albatross have infrequently collided with airplanes in flight but collisions of any albatross species with ships are unknown and are expected to be highly unlikely;
- 120 LNG carrier trips per year to the LNG terminal are expected to cause unmeasurable increase in potential ship strikes on short-tailed albatrosses;
- LNG carriers approaching Coos Bay would be traveling slowly and escorted by tractor tugs from 5 nautical miles offshore; and
- given vessel design, on-board spill kits, safety records, and implementation of Coast Guard recommendations, it is not likely that there would be a major ship spill of hazardous materials that may adversely affect water quality or aquatic species. Any oil released at sea would be in small enough quantities that potential effects on short-tailed albatrosses would be discountable.

No critical habitat has been designated or proposed for the short-tailed albatross.

Western Snowy Plover (coastal) (Federal Threatened Species with Critical Habitat, State Threatened Species)

The Pacific Coast population of western snowy plover has been listed as a threatened species under the ESA since March 5, 1993 (FWS 1993a). The Pacific coast population includes birds that nest adjacent to tidal waters, including all nesting birds on the mainland coast, peninsulas, offshore islands, adjacent bays, estuaries, and coastal rivers (FWS 1993a). The western snowy plover is a year-round, uncommon resident of the North Spit (BLM 2005); the spit supports the most productive snowy plover population segment on the Oregon coast (BLM 2008). Western snowy plovers may be encountered along the LNG carrier transit route from nearshore coastal waters to the LNG terminal. Potential effects include increased noise associated with construction of the Jordan Cove LNG Project, operation activities associated with shipping, increased recreation, increased habitat conversion, habitat degradation by human encroachment, and increased illegal harvest (Comer 1982). Conservation measures proposed to reduce effects include implementation of BMPs, education and outreach, and monitoring. CHUs OR-10 and OR-9 are located 2.6 and 6.9 miles from the LNG terminal, respectively; both units were occupied by western snowy plovers at the time of listing (1993) and in 2012. Below is a determination of effects summary for the western snowy plover and critical habitat. More details will be provided in our pending BA.

The Project **may affect** western snowy plovers because:

- the closest western snowy plover nesting habitat to the Project is on the North Spit approximately 1 mile from LNG terminal site, and contained active nests during 2016 surveys;
- temporary construction activities would occur at the Port Laydown site, which is less than 1 mile from known nesting sites;
- the meteorological station is located east of the foredune, approximately 100 feet from the northern extent of known nesting sites;
- impact hammer noise associated with the Navigation Reliability Improvement temporary facilities is expected to be above ambient levels, and may disturb wintering western snowy plovers if present along the eastern edge of the primary nesting area on the North Spit, which is within 0.25-miles of Dredge Area 1; and
- Jordan Cove terminal construction and operations personnel would likely use the North Spit for recreational purposes and increased recreational use could result in increased plover disturbance including destruction of nests by dogs, off-road vehicle traffic, inadvertent trampling, or increased predation if scavengers and predators (corvids, coyotes, striped skunk, feral cats) are attracted to nesting areas due to the presence of trash and food remains.

However, the Project is **not likely to adversely affect** western snowy plover because:

- Jordan Cove LNG Project construction noise at active nest sites (approximately 1 mile) and critical habitat (approximately 2.6 miles) is not expected be above ambient levels.
- Dredging operations would take place within the ODFW in-water work window, which is outside of the nesting period for western snowy plovers and dredging noise level is unlikely to affect wintering plovers approximately 0.25 miles away. Access to dredging areas would be by marine transport with no land-based access near primary snowy plover habitat.
- The meteorological station would be constructed outside the nesting season (March 15 to September 15) to avoid disturbance to snowy plovers and would include spikes or other deterrent measures on any potential perching surface, bird deterrent measures if guy-lines are required, and shielded security lighting to minimize glare. Operational activities would be maintenance-related and would be scheduled outside of the nesting season.
- Jordan Cove would minimize disturbance by humans, pets, vehicles or human-attracted predators through implementation of (1) BMPs to minimize predator density related to

increased human presence and habitat removal, and (2) education and outreach programs intended to train all construction and operations staff on the need for snowy plover conservation; current snowy plover regulations and recreational use restrictions; and the importance of conservation measures, including: litter control, avoidance of nesting and foraging areas, keeping pets on-leash, and remaining on established roads and trails.

Even though the northern end of CHU OR-10 on the North Spit is located approximately 2.6 miles from the Jordan Cove LNG Project, the Project **may affect** designated critical habitat for the western snowy plover because:

- temporary construction activities would occur at the Port Laydown site, which is approximately 1 mile from critical habitat;
- the Navigation Reliability Improvements Dredge Area 1 is approximately 0.25 mile from critical habitat; and
- the Project would result in a large but temporary increase in people employed on the North Spit during construction, and a much smaller long-term increase of operations staff. The additional human presence is likely to increase use of the North Spit with concomitant potential increase of pets, vehicles, and/or human-attracted predators.

However, the Project is **not likely to adversely affect** designated critical habitat for the western snowy plover because:

- dredging noise level is unlikely to affect physical or biological features (PBF) at CHU OR-10 approximately 0.25 miles away; and
- Jordan Cove would minimize potential secondary effects on the critical habitat PBF that identifies disturbance by humans, pets, vehicles or human-attracted predators through implementation of (1) BMPs to minimize predator density related to increased human presence and habitat removal, and (2) education and outreach programs intended to train all construction and operations staff on the need for snowy plover conservation; current snowy plover regulations and recreational use restrictions; and the importance of conservation measures, including: litter control, avoidance of nesting and foraging areas, keeping pets on leash, and remaining on established roads and trails.

Marbled Murrelet (Federal Threatened Species with Critical Habitat, State Threatened Species)

MAMUs in Washington, Oregon, and California were listed as threatened under the ESA on October 1, 1992 (FWS 1992a). Critical habitat for the MAMU was first designated on May 24, 1996 (FWS 1996) and subsequently revised in 2011 (FWS 2011b, 2016b). Throughout the forested portion of their range, MAMU habitat use is positively associated with the presence and abundance of mature and old-growth forests, large core areas of old-growth, low amounts of edge and fragmentation, proximity to the marine environment, and increasing forest age and height, although the presence of platforms is the most important characteristic of nesting habitat (FWS 2006c).

Through a combination of GIS data provided by the BLM and private timber companies, and field surveys conducted between 2007 and 2018, Pacific Connector identified 175 occupied and presumed occupied MAMU stands within 0.25 mile of the proposed action, or within 0.5 mile of federally-designated critical habitat that would be affected by the proposed action.

Construction of the Project would remove a total of about 806 acres of MAMU habitat (suitable, recruitment, capable), including about 78 acres of suitable habitat removed from 37 stands (18 occupied MAMU stands and 19 presumed occupied stands). There is the potential that effects could extend over a total of about 7,145 acres of suitable nesting habitat in the terrestrial nesting analysis area (i.e., the extent of disturbance/disruption of MAMU during the breeding season; FWS 2014c), where Project-related noise, primarily use of access roads, may affect MAMU behavior, including breeding activities. HDD and DP activities are not anticipated to disturb nesting MAMU as noise associated with this work would attenuate to ambient levels before reaching MAMU stands. Ten occupied and 24 presumed occupied MAMU stands occur within CHU OR-06 (b, c, and d) within the proposed terrestrial nesting analysis area. Overall, construction of the Pacific Connector Pipeline Project would remove about 4 acres of suitable MAMU nesting habitat (PBF-1) and about 12 acres of recruitment habitat and 15 acres of capable habitat (both of which make up PBF-2) within CHU OR-06-d.

Pacific Connector would implement several measures to reduce effects on MAMU habitat, including using UCSAs, and replanting conifer trees outside of the 30-foot-wide maintenance corridor on certain federal lands and non-federal lands. However, replanted trees may be harvested from non-federal lands or federal lands slated for timber harvest (i.e., Matrix lands and Harvest Land Base), and if allowed to grow would provide minimal benefit to MAMUs because it would take decades at a minimum to restore replanted forests to recruitment or suitable habitat conditions. To ensure that trees with active murrelet nests and chicks are not felled, timber would be removed outside of the entire MAMU breeding season (after September 15 but before March 31) within 300 feet of MAMU stands to avoid this direct effect on MAMU. To minimize disturbance and disruption of MAMU during operations and maintenance, vegetation maintenance activities would occur between August 1 and April 15, and Pacific Connector would apply daily timing restrictions during activities to minimize effects on MAMU during the late breeding season (August 6 – September 15).

Below is a determination of effects summary for the MAMU and critical habitat. More details will be provided in the pending BA.

The Project **may affect** MAMUs because:

- suitable habitat is available within the terrestrial nesting analysis area;
- MAMUs have been located within the terrestrial nesting analysis area during survey efforts for the proposed action; and
- MAMUs are expected to forage offshore in the marine analysis area, and within Coos Bay in the estuarine analysis area.

The Project is **likely to adversely affect** MAMUs for the following reasons:

- Disturbance associated with Pacific Connector Pipeline Project activities and construction of the Kentuck project would occur within the critical breeding season and within 0.25 mile of known MAMU stands.
- Proposed actions that generate noise above local ambient levels levels in approximately 7,145 acres of suitable habitat might disturb or disrupt MAMUs and interfere with essential nesting behaviors:

  - 82 MAMU stands (25 occupied and 57 presumed occupied) are within 0.25 mile of the pipeline that could be constructed during the breeding season.
  - 168 MAMU stands (50 occupied and 118 presumed occupied) are within 0.25 mile of access roads that could be used during pipeline construction in the breeding season.
- Blasting for the pipeline trench may occur within 0.25 mile of 11 MAMU stands between April 1 and September 30.
- Helicopter use within 0.25 mile of eight occupied MAMU stands during the breeding period (between April 1 and September 15) could occur and disturb MAMU adults and nestlings, as well as potentially blow nestlings out of the nest tree within six occupied MAMU stands from rotor wash.
- The Pacific Connector Pipeline Project would remove approximately 78 acres of suitable nesting habitat within the range of the MAMU; or approximately 0.5 percent of the 14,310 acres of suitable habitat available in the terrestrial nesting analysis area.
- The Pacific Connector Pipeline Project would remove approximately 307 acres of recruitment habitat and 421 acres of capable habitat within the range of the MAMU. These habitats do not currently support the recovery of the species.
- The Pacific Connector Pipeline Project would modify (cause other indirect effects such as increases in edge habitat and loss of interior forest habitat, including increased predation) approximately 656 acres of suitable, 2,058 acres of recruitment, and 2,449 acres of capable habitat.
- Turbidity generated during HDD if a frac-out occurred could affect local major prey species for chicks such as anchovy, sand lance, and smelt.
- LNG carrier traffic in the estuarine analysis area to the Jordan Cove terminal could cause potential behavioral effects on foraging MAMU, and fuel and lubricant spills from LNG carriers could cause injury or mortality to foraging MAMUs.

The Project **may affect** MAMU critical habitat because:

- the Project occurs within designated MAMU critical habitat; and
- the Project would affect habitat within designated critical habitat areas.

The Project is **likely to adversely affect** MAMU critical habitat because:

- the proposed action could remove or degrade individual trees with potential nesting platforms or the nest platforms themselves, resulting in a decrease in or elimination of the value of the trees for future nesting use (PBF 1, or suitable or potentially suitable habitat); and
- the proposed action could remove or degrade trees adjacent to trees with potential nesting platforms that provide habitat elements essential to the suitability of the potential nest tree or platform, such as providing cover from weather or predators (PBF 2, or recruitment/capable habitat).

As described above, construction of the pipeline (including clearing of timber, access road use, helicopter use, and blasting), as well as pipeline operation and maintenance, would occur within the MAMU breeding season and within 0.25 mile of known MAMU stands. These activities could disturb or disrupt MAMUs and interfere with essential nesting behaviors during the breeding season. Therefore, to reduce these effects during the breeding season, **we recommend that:**

- **Prior to construction, Pacific Connector shall file with the Secretary its commitment to adhere to FWS-recommended timing restrictions within threshold distances of MAMU and NSO stands during construction, operations, and maintenance of the pipeline facilities.**

The FWS timing restrictions for MAMU and NSO, as referenced in the above recommendation, were outlined in FWS (2016c).

Given the anticipated avoidance of disturbance and disruption to MAMU during the breeding season per inclusion of the recommendation above into the proposed action (i.e., implementation of distance and timing restrictions, without exception), noise and visual effects on breeding MAMU as a result of construction would be minimized. However, there would be a loss of future breeding opportunities due to the removal of suitable, recruitment, and capable habitat during construction, as there would be less suitable habitat available for nesting. Additionally, the quality of the remaining habitat would be reduced due to habitat fragmentation and the addition of edge along the pipeline corridor. Removal of suitable nesting habitat by harvest of old-growth timber has been cited as the primary reason for the species' decline (FWS 1992a). Suitable MAMU nesting habitat takes a long time to develop (more than 250 years on average); therefore, any removal of suitable habitat may affect the recovery of the MAMU. Jordan Cove has indicated an interest in working with the FWS to discuss possible mitigation and conservation measures but has not proposed compensatory mitigation. In the absence of mitigation other than avoidance and minimization, the Project would result in long-term negative effects on this this threatened species.

Northern Spotted Owl (Federal Threatened Species with Critical Habitat, State Threatened Species)

In Oregon, the NSO is found in low- and mid-elevation coniferous forest in the Coast, Siskiyou, and Cascade Ranges (Forsman 2003). Suitable habitat for NSOs provides elements necessary for nesting, roosting and foraging. NSOs generally nest in forests with multilayered, multispecies canopies with large (20–30 inches dbh or greater) overstory trees, a high basal area (greater than 240 square feet/acre), and a high diversity of different diameters of trees. NSOs have large home ranges and utilize large tracts of land containing substancial acreage to meet their biological needs and a wide array of forest types and structures are necessary to support the various life histories (FWS 2011a). Typically, a larger area is required for NSOs in more fragmented habitats (Courtney et al. 2004). NSOs remain on their home range throughout the year. As a result, NSOs have large home ranges that provide all the habitat components and prey necessary for the survival and successful reproduction of a territorial pair.

Home ranges contain three distinct use areas: 1) the nest patch, which research has shown to be an important attribute for site selection by NSOs and includes approximately 70 acres of usually contiguous forest (300-meter radius around an activity center; FWS et al. 2008), 2) the core area, which is used most intensively by a nesting pair and varies considerably in size across the geographic range, but on average encompasses approximately 500 acres around the nest site (0.5-mile radius around the activity center), and is generally made up of mostly mature/old-growth forest (FWS 2007c; Courtney et al. 2004), and 3) the remainder of the home range which is used for foraging and roosting and is essential to the year-round survival of the resident pair (FWS 2007c). NSO home range size varies by physiographic province. In the Coast Range

Physiographic Province (MP 0.00 to MP 51.74), the home range is assumed to be circular with a radius of 1.5 miles. Within the Klamath Mountains Physiographic Province (MP 51.74 to MP 122.67), the home range radius is 1.3 miles, and in the West Cascades (MP 122.67 to MP 167.76) and East Cascade Physiographic Provinces (MP 167.76 to MP 190.64) the home range radius is 1.2 miles (FWS 1992b). Surveys conducted by Pacific Connector in 2007 identified 12 NSO pairs and a resident single but no nests. In 2008, surveys found NSO pairs at 20 locations, with two nests identified, and resident singles noted at six sites. Surveys in 2015 along the Blue Ridge route did not document any NSO. In addition to NSO sites identified by these surveys, Pacific Connector also considered home range information from the BLM and Forest Service, historic home ranges, best location home ranges (alternate sites closest to proposed action), and Pacific Connector-assumed home ranges (determined by Pacific Connector's assessment of habitat maps). Taking a conservative approach, all owl sites (known, best location, and Pacific Connector-assumed) were analyzed as if occupied and reproductive.

The Project would affect habitat within 97 NSO home ranges and 9 nest patches. About 37 miles of pipeline route would cross 7 designated critical habitat sub-units. Project construction would remove a total of about 517 acres of nesting, roosting, or foraging (NRF) habitat for NSO, of which 134 acres would be permanently lost within the 30-foot-wide corridor maintained in an herbaceous state. Additionally, 214 acres of NRF habitat for NSO would be modified and used as UCSAs. Approximately 1,158 acres of dispersal habitat (high NRF, NRF, and dispersal only habitat) would be removed by the Project. Approximately 919 acres of NSO capable habitat would be removed by construction of the proposed Project, of which 216 acres would remain in a permanent herbaceous/shrub state within the 30-foot operational ROW. Approximately 13,294 acres of NSO habitat (1,307 acres of high NRF/NRF habitat, 4,147 acres of dispersal only habitat, and 5,690 acres of capable habitat) occur within 100 meters (328 feet) of habitat removal, of which 4,326 acres (or 32.5 percent of NSO habitat within 100 meters of habitat removal) of interior NSO habitat would be indirectly affected (1,586 acres of high NRF/NRF habitat, 1,388 acres of dispersal only habitat, and 1,352 acres of capable habitat). The Pacific Connector Pipeline Project would remove 442 acres from LSRs , of which 379 acres is NSO habitat or capable of becoming NSO habitat (approximately 69 acres of high NRF, 93 acres of NRF [includes about 9 acres of "post-fire" NRF], 71 acres of dispersal only habitat, and 146 acres of capable habitat).

Potential direct effects on NSOs would include the following: (1) removal of a known nest tree during the entire breeding season (March 1 through September 30), and (2) human and noise disturbance due to ROW clearing and construction during the breeding period, including noise due to blasting and helicopter support during construction, and smoke from prescribed burnings. Potential indirect effects include the following: (1) removal or modification of suitable NRF habitat, dispersal habitat, and habitat that would be capable, over the life of the Project, to achieve dispersal or NRF habitat characteristics but for the Project's effects within LSR, Riparian Reserves, or NSO home ranges; (2) habitat fragmentation; and (3) other indirect effects that occur due to Project-related increases in edge habitat and loss of interior forest habitat, including increased predation, increased competition, and effects on prey utilized by NSOs. HDD and DP activities are not anticipated to disturb nesting NSO because noise associated with this work would attenuate to ambient levels before reaching NSO sites.

Pacific Connector would minimize effects on NSO habitat using the BMPs for crossing forested lands described in section 4.4 of this EIS. Pacific Connector would reduce effects on NSO habitat by replanting conifer trees outside of the 30-foot-wide maintenance corridor on certain federal lands and non-federal lands. However, replanted trees may be harvested from non-federal lands or federal lands slated for timber harvest (i.e., Matrix lands and Harvest Land Base), and if allowed to grow would provide minimal benefit to NSOs because it would take 80 years at a minimum to restore replanted forests to suitable habitat conditions. Timber removal would occur outside the entire NSO breeding season (March 1 through September 30) within 0.25 mile of NSO activity centers, and as a result, no nest trees within activity centers would be removed during the NSO nesting period, and disturbance or disruption would also be reduced. Additionally, Pacific Connector would install the pipeline within 0.25 mile of activity centers after the critical breeding period (after July 15). However, activities from pipeline construction during the late breeding period (July 16 through September 30) could disrupt or disturb NSO at 10 NSO activity centers within 0.25 mile of the pipeline ROW, and construction activities off the ROW would occur during the entire breeding season and could disturb NSO at two known activity centers located 0.25 mile of pipeline project components, if NSO are present.

For operations and maintenance activities, Pacific Connector would not conduct vegetation maintenance activities within 0.25 mile of NSO activity centers during the entire breeding season (March 1–September 30) to minimize disturbance and disruption to NSO. Other operations and maintenance activities may occur within the breeding season. Mitigation projects such as snag creation projects proposed by the Forest Service to meet LRMP objectives would benefit NSO.

Below is a determination of effects summary for the NSO and critical habitat. More details will be provided in the pending BA.

The Project **may affect** NSOs because:

- suitable habitat is available within the Provincial Analysis Area;[138] and
- NSO pairs and resident singles have been located within the Provincial Analysis Area during survey efforts.

The Project is **likely to adversely affect** NSOs for the following reasons:

- Noise from blasting during pipeline construction within 0.25 mile of NSO sites during the late breeding season would occur and could increase the risk of predation to fledglings that are generally not as able to escape as adults during the latter part of the breeding season.
- Construction of the Pacific Connector Pipeline Project would remove approximately 517 acres of high NRF and NRF habitat (including 26 acres of "post fire NRF" within the 2015 Stouts Creek fire area) within the provincial analysis area. This would result in effects on nest patches, core areas, and home ranges of known, best location, and Pacific Connector-assumed owls, some of which are currently below thresholds needed to sustain NSOs. Once suitable NRF habitat is reduced or modified in NSOs' home ranges, there is an increased likelihood that NSOs remaining in the Project area would be subject to:
  – displacement from nesting areas;
  – concentration into smaller, fragmented areas of suitable nesting habitat that may already be occupied;

[138] The Provincial Analysis Area includes the extent of the following potential Project effects: 1) habitat removal or modification, and 2) disturbance/disruption of NSO during the breeding season

   - increased interspecific (with barred owls) and intraspecific competition for suitable nest sites and forage;
   - decreased survival due to increased predation and/or limited resource (forage) availability; and
   - diminished reproductive success for nesting pairs.
- Construction of the Pacific Connector Pipeline Project would remove and modify high NRF, NRF, dispersal only, and capable habitat for NSOs throughout the Project area, including removal of habitat within the home range of 97 NSOs, 58 of which are currently below sustainable threshold levels of suitable habitat for continued persistence in their home range and/or core area.
- Construction of the Pacific Connector Pipeline Project would bring one NSO core area (best location activity center affected by 2015 Stouts Creek fire) below the 50 percent NRF threshold, and two NSO home range (known activity centers, one of which was affected by the 2015 Stouts Creek fire) below the 40 percent NRF threshold (best location activity center).

The Project **may affect** NSO critical habitat because:

- the Project would occur within designated NSO critical habitat; and
- the Project would affect habitat within designated critical habitat areas.

The Project is **likely to adversely affect** NSO critical habitat because:

- The proposed action would remove or potentially downgrade PBFs in critical habitat sub-units ORC-6, KLE-1, KLE-2, KLE-3, KLE-4, KLE-5, and ECS-1 as defined in the Final Rule designating critical habitat for the NSO (FWS 2012b).

As described above, construction of the pipeline (including access road use, helicopter use, and blasting), as well as pipeline operations and maintenance, would occur within the NSO breeding season and within 0.25 mile of NSO activity centers. These activities would disturb or disrupt NSOs and interfere with essential nesting behaviors during the entire breeding season. Therefore, to reduce these effects during the breeding season, we have recommended that Pacific Connector adhere to FWS-recommended timing restrictions within threshold distances of NSO activity centers (FWS 2016c; see recommendation above in the MAMU section).

Given the anticipated avoidance of disturbance and disruption to NSO during the breeding season per inclusion of the recommendation above into the proposed action (i.e., implementation of distance and timing restrictions, without exception), noise and visual effects on breeding NSO as a result of construction would be minimized. However, there would be a loss of future breeding opportunities due to the removal of suitable habitat during construction, as there would be less suitable habitat available for nesting. Additionally, the quality of the remaining habitat would be reduced due to habitat fragmentation and the addition of edge along the pipeline corridor. Habitat loss and modification, whether to nesting, roosting or foraging habitats, due to forest clear-cutting has been the primary factor causing declines of the NSO (FWS 1992c). Habitat losses and habitat fragmentation have indirect effects that can affect survival and reproduction of NSOs. Jordan Cove has indicated an interest in working with the FWS to discuss possible mitigation and conservation measures but has not proposed compensatory mitigation. In the absence of mitigation other than avoidance and minimization, the Project would result in long-term negative effects on this threatened species.

4.6.1.3 Fish

In this section, we summarize the listing status, life history, and presence and determination of Project action effects on the federally listed fish species and their critical habitat that could be affected by the Project. The species addressed include the Coho Salmon-Southern Oregon/Northern California Coast ESU, Coho Salmon-Oregon Coast ESU, North American Green Sturgeon–Southern DPS, Eulachon–Southern DPS, Lost River sucker, and shortnose sucker. Project effects on waterbodies are described in section 4.3 of this EIS. Minimization measures are currently proposed to reduce effects on threatened and endangered fish species. Overall, the types, methods, and magnitude of effects on listed fish species are represented by those presented for fish in general as presented earlier in section 4.5 of this EIS.

Coho Salmon-Southern Oregon/Northern California Coast ESU (Federal Threatened Species, State Sensitive Species)

The Southern Oregon/Northern California Coast (SONCC) ESU coho salmon was listed as a threatened species on June 28, 2005, between Punta Gorda, California, and Cape Blanco, Oregon (70 FR 37160). It includes all naturally spawning populations as well as three artificial propagation programs, of which one, the Cole Rivers Hatchery (ODFW stock #52) located on the Rogue River, is within the Project area.

Critical habitat for the SONCC ESU was designated in May 5, 1999 (74 FR 24249) and includes the accessible reaches of all rivers (including water, substrate, and adjacent riparian zone of estuarine and riverine reaches) between the Mattole River in California and the Elk River in Oregon. The Pacific Connector pipeline route would cross designated critical habitat within waterbodies of the Upper Rogue HUC (17100307) below Lost Creek, Willow Creek, and Fish Lake Dams.

Major rivers, estuaries, and bays known to support coho salmon within the range of the SONCC ESU include the Rogue River, Smith River, Klamath River, Mad River, Humboldt Bay, Eel River, and Mattole River (NMFS 1999), two of which (i.e., the Rogue and Klamath Rivers) are within the Project area although this ESU is currently prevented from accessing the potential Project-affected Klamath River areas due to dam passage barriers downstream.

Direct and indirect effects on SONCC Coho salmon are not expected within the marine analysis area. Coho salmon can avoid acoustic effects from LNG carriers during transit. Potential oil and gas spills from LNG carriers in the marine analysis area are highly unlikely to occur; even if LNG spilled or leaked, it would turn to vapor and would not mix with water, and vessel response plans required to address accidental spills of LNG and other petroleum products onboard would be implemented. Effects within the riverine analysis area are expected from in-water construction activities resulting in short-term increased sediment levels that would be stressful to fish, short-term benthic food source reduction, temporary migration impedance, short-term terrestrial/riparian habitat modifications, and limited long-term reduction in LWD sources. Limited fish mortality would also occur from fish salvage.

Below is the determination of effects summary for SONCC Coho Salmon ESU and critical habitat; see the details in our pending BA.

The Project **may affect** coho salmon in the SONCC ESU because:

- several stages and activities of coho salmon (upstream adult migration, juvenile rearing, and juvenile out-migration) are expected to occur at various locations in the riverine analysis area during construction and operation of the proposed action.

The Project is **likely to adversely affect** Coho salmon in the SONCC ESU for the following reasons:

- Juveniles would be exposed to elevated TSS concentrations during standard dry open-cut construction (fluming or dam-and-pump) for 2 to 5 hours. Such an exposure could cause injury, a short-term reduction in both feeding rate and feeding success, and minor physiological stress.
- A site crossing failure while dry open-cut construction is underway could result in elevated TSS concentrations for six hours while repair of failed isolation structures occurs, which could cause moderate habitat degradation injury, a short-term reduction in both feeding rate and feeding success, impaired fish homing, and possibly major physiological stress.
- Literature-based estimates of suspended sediment effects from pipeline construction on severity of ill effect (SEV) scores suggest typical dry crossing methods could result in SEVs of 4 and 6 for Coho salmon within a few hundred feet (e.g., 150 to 500 feet) below the crossing, which may include factors ranging from short-term reduction in feeding to moderate physiological stress. If failure of sealing occurs, SEV scores for coho salmon could be as high as 8, which may include habitat degradation, major physiological stress, and long-term reduction in feeding rate or success.
- Construction-induced blasting at 13 streams (4 at streams known to contain coho) could cause mortality to fish by rupturing swim bladders, but active fish removal from area prior to blasting would reduce risk of occurrence.
- Fish salvage would occur for some dry stream crossings as discussed in Pacific Connector's *Fish Salvage Plan*.[139] Capture and handling constitutes a taking under ESA and subjects coho salmon to injury and mortality.
- Lack of LWD is a limiting factor in most streams within range of SONCC coho salmon. Removal of mid-seral riparian forest (40 to 80 years old) would have long-term effects on recruitment of LWD, and removal of LSOG forest (80 years old or older) would have permanent effects on recruitment of LWD because planted conifers would not attain those age classes within the 50-year life of the Project, plus the ongoing loss of trees within the 30-foot-wide maintance corridor.

The Project **may affect** designated critical habitat for coho salmon in the SONCC ESU because:

- the Pacific Connector pipeline crosses designated critical habitat within waterbodies of the Upper Rogue HUC (17100307) below the Lost Creek, Willow Creek, and Fish Lake Dams.

[139] Appendix L of Pacific Connector's POD filed with the FERC in January 2018.

The Project is **likely to adversely affect** designated critical habitat for coho salmon in the SONCC ESU for the following reasons:

- a failure of dry open-cut crossing could cause moderate or more severe habitat degradations in some crossing areas;
- increases in turbidity are expected to temporarily affect the water quality downstream from stream crossing sites during construction;
- food resources would potentially be affected over the short term by dry open-cut and diverted open-cut construction methods that would remove substrate and benthos at crossing sites;
- freshwater migration corridors would potentially be affected over the short term by dry open-cut and diverted open-cut construction methods that would create temporary barriers to in-stream movements; and
- approximately 17 acres of native riparian vegetation (forest, wetlands, unaltered, and nonforested habitats) and altered habitat would be removed during construction within riparian zones associated with designated critical habitat. Adverse effects on riparian zones associated with critical habitat would be long term or permanent depending on whether mid-seral riparian forests (7 acres) or LSOG riparian forests (2 acres) are removed.

Coho Salmon-Oregon Coast ESU (Federal Threatened Species, State Sensitive Species)

This Coho salmon ESU was first proposed for listing on July 25, 1995 (60 FR 38011) and subsequently listed as threatened on June 20, 2011 (76 FR 35755). The Oregon Coast ESU includes all naturally spawned populations of coho in Oregon coastal streams south of the Columbia River and north of Cape Blanco, including the Cow Creek (ODFW stock #37) coho salmon hatchery program (NMFS 1995). Critical habitat for Oregon Coast coho salmon was designated on February 11, 2008 (73 FR 7816) and includes water, substrate, and adjacent riparian zones of estuaries and rivers within the range of the Oregon Coast ESU. There are three subbasins that coincide with the Project: South Umpqua Subbasin (HUC 17100302) and Coquille Subbasin (HUC 17100305), which are crossed by the Pacific Connector pipeline; and Coos Subbasin (HUC 17100304), which includes the Coos Bay estuary where the LNG terminal, slip, navigation channel improvements, and HDD portion of the Pacific Connector pipeline route would be located contain critical habitat watersheds. Within these subbasins are eight fifth-field watersheds crossed that contain designated critical habitat. Life stage requirements of coho salmon, within freshwater habitats in the Oregon Coast ESU, are expected to be similar to those described above for Coho salmon in the SONCC ESU.

Coho salmon would be expected to avoid acoustic effects from LNG carriers during transit of marine areas, and no substantial adverse oil and gas marine spills from LNG carriers are expected. Short-term adverse effects on coho salmon in the estuarine analysis area would result from locally increased turbidity from dredging activities and LNG carrier propeller wash and ship wake, causing avoidance and short-term reduction in food supply. Entrainment and impingement of coho salmon could occur in LNG carriers' cooling water intake port during LNG carrier loading and possibly dredging. Acoustic effects would likely cause at least avoidance during LNG terminal construction. Habitat modification would occur from all dredging activity and restoration activities at the Kentuck project site. Suspended sediment released accidentally during HDD construction across Coos Bay and the Coos River would also result in elevated sediment levels.

Effects within the riverine analysis area primarily from in-water construction activities would include short-term increased sediment levels causing fish stress, reduced short-term benthic food supplies, temporary migration impedance, terrestrial/riparian habitat modifications, and limited long-term reduction in LWD sources. Limited mortality from fish salvage would also occur.

Below is the determination of effects summary for Oregon Coast Coho Salmon ESU and critical habitat; see our pending BA for details.

The Project **may affect** coho salmon in the Oregon Coast ESU because:

- several stages and activities of coho salmon (upstream adult migration, juvenile rearing, and juvenile out-migration) are expected to occur at various locations in the riverine analysis area during construction and operation of the proposed action;
- several stages and activities of coho salmon (juveniles, adults) are expected to occur within the estuarine analysis area during construction and operation of the proposed action; and
- juvenile and adult coho salmon area expected to occur within the marine analysis area during operation of the proposed action.

The Project is **likely to adversely affect** coho salmon in the Oregon Coast ESU for the following reasons:

- Short-term increase in noise associated with in-water or nearwater pile driving at various temporary construction activities throughout the bay may cause disturbance and physical injury to Oregon Coast coho if they are in proximity to the noise during construction.
- Some juvenile coho may be subject to localized entrainment by dredging associated with the access channel and Navigation Reliability Improvements, as well as ongoing maintenance dredging.
- Local short-term increases in suspended sediment in Coos Bay from in-water construction, particularly during dredging of Jordan Cove terminal access channel and navigation channel widening, may result in behavioral effects on rearing coho salmon juveniles with physiological consequences that may affect growth and survival.
- Short-term effects on the benthic community and potential food resources for Oregon Coast coho would result from dredging the proposed marine waterway modifications in Coos Bay.
- Installation of the proposed pipeline beneath Coos Bay and the Coos River using HDD construction would avoid effects on coho unless an inadvertent return of drilling fluid occurred. An inadvertent return would temporarily increase sedimentation and turbidity and likely result in behavioral avoidance of the affected area.
- Individual Coho salmon may be directly affected by local restoration activities at the Kentuck project due to short-term construction-related increases in turbidity, in-water work, and isolation measures.
- Water intakes by LNG carriers at the Jordan Cove terminal berth during engine cooling operations could entrain or impinge juvenile salmon.
- Dredging of the Jordan Cove terminal access channel in Coos Bay in the short term could remove eelgrass and benthic community that provide potential food resources and rearing habitat for Oregon Coast Coho salmon;

- Removing eelgrass from donor stocks in the bay to develop the Eelgrass Mitigation site may reduce cover and food sources for rearing juvenile coho salmon in the short term:
- Exposure to TSS concentrations during dry open-cut construction (fluming or dam-and-pump) for 2 to 6 hours could potentially cause minor physiological stress (increased coughing rate and/or increased respiration rate) in juvenile coho salmon.
- A site crossing failure while dry open-cut construction is underway could result in elevated TSS concentrations for six hours while repair of failed isolation structures could cause moderate habitat degradation, impaired homing by fish, moderate to major physiological stress, and, in very limited areas, reduced growth and reduced fish density.
- Literature-based estimates of suspended sediment effects from pipeline construction on SEV scores suggest typical dry crossing methods could result in SEVs between 4 and 6 for coho salmon within a few hundred feet (e.g., 150 to 500 feet) below the crossing, which may include factors ranging from short-term reduction in feeding to moderate physiological stress. If failure of sealing occurs, SEV scores for coho salmon could be as high as 8, which may include habitat degradation, major physiological stress, and long-term reduction in feeding rate or success.
- Blasting at 22 streams (12 known or assumed to have Coho salmon at the crossing) could cause mortality to fish by rupturing swim bladders but active fish removal from the area prior to blasting would reduce risk of occurrence.
- Fish salvage would occur within isolated construction sites, possibly when adult and juvenile coho salmon are present. Coho salmon are considered vulnerable to electrofishing, subject to injury and mortality. Seining, electrofishing, and handling during salvage may adversely affect Oregon Coast coho salmon.
- Lack of LWD is a limiting factor in most streams within range of Oregon Coast coho salmon. Removal of mid-seral riparian forest (40 to 80 years old) would have long-term effects on recruitment of LWD, and removal of LSOG forest (80 years old or older) would have permanent effects on recruitment of LWD because planted conifers would not attain those age classes within the 50-year life of the Project, plus the ongoing loss of trees within the 30-foot-wide maintance corridor.

The Project **may affect** designated critical habitat for coho salmon in the marine analysis area, the estuarine analysis area, and the riverine analysis area for the Oregon Coast ESU because:

- construction and operation of the Project would occur in or cross designated critical habitat within waterbodies of the Coos, Coquille, and South Umpqua subbasins.

The Project is **likely to adversely affect** proposed critical habitat for coho salmon in the Oregon Coast ESU for the following reasons:

- dredging of the Jordan Cove terminal access channel in Coos Bay and marine waterway modifications could remove eelgrass and benthic community that are potential food resources and rearing habitat for Oregon Coast coho salmon;
- increases in turbidity are expected to temporarily affect the water quality downstream from stream crossing sites during construction;
- TSS concentrations generated during dry open-cut construction and potential failure of isolation structures would adversely affect freshwater habitats by changing coho habitat preferences (SEV = 3) or causing moderate habitat degradations (SEV = 7 or 8);

- a failure of dry open-cut crossing lasting up to 6 hours could cause moderate or more habitat degradations in some streams;
- food resources would potentially be affected over the short term by dry open-cut and diverted open-cut construction methods that would remove substrate and benthos at crossing sites;
- freshwater migration corridors would potentially be affected over the short-term by dry open-cut and diverted open-cut construction methods that would create temporary barriers to in-stream movements; and
- approximatedly 88 acres of native riparian vegetation (forest, wetlands, and nonforested habitats) and altered habitat would be removed during construction within riparian zones associated with designated critical habitat associated with waterbodies within range of Oregon Coast coho ESU. Adverse effects on riparian zones associated with critical habitat would be long term or permanent depending on whether mid-seral riparian forests (14 acres) or LSOG riparian forests (4 acres) are removed.

North American Green Sturgeon – Southern Distinct Population Segment (Federal Threatened Species, State Sensitive-Critical Species)

On January 23, 2003 (NMFS 2003), NMFS determined that the North American green sturgeon comprises two DPSs that qualify as species under the ESA: (1) a northern DPS consisting of populations in coastal watersheds northward of and including the Eel River in California; and (2) a southern DPS consisting of coastal and Central Valley populations south of the Eel River, with the only known spawning population in the Sacramento River. On April 7, 2006, NMFS listed the southern DPS as federally threatened under the ESA, including spawning populations of green sturgeon south of the Eel River, principally the Sacramento River spawning population (71 FR 17757). Designated critical habitat extends from U.S. marine waters to 110 meters depth (360 feet) or 60 fathoms from Monterey Bay, California, north to Cape Flattery, Washington, including the Strait of Juan de Fuca (74[195] FR 52300 [October 9, 2009]). Critical habitat includes three components that are occupied by and are essential to different life stages of green sturgeon: (1) freshwater riverine systems, (2) estuarine areas, and (3) nearshore marine waters. No rivers in Oregon were included in the listing. However, many estuaries were part of the critical habitat proposal in Washington, Oregon, and California. Estuaries in Oregon proposed for inclusion were the Columbia River estuary, Winchester Bay, Yaquina Bay, Nehalem Bay, and Coos Bay. Large numbers of this green sturgeon DPS are within Coos Bay. Subadults and adults may occupy Coos Bay for feeding, optimization of growth, and thermal refuge, and the Bay supplies oversummer habitat. Similarly, coastal marine waters 110 meters deep or less. The North American green sturgeon (both northern and southern DPSs) occurs within Coos Bay and its adjacent waterbodies (Israel and May 2007) and is considered abundant in the bay (73 [174] FR 52084 [September 8, 2008]). This fish may also occur in the lower portions of the Coos River.

Green sturgeons spawn every three to five years in deep pools in large, turbulent river mainstems, generally from March through July (Tracy 1990; Moyle et al. 1992). Little is known about sturgeon feeding, but some studies have found that adults and juveniles feed on benthic invertebrates including shrimp, mollusks, amphipods, and even small fish (Moyle et al. 1992; Radtke 1966). Natural reproduction in this estuary is considered low (Wagoner et al. 1990). The Coos River system is not considered to provide suitable spawning habitat for green sturgeon (Whisler et al. 1999). Green sturgeon, likely less than three years of age, may utilize both shallow and deep-water habitats within the estuarine area, though there is no information relating individual occurrence to DPS membership. Green sturgeon may also occur in bottom areas along the LNG carrier transit route, in waters mostly less than 110 meters deep, which would be primarily only during entry and exit of the vessels as they would travel in deeper water during transit between ports.

Direct and indirect effects on green sturgeon in the southern DPS are not expected within the marine analysis area. Green sturgeon might detect noise from LNG carriers but would be able to avoid adverse effects from noise. Potential oil and gas spills from LNG carriers in the marine analysis area are unlikely to affect aquatic resources because they are highly unlikely to occur; if LNG spilled or leaked, it would turn to vapor, would not mix with water, and would not contaminate surface water; and vessel response plans required to address accidental spills of LNG and other petroleum products onboard would be implemented. Effects on green sturgeon in the estuarine analysis area include acoustic effects such as avoidance during terminal construction, increased turbidity sedimention affecting benthic food sources from dredging activities, bed and bank erosion from LNG carrier propeller wash and ship wake, loss of forage from removal of eelgrass and shallow water habitat, and elevated suspended sediment released from an accidental drilling mud release during HDD construction across Coos Bay and the Coos River. Effects within the riverine analysis area include increased turbidity and sedimentation causing short-term avoidance and food source reduction from in-water construction activities on Stock Slough.

Below is the determination of effects summary for the Southern DPS of green sturgeon and critical habitat. Details will be provided in our pending BA.

The Project **may affect** green sturgeon (Southern DPS) because:

- adult and/or subadult green sturgeon may occur within the estuarine analysis area during construction and operation of the proposed action;
- adult and/or subadult green sturgeons may occur within the marine analysis area during operation of the proposed action; and
- the proposed action may affect potential food resources and water quality during the short-term construction period and maintenance dredging within the estuarine analysis area.

The Project is **likely to adversely affect** green sturgeon (Southern DPS) because:

- short-term increase in noise generated from in-water and nearshore pile driving at various temporary construction sites throughout the bay may cause disturbance and physical injury to green sturgeon if individuals are in proximity to the noise during construction;
- exposure to TSS concentrations during dry open-cut construction (fluming or dam-and-pump) could potentially cause minor physiological stress, a short-term reduction in feeding rate, and short-term reduction in feeding success in the Stock Slough estuarine stream/river channel crossed by the pipeline if present there at the time of construction;
- on a localized basis, the proposed action may affect migratory and feeding behavior, potential food resources, and water quality (TSS) during the short-term construction period and periodic maintenance dredging within the estuarine analysis area;
- bottom disturbance from Project construction, navigation channel widening, and maintenance dredging may reduce the abundance and diversity of benthic food supply within Coos Bay; and

- short-term increased turbidity could cause avoidance in Coos Bay or lower Coos River HDD if frac-out were to occur.

The Project **may affect** critical habitat for green sturgeon (Southern DPS) because:

- Project activities would occur within portions of the Coos Bay estuary, Stock Slough, and coastal marine waters, which have been designated as critical habitat;

The Project is **likely to adversely affect** critical habitat for the southern DPS of green sturgeon because:

- bottom disturbance from Project construction, navigation channel widening, and maintenance dredging may disrupt local food supply and habitat usability within Coos Bay; and
- suspended sediment produced during dry open-cut crossing Stock Slough could affect water quality in freshwater riverine critical habitat.

Eulachon – Southern Distinct Population Segment (Federal Threatened, No State Status)

On March 18, 2010, the NMFS published in the Federal Register the final rule to list the southern DPS of the Pacific eulachon as threatened under the ESA (75 FR 13012 [March 18, 2010]). The NMFS has identified the eulachon southern DPS as those populations which spawn in rivers south of the Nass River in British Columbia, Canada, to and including the Mad River in California (NMFS 2008c). The southern DPS has been further segregated into four subareas: Klamath River, Columbia River, Fraser River, and British Columbia coastal rivers south of the Nass River (NMFS 2008c). A total of 16 distinct regions in Washington, Oregon, and California have been designated as critical habitat for Pacific eulachon (76 FR 65323 [October 20, 2011]). No part of the Project or its effects would occur within waterbodies included in the eulachon critical habitat designation.

Adult Pacific eulachon usually spend three to five years in saltwater before returning to freshwater to spawn from late winter though early summer in rivers (74 FR 10857 [March 13, 2009]). Fertilized eggs adhere to river bottoms and shortly after hatching, the larvae are carried downstream and dispersed by estuarine and ocean currents (74 FR 10857 [2009]). No recent spawning runs have been documented for the Coos River, although some may have occurred historically and have recently been found in Winchester Creek, a major tributary to South Slough that enters Coos Bay near the ocean (Willson et al. 2006; Wagoner et al. 1990, NMFS 2018b).

Little is known about the use of marine waters by eulachon and, due to paucity of sampling, little specific information exists on eulachon distribution off the U.S West Coast, including Oregon (Gustafson et al. 2010). Larvae and young juveniles become widely distributed in coastal waters, with fish found mostly at depths up to 15 meters (171 feet) but sometimes as deep as 182 meters (597 feet; Hay and McCarter 2000). Larger rearing fish have been reported to be in the near benthic habitats in open marine waters of the continental shelf between 20 and 150 meters (66 to 492 feet) deep (Barraclough 1964 as cited in Gustafson et al. 2010).

Adults and juveniles commonly forage at moderate depths (15 to 182 meters [50 to 600 feet]) in inshore waters, feeding on zooplankton, primarily eating crustaceans (Hay and McCarter 2000). Adults are found rarely in Coos Bay (64 FR 66601 [1999]), but have been reported to utilize both shallow and deep habitats in the estuary (64 FR 66601 [1999]). A 1971 report (Cummings and Schwartz 1971) noted their distribution only in the outer 7 miles of Coos Bay. Detailed larvae and juvenile fish sampling in Coos Bay over a 3.5-year period (1998-2001) found no eulachon (Miller and Shanks 2005). More recently, pelagic Tucker trawl samples over a 17-month period found larvae and small juveniles of a close relative, surf smelt, but no eulachon near the proposed terminal in Coos Bay (Shanks et al. 2011). However, given the limited survey effort and highly variable presence of eggs and larvae, eulachon occurrence in Coos Bay could not be ruled out (Storch and Van Dyke 2014).

Direct and indirect effects on eulachon in the southern DPS are not expected within the marine analysis area. Eulachon might detect noise from LNG carriers, but would be able to avoid adverse effects from noise. Potential oil and gas spills from LNG carriers in the marine analysis area are unlikely to affect aquatic resources because they are highly unlikely to occur; if LNG spilled or leaked, it would turn to vapor, would not mix with water, and would not contaminate surface water; and vessel response plans required to address accidental spills of LNG and other petroleum products onboard would be implemented. Effects on eulachon in the estuarine analysis area include increased turbidity from dredging activities and LNG carrier propeller wash and ship wake causing avoidance and reduced food supply, increased suspended sediment should an HDD construction failure occur in Coos Bay or the Coos River, entrainment and impingement in LNG carriers' water intake ports, acoustic effects including avoidance during terminal construction, habitat modification from dredging, and restoration activities at the Kentuck project site.

Below is the determination of effects summary for Pacific eulachon (Southern DPS) and critical habitat. Details will be provided in our pending BA.

The Project **may affect** Pacific eulachon (Southern DPS) because:

- Pacific eulachon may be present within the estuarine analysis area during construction and operation of the Project;
- Pacific eulachon may occur within the marine analysis area during operation of the proposed action;

The Project is **likely to adversely affect** Pacific eulachon (Southern DPS) because:

- Bottom disturbance and suspended sediment from Project construction, navigation channel widening, and maintenance dredging may affect the abundance and diversity of potential benthic and pelagic food resources, water quality, and suspended sediment during the short-term duration of these actions within the estuarine analysis area.
- Short-term increase in noise generated from the MOF land-based pile driving and in-water pile driving in various Coos Bay estuarine analysis areas may cause physical injury to individual eulachon at a limited distance during construction.
- Although eulachon would be rare in Coos Bay, and their large size would allow most to be able to avoid the LNG carrier cooling water intake, some limited number could be entrained during dredging and vessel loading in the bay.

The Project would have **no effect** on critical habitat for the Pacific eulachon (Southern DPS) because no designated critical habitat is present within the areas affected by the Project.

Lost River Sucker (Federal Endangered Species, State Endangered Species)

The Lost River sucker was listed as a federally endangered species on July 18, 1988, because of a variety of factors including loss of habitat and access to historical range, overfishing, degraded water quality, lack of adaquate recruitment, inadequate regulatory mechanisms, and a variety of other reasons resulting in declining populations (FWS 1988). Lost River sucker critical habitat was originally proposed in 1994 (59 FR 61744) but that proposal was never finalized. In 2011, a revised critical habitat designation was proposed and ultimately finalized in December 11, 2012 (77 FR 73739). Designated critical habitat for the Lost River sucker includes two units: the Upper Klamath Lake Unit and Lost River Basin Unit

The present distribution of the Lost River sucker includes Upper Klamath Lake and its tributaries, Clear Lake Reservoir and its tributaries, Tule Lake and the Lost River, the Klamath River, and Copco, Iron Gate, and John C. Boyle Reservoirs with no substantial change since listing (Reclamation 2007, 2012; FWS 2007d). They have also been found in Tule Lake (Reclamation 2012; FWS 2007d, 2013d). Critical habitat that could potentially be affected by construction of the Pacific Connector pipeline includes the Klamath River.

In the Upper Klamath Lake watershed, the Lost River sucker spawning runs are primarily limited to Sucker Springs in Upper Klamath Lake, and the Sprague and Williamson Rivers. Spawning runs also occur in the Wood River and in Crooked Creek in this watershed. In the Project vicinity, Lost River suckers spawn in the Lost River and are present in John C. Boyle Reservoir, downstream from the pipeline crossing at river mile (RM) 225 (NRC 2004). In addition to collections of Lost River suckers in John C. Boyle Reservoir, ORBIC (2012) cites records of collections in Lake Ewauna and in the Lost River Diversion Channel connecting the Klamath River (at RM 249.8) to the Lost River at the Lost River Diversion Dam, approximately 10 river miles downstream from the Pacific Connector pipeline crossing of the Lost River at RM 9.5.

The Pacific Connector pipeline route would cross Lost River (MP 212.07) 7.6 miles upstream of the known spawning area downstream of Anderson–Rose Dam, using a dry, open-cut method during low flows that coincide with the ODFW instream construction window extending from July 1 through March 31.

Spawning occurs within limited areas of the Lost River (FWS 2013d; Reclamation 2012), and occasional individuals have been found in this stream (NMFS and FWS 2013), which suggests it is possible that Lost River sucker occurs at the Pacific Connector pipeline crossing of Lost River at MP 212.07 during the non-spawning period. An additional 31 dry open-cut small intermittent stream crossings could also contain Lost River suckers as surveys have not been conducted for their presence.

Potential effects on the Lost River sucker are associated with pipeline stream crossings. These effects include the release of drilling mud from Klamath River HDD potential frac-out as well as potential entrainment or entrapment of fish, and increased turbidity and suspended sediment in occupied stream affecting fish avoidance and benthic food supply. Pacific Connector would install a temporary flowing stream crossing by lifting or spanning a structure from a bank so that equipment does not enter flowing waters. However, if it is not possible to do this safely, only equipment necessary to install the bridge would cross the stream. This would cause some limited short-term bottom benthic disruption and possibly elevated suspended sediment. Adults and juveniles subject to fish salvage associated with the Lost River crossing could be injured or killed if electrofishing is used, and stressed if seining is used. Incidental take of a Lost River sucker is possible, but salvage operations would follow Pacific Connector's *Fish Salvage Plan* which describes netting methods (e.g., beach seining, dip netting) that would be used before using electrofishing. There are additional salvage methods that have been specifically developed for these listed suckers to further reduce the potential effects of salvage (see the Klamath Project Operations Biological Opinion [Reclamation 2008] consistent with Reclamation's *Handling Guidelines for Klamath Basin Suckers).*

Below is the determination of effects summary for Lost River sucker and critical habitat. Details will be provided in our pending BA.

The Project **may affect** Lost River suckers because:

- Lost River suckers occur within the Upper Klamath River subbasin and Lost River subbasin, which would be affected during construction of the proposed action.

The Project is **likely to adversely affect** Lost River suckers because:

- Lost River suckers could occur in 19 waterbodies crossed by dry open-cut construction in the Lake Ewauna-Klamath River watershed and in 13 waterbodies west of MP 214.38 (including the Lost River) crossed in the Mills Creek-Lost River watershed and be indirectly affected by elevated suspended sediment levels, streambank erosion and stability, and aquatic nuisance species introductions; and
- fish salvage during the crossing of 31 ditches crossed by dry-open cuts and the Lost River crossing could result in injuring or killing of Lost River suckers if electroshocking is used, and stressing fish if seining is used.

The Project **may affect** designated critical habitat for the Lost River sucker because:

- there is a low risk of HDD failure during crossing of the Klamath River, resulting in a frac-out that releases drilling mud into the river.

However, the Project is **not likely to adversely affect** designated critical habitat for the shortnose sucker because:

- HDD crossing methods would avoid critical habitat in the Klamath River;
- the potential for hydraulic fracture during HDD drilling is so unlikely as to be discountable; and
- in the event of released bentonite, corrective actions would contain and temporally limit drill mud volumes.

Shortnose Sucker (Federal Endangered Species, State Endangered Species)

The shortnose sucker was listed as a federally endangered species on July 18, 1988 (FWS 1988). The final rule to list the shortnose sucker as endangered suggested several reasons for their decline, including the construction of dams, water diversions, overfishing, competition and predation by exotic species, water quality problems associated with timber harvest, removal of riparian vegetation, livestock grazing, lack of adaquate recruitment, inadequate regulatory mechanisms and agricultural practices. Shortnose sucker critical habitat was originally proposed in 1994 (59 FR 61744) but that proposal was never finalized. In 2011, a revised critical habitat designation was proposed and ultimately finalized in December 11, 2012 (77 FR 73739). Designated critical habitat for the shortnose sucker includes two units: the Upper Klamath Lake Unit and Lost River Basin Unit. The Klamath River is the only critical habitat for the shortnose sucker crossed by the pipeline or potentially affected by any Project actions.

Currently, shortnose suckers are present in upper Klamath Lake and tributaries, Lost River, Clear Lake Reservoir, the Klamath River, and three large Klamath reservoirs (Keno, Copco, and possibly Iron Gate Reservoirs) with no substantial change since listing (Reclamation 2007, 2012). They have also recently been found in Tule Lake and Gerber Reservoir (Reclamation 2012; FWS 2007d, 2013e).

Shortnose suckers live in lakes and spawn in rivers, streams or springs associated with the lake habitats, generally from early February through mid-April. After hatching, larval suckers migrate out of spawning substrates, which are usually gravels or cobbles, and drift downstream into lake habitats from early May to mid-June (FWS 1988, 1993b). The shortnose sucker is known to migrate out of Tule Lake to spawn in the Lost River below Anderson–Rose Dam about 7.6 miles downstream from the Lost River crossing. Therefore, the Pacific Connector pipeline would cross the Lost River where shortnose suckers could be present.

Potential effects on the shortnose sucker are associated with pipeline stream crossings. These effects include the release of drilling mud from Klamath River HDD potential frac-out as well as potential entrainment or entrapment of fish, and increased turbidity and suspended sediment affecting fish avoidance and benthic food sources in occupied streams, and fish being injured or killed during fish salvage efforts. Pacific Connector would install temporary flowing stream crossing by lifting or spanning a structure from a bank so that equipment does enter flowing waters. However, if it is not possible to do this safely, only equipment necessary to install the bridge would cross the stream. This would cause some limited, short-term bottom benthic disruption and possibly elevated suspended sediment. Adults and juveniles subject to fish salvage within the isolated construction site at the Lost River could be injured or killed if electroshocking is used and stressed if seining is used. Pacific Connector has included guidelines noted above under the Lost River sucker section in their *Fish Salvage Plan* that would be used near listed suckers. However, despite these measures, it is still possible that shortnose suckers could be killed by salvage operations and modifications to these plans may be needed to reduce this risk (see the Lost River Sucker section above).

Spawning occurs within limited areas of the Lost River (FWS 2013d; Reclamation 2012), and occasional individuals have been found in this stream region (NMFS and FWS 2013), suggesting it is possible that shortnose sucker could occur at the Pacific Connector pipeline crossing of Lost River at MP 212.07 during the non-spawning period. An additional 31 dry open-cut small intermittent stream crossings cannot be ruled out completely from potentially having shortnose sucker present because surveys have not been conducted for their presence.

The Project **may affect** shortnose suckers because:

- shortnose suckers occur within the Upper Klamath River subbasin and Lost River subbasin, which would be affected during construction of the proposed action.

The Project is **likely to adversely affect** shortnose suckers because:

- there is a possibility that shortnose suckers could occur within the Lost River when it would be crossed by the Pacific Connector pipeline and may be affected by elevated suspended sediment;
- shortnose suckers could occur in 19 waterbodies crossed by dry open-cut construction in the Lake Ewauna-Klamath River watershed and in 13 waterbodies west of MP 214.38 (including the Lost River) crossed in the Mills Creek-Lost River watershed and be indirectly affected by elevated suspended sediment levels, streambank erosion and stability, and aquatic nuisance species introductions; and
- adults and juveniles subject to fish salvage within the isolated construction site at 31 ditches crossed by dry-open cuts and the Lost River could be affected if electroshocking is used and stressed if seining is used.

The Project **may affect** designated critical habitat for the shortnose sucker because:

- there is a low risk of HDD failure during crossing of the Klamath River, resulting in a frac-out that releases drilling mud into the river.

However, the Project is **not likely to adversely affect** designated critical habitat for the shortnose sucker because:

HDD crossing methods would avoid critical habitat in the Klamath River;

- the potential for hydraulic fracture is so unlikely as to be discountable; and
- in the event of released bentonite during an HDD crossing, corrective actions would contain and temporally limit drill mud volumes.

4.6.1.4 Amphibians and Reptiles

Oregon Spotted Frog (Federally Threatened Species, Critical Habitat, State Sensitive-Critical)

On August 29, 2014, FWS listed the Oregon spotted frog as threatened (79 FR 51657). Critical habitat for the Oregon spotted frog was finalized in May 2016 and includes critical habitat in Oregon (Units 7 through 14; 81 FR 29335). This species is almost always found in or near a perennial body of water that includes zones of shallow water and abundant emergent or floating aquatic plants, which the frogs use for basking and escape cover (Corkran and Thoms 1996; FWS 2013f). The closest designated critical habitat unit to the Project is CHU 14 – Upper Klamath, which consists of 262 acres of lakes and creeks in Klamath and Jackson Counties and is currently occupied by Oregon spotted frogs (1 FR 2933). The Buck Lake population within CHU 14 is the closest occurrence of Oregon spotted frogs to the Project. This site includes seasonally wetted areas adjacent to the western edge of Buck Lake encompassing Spencer Creek downstream due west of Forest Service Road 46, three unnamed springs, and Tunnel Creek (81 FR 29335).

Oregon spotted frogs at Buck Lake have been consistently monitored from 2012 to 2016, along with other populations in the Oregon Cascades (Adams et al. 2017). Observations of frogs at two sites in Buck Lake and one in Tunnel Creek (both in CHU 14) indicate some variability in counts for each of several life stages but adults and larva or juveniles were found each year. Spencer Creek upstream of Buck Lake is almost equally subdivided into Buck Marsh, closest to Clover

Creek Road, and Buck Meadow, closest to Buck Lake (Lerum 2012). Buck Marsh is fed by several springs with evidence of beaver activity, and Buck Meadow is a pasture that often floods in the spring but does not stay flooded long enough to provide Oregon spotted frog breeding habitat. Further, soils in Buck Marsh are dense, possibly compacted by past heavy livestock use, and provide little water infiltration. Neither Buck Marsh nor Buck Meadow currently provide habitat for Oregon spotted frogs (Lerum 2012). Riparian vegetation is sparse and is unlikely to support beaver occupancy that could help to create suitable habitat (Lerum 2012).

The Project would cross Spencer Creek on the north side of Clover Creek Road, approximately 6,400 feet upstream from the CHU 14 at Buck Lake and pass within 280 feet of critical habitat in Spencer Creek downstream of Buck Lake. Potential effects on Oregon spotted frogs include changes to habitat quality and acoustic. Conservation measures proposed by Pacific Connector to minimize construction and operation effects on waterbodies and riparian zones would apply to Oregon spotted frogs.

Spencer Creek upstream of Buck Lake is not currently suitable habitat for Oregon spotted frogs and is unlikely to become suitable habitat and support Oregon spotted frogs at the time of construction. Clover Creek road separates the ROW from Spencer Creek downstream of Buck Lake so sediment from the construction ROW is not expected to enter Spencer Creek.

The Project **may affect** Oregon spotted frogs because:

- the Pacific Connector pipeline route would cross Spencer Creek, which is hydrologically connected to Buck Lake which is occupied by the frog; and
- the Pacific Connector pipeline route is within 280 feet of Spencer Creek and would cross tributaries to Spencer Creek downstream of Buck Lake, which is occupied by the Oregon spotted frog.

However, the Project **is not likely to adversely affect** Oregon spotted frogs for the following reasons:

- Buck Lake is approximately 6,400 feet downstream from where the pipeline route would cross Spencer Creek. Suspended sediment generated by the proposed action is expected to remain in the water column for 1,450 feet downstream from the construction site.
- Suspended sediment resulting from the crossing of Spencer Creek would pass through Buck Marsh, which Oregon spotted frogs do not currently inhabit. If the Oregon spotted frog does occur in Buck Marsh at the time of pipeline construction, conservation measures would limit potential effects due to acoustic shock, introduction of non-native species and/or disease, fuel and chemical spills, and herbicides.
- Future presence of Oregon spotted frogs in the Spencer Creek upstream of Buck Lake at the time of construction is extremely unlikely and considered to be discountable.
- Although the ROW occurs as close as 280 feet from Spencer Creek downstream of Buck Lake, they are not hydrologically connected because Clover Creek road separates the ROW from Spencer Creek; BMPs and erosion control measures should prevent sediment from the construction ROW from entering Spencer Creek.

The Project **may affect** designated critical habitat for the Oregon spotted frog because:

- the Pacific Connector pipeline route would be within 280 feet of proposed critical habitat within Spencer Creek downstream of Buck Lake.

The Project **is not likely to adversely affect** designated critical habitat for the Oregon spotted frog because:

- the designated critical habitat within 280 feet of the pipeline is not hydrologically connected to the ROW because it is separated by Clover Creek Road; and
- test water from the proposed hydrostatic discharge site at MP 169.52 is not expected to reach the critical habitat in Spencer Creek or Buck Lake, so effects on PBFs from changes in hydrology or introduction of nonnative species from the Project are discountable.

Sea Turtles

Four federally listed sea turtles potentially occur near the Project: green sea turtles, leatherback sea turtle, olive ridley sea turtle, and loggerhead sea turtle. All four species are federally threatened and state endangered.

Green sea turtles have been sighted from Baja California to southern Alaska, but most commonly occur from San Diego south (NMFS 2007a). Green turtles primarily use three types of habitat: oceanic beaches (for nesting), convergence zones in the open ocean, and benthic feeding grounds in coastal areas (NMFS 2007a). Reports of stranding suggest that the green turtle is a frequent visitor to the coast of California. Based on this data, green turtles are likely infrequent, transient visitors to the Oregon Coast, but may occasionally be found in the marine analysis area.

The leatherback sea turtle is the most common sea turtle in United States waters north of Mexico (NMFS and FWS 1998), and numerous sightings have been documented off the Oregon Coast. Adult leatherback turtles are highly migratory and available information indicates that eastern Pacific migratory corridors exist along the west coast of the United States (NMFS and FWS 1998). The west coast of the United States may represent some of the most important foraging habitat in the world for the leatherback turtle (NMFS and FWS 1998). Despite occasional reports of leatherbacks sighted at sea, and a growing database documenting their incidental catch in coastal and pelagic fisheries, there are very few areas where the species is routinely encountered. Exceptions include Monterey Bay, California (NMFS and FWS 1998). These data suggest that leatherback sea turtles would be present in the marine analysis area in higher densities relative to other sea turtle species, but still in low densities overall.

At-sea occurrences of olive ridley sea turtles in waters under United States jurisdiction are limited to the west coast of the continental United States and Hawaii, where the species is rare, but possibly increasing. During feeding migrations, olive ridley turtles may disperse into waters off the Pacific west coast as far north as Oregon (FWS 2013g). Based on sightings off the Oregon coast, olive ridley turtles may occasionally occur in the marine analysis area.

Loggerhead sea turtles occupy three different ecosystems during their lives—the terrestrial zone, the oceanic zone, and the neritic zone (NMFS 2007b). In the United States, occasional sightings are reported from the coasts of Washington and Oregon, but most records are of juveniles off the coast of California (NMFS 2007b). The potential importance of Oregon waters and the marine analysis area to loggerhead turtles is unknown, although two loggerhead turtles have been reported stranded in Oregon and Washington since the beginning of 1997 through 2007 (NMFS 2008d).

Direct effects of the proposed action include injury and/or mortality due to ship-strikes, underwater ship noise, and potential adverse effects from a vessel spill or ship release of LNG and fire at sea. Spills and/or release could indirectly affect federally listed sea turtles by affecting forage species. Below is a determination of effects summary for the federally listed sea turtles and critical habitat. More details will be provided in the pending BA.

The Project **may affect** federally listed sea turtles because:

- these sea turtles may occur within the marine analysis area during operation of the proposed action;
- the proposed action would increase shipping traffic (LNG carriers) within the marine analysis area; and
- the continental U.S. Pacific Coast provides important foraging habitat for leatherback turtles.

However, the Project is **not likely to adversely affect** federally listed sea turtles because:

- ship strike on sea turtles would be highly unlikely;
- Jordan Cove would provide a ship strike avoidance measures package to LNG carrier operators transporting cargo from the terminal that consists of multiple measures to avoid striking marine mammals, which should also benefit sea turtles;
- The FERC does not have authority over the LNG carrier; however, the independent carrier operators would be required to follow all Coast Guard requirements regarding the operation of LNG carriers including carrier speeds;
- noise produced by LNG carriers would contribute to overall noise levels within the marine analysis area en route to the Port of Coos Bay and effects of ship noise on sea turtles could exceed NMFS interim noise exposure criteria for Level B single non-pulse noise (NMFS 2016c, NMFS 2017b, NMFS 2018c), but would not exceed existing background ship noise levels and would not cause injury; and
- given vessel design, on-board spill kits, safety records, and implementation of Coast Guard recommendations, it is not likely that there would be a major ship spill of hazardous materials that may adversely affect water quality or aquatic species. Fuel released at sea, if any, would be in small enough quantities that potential effects on listed sea turtles would be discountable, especially given the low density of sea turtles within the marine analysis area.

No critical habitat has been designated or proposed for the olive ridley or loggerhead sea turtles. Critical habitat was established for the green turtle on Culebra Island, Puerto Rico, on September 2, 1998 (NMFS 1998); however, no critical habitat for green sea turtles occurs on the U.S. Pacific Coast, and the Project would therefore have no effect on designated critical habitat for the green turtle.

The Project **may affect** designated critical habitat for the leatherback turtle because:

- Critical habitat coincides with nearshore waters in the marine analysis area through which LNG carriers would transit to Coos Bay and the LNG terminal.

However, the Project is **not likely to adversely affect** designated critical habitat for the leatherback turtle because:

- LNG carriers and the Jordan Cove LNG Project are not likely to contribute oil, fuel, lubricants, or other contaminants to critical habitat to the extent that would adversely affect the occurrence of prey species, primarily jellyfish, of sufficient condition, distribution, diversity, and abundance to support individual as well as population growth, reproduction and development (PBF 1); and
- disturbance of benthic habitats within Coos Bay due to dredging would be of sufficiently short duration and small scale relative to the area available for settlement of larvae of the scyphozoan prey species within Area 2 that effects on PBF 1 would be unmeasurable and would therefore be discountable.

4.6.1.5 Invertebrates

Vernal Pool Fairy Shrimp (Federally Threatened Species with Critical Habitat, No State Status)

Vernal pool fairy shrimp were listed as threatened under the ESA on September 19, 1994 (FWS 1994a). This crustacean inhabits vernal pools, or seasonal wetlands that fill with water during fall and winter rains, in California and southwestern Oregon. The vernal pool fairy shrimp was identified relatively recently (in 1990) and was not discovered in Jackson County, Oregon until 1998 (FWS 2005s). As a result, it is possible that additional locations for the species will be found in Oregon in the future (FWS 2005a). Suitable vernal pool habitat occurs within and adjacent to Project facilities, some of which has not been surveyed. Additionally, a proposed pipe storage yard is in the Burrill Lumber industrial yard adjacent to the vernal pool fairy shrimp critical habitat unit VERFS 3A. Potential effects on vernal pool fairy shrimp and critical habitat include possible disturbance to pools from driving or storing equipment or pipes near or on pools or wetlands, and alteration of hydrology. Although nine vernal pools within the ROW between MPs 145.3 and 145.4 are outside the known range for vernal pool fairy shrimp, the vernal pools may provide suitable habitat for the species because the pools occur within the appropriate soils type (Agate-Winlo) for vernal pool fairy shrimp, occur near (i.e., within 8.2 miles of) the known and relatively recently (1998) expanded range of the species, and the species' absence has not been confirmed. Based on the relatively recent expansion of the known range of this species and the presence of potentially suitable habitat (including soil type) that has not been surveyed, there is potential for this species to be present within the ROW and be affected by pipeline construction.

These effects would be minimized through avoidance and minimization measures. Specifically, Pacific Connector has indicated they would avoid using areas within yards that may contain vernal pool fairy shrimp and, if this species is noted during survey efforts, they would implement proper sedimentation control barriers to minimize potential effects on the species. Below is a determination of effects summary for the vernal pool fairy shrimp and critical habitat. More details will be provided in the pending BA.

The Project **may affect** vernal pool fairy shrimp for because:

- Potentially suitable habitat for vernal pool fairy shrimp has been identified near four proposed Jackson County pipe storage yards, as well as within and adjacent to the pipeline ROW between MPs 145.30 and 145.40.

The Project is **likely to adversely affect** vernal pool fairy shrimp because:

- Effects on vernal pool fairy shrimp are possible due to the Project's crossing of potentially suitable, unsurveyed habitat within the pipeline ROW between MPs 145.30 and 145.40 (within Agate-Winlo soils).

The Project **may affect** vernal pool fairy shrimp critical habitat because:

- the Project occurs adjacent to designated vernal pool fairy shrimp critical habitat; and
- the Project may affect suitable habitat within designated critical habitat adjacent to the Project.

However, the Project is **not likely to adversely affect** vernal pool fairy shrimp critical habitat because:

- Although the proposed Burrill Lumber pipe yard occurs within 250 feet of designated vernal pool fairy shrimp critical habitat unit (VERFS 3A), it is separated from the critical habitat unit by Agate Road, which is a two-lane paved road that acts as a barrier to hydrologic connectivity that is considered a definitive boundary to the area of effects.
- Burrill Lumber pipe yard has been previously disturbed, and additional surface disturbances and/or soil compaction by heavy machinery from use within Burrill Lumber pipe storage yard should be minimal. Also, Agate Road is located between Burrill Lumber pipe yard and critical habitat unit VERFS 3A, which is raised and paved, and would serve as an existing barrier between the pipe yard and critical habitat unit. Therefore, use of the Burrill Lumber pipe storage yard is not expected to adversely modify geographic, topographic, and edaphic features potentially within 250 feet of the yard that support systems of hydrologically interconnected pools, swales, and other ephemeral wetlands and depressions within the matrix of surrounding uplands (PBF 2).
- Proposed conservation measures would reduce the potential for increased sediment mobilization, increased fugitive dust, and the potential spread of invasive species to suitable vernal pool habitats.

4.6.1.6 Plants

A botanical analysis area applies to the extent of Project-related effects on listed plant species. The botanical analysis area for this Project extends to 98 feet (30 meters) each side of the pipeline project (i.e., construction ROW, TEWAs, UCSAs, rock source and disposal sites, proposed storage yards, and aboveground facilities) as well as the footprint for the Jordan Cove LNG Project. The botanical analysis area, in general, includes the area surveyed for sensitive and listed plant species (at least 100 feet from habitat removal on federal lands and at least 50 feet from habitat removal on non-federal, private lands) and distance that indirect effects on plants would be expected. Surveys are incomplete in areas of potential habitat along the pipeline route where landowner permission was denied. Pacific Connector would survey these areas after the Project is certificated, but before construction begins (i.e., if the Project is approved and Pacific Connector gains access using eminent domain proceedings under Section 7h of the NGA). Pacific Connector identified unsurveyed areas that may contain suitable habitat for listed species, as will be discussed in our pending BA.

Pacific Connector has developed a *Federally-listed Plant Conservation Plan* to address how avoidance, minimization, propagation, restoration, and other conservation measures would be applied to protect listed plant species, as well as how potential effects on unsurveyed lands would be addressed. For example, if populations of listed plant species are identified where surveys were previously denied, Pacific Connector would apply mitigation measures that have been developed for surveyed lands to minimize and avoid effects on these species including (1) minor alignment or route adjustments; (2) narrowing or necking-down the construction ROW; or (3) eliminating or removing a portion of a TEWA or UCSA (depending on where new populations of these species were identified). Additional construction measures that would be implemented in areas that contain listed plants to minimize and avoid effects on these species, if they occur, include the following measures listed below.

- The construction ROW and TEWAs would be surveyed and flagged to clearly mark the limits of construction disturbance (i.e., clearing/grading).
- Where feasible, the EI would monitor the survey and flagging efforts and would provide additional protective buffers or neckdowns to ensure protection of adjacent plant populations or provide additional avoidance. The EI would consult with Pacific Connector's Chief Inspector and the construction contractor during construction to determine where additional buffer protections or neckdowns could be accommodated without affecting construction safety.
- Known plant populations adjacent to the construction ROW or other plants populations identified during preconstruction surveys would be protected by a safety fence and silt fence to ensure these plants are not inadvertently affected by Project activities.
- BMPs outlined in Pacific Connector's *Air, Noise and Fugitive Dust Control Plan*[140] to minimize wind erosion and fugitive dust emissions during construction and restoration activities would be implemented. Water would be used to control fugitive dust along the construction ROW (no Dustlok® would be used within 150 feet of any listed plants). Only enough water would be sprayed to control the dust or to reach the optimum soil moisture content to create a surface crust; no runoff would be generated.
- Equipment would be inspected and cleaned of potential noxious weed seed or plant parts consistent with the requirements of Pacific Connector's *Integrated Pest Management Plan*.
- Topsoil salvaging would occur within affected populations after species-specific seed, bulb, or whole plant salvage has occurred. The salvaged topsoil would be returned to its original location during restoration.
- During restoration, all areas would be regraded as closely as possible to the original contours to ensure preconstruction drainage patterns are not affected.

[140] Appendix B in Pacific Connector's POD filed with the FERC in January 2018,

- The construction ROW would be restored to its original contours and reseeded with an appropriate seed mixture recommended by FWS prior to the following growing season.
- When feasible, Pacific Connector would collect and bag seeds and/or bulbs of affected listed plants and provide these seeds and/or bulbs to a suggested repository. Upon FWS approval, the collected seeds would be replanted within or adjacent to the construction ROW on suitable federal lands where future protection can be managed or on private lands where a conservation easement has been acquired.
- Construction activities would occur in the fall and winter outside the critical growing, flowering, and seeding periods.
- Wetland mats would be used in travel areas in saturated soil areas to minimize soil rutting and soil compaction and protect existing plants that may be present.

The *Federally-listed Plant Conservation Plan* includes specific mitigation plans for Applegate's milk-vetch, Gentner's fritillary, Kincaid's lupine, and Cox's mariposa-lily. In addition, the Forest Service has developed mitigation measures/requirements related to their ROW Grant that may also indirectly benefit listed plant species (see chapter 2 of this EIS and appendix F).

Below is a discussion of each federally-listed plant species that could be affected by the Project. The mitigation measures discussed above would apply to all federally-listed plants discussed in this section.

Applegate's Milk-vetch (Federally Endangered Species, State Endangered Species)

FWS listed Applegate's milk-vetch (*Astragalus applegatei*) as endangered on July 28, 1993 (FWS 1993c). This species has a narrow range, known only in the Lower Klamath Basin (the plain containing Lower Klamath Lake), near the city of Klamath Falls in southern Oregon. It was believed to be extinct until its rediscovery in 1983 and at the time of listing was only known from two extant sites. Applegate's milk-vetch grows in flat-lying, seasonally moist, alkaline soils with underlying clay hardpans. The species' habitat was historically characterized by sparse, native bunchgrasses and patches of bare soil, allowing for some seed dispersal by wind. Today, dense coverage of the habitat by introduced grasses and weeds means seed dispersal is highly localized, with most seedling establishment found adjacent to mature plants (FWS 1998b). Continued destruction, modification, and/or curtailment of its habitat or range due to urban and commercial development, and loss of habitat through competition with non-native weeds, are the principal threats to the survival of the species (FWS 2009a).

The Pacific Connector Project is located within known and historic Applegate's milk-vetch range between MPs 191.20 to 214.30. The "Collins Tract site," which is located within and adjacent to the botanical analysis area between approximately MP 195.3 and MP 196.7, contains 19 sub-populations of Applegate's milk-vetch, several of which were discovered by FWS and SBS during surveys conducted for Pacific Connector. This area was revisited in 2018 and no new sites were documented. Pacific Connector has revised its proposed route slightly in this area to avoid direct effects on the plants identified in 2008 within the Collins Tract site. Survey efforts of the pipeline route subsequent to these initial survey efforts in 2007 and 2008 have not identified any additional plants; however, Pacific Connector has not surveyed all potential habitat. Additionally, in 2009, the FWS and The Nature Conservancy documented 1,260 plants within and adjacent to the proposed Klamath Falls Memorial Drive 2 pipe storage yard, in an area that has not been surveyed for the Project (ORBIC 2017a).

The route has been relocated to avoid known populations of Applegate's milk-vetch as well as suitable habitat found during surveys conducted during summer 2008; therefore, no direct effects on known plants in those sites are expected. Additionally, Pacific Connector would resurvey the Klamath Falls Memorial Drive 2 pipe storage yard prior to construction and avoid the use of the proposed yard within 30 meters of known and documented Applegate's milk-vetch plants. Project surveys of all suitable habitat have not been completed for this species; therefore, additional plants could potentially be encountered and affected by the Project. Measures to reduce impacts on unidentified plants are included in the *Applegate's Milk-vetch Mitigation Plan*; however, the FWS has indicated it may require additional mitigation for these potential impacts as part of their BO (including additional survey, seed collection, and salvage requirements). Below is a determination of effects summary for Applegate's milk-vetch and critical habitat. More details will be provided in the pending BA.

The Project **may affect** Applegate's milk-vetch because:

- suitable habitat is available within the botanical analysis area; and
- individual plants have been located within the analysis area during survey efforts.

The Project is **likely to adversely affect** Applegate's milk-vetch because:

- approximately 175.3 acres of potential suitable habitat that has not been surveyed occurs within the botanical analysis area along the pipeline route, which includes 77 acres within the pipeline ROW; therefore, it is possible that unidentified plants occur within the construction ROW and workspace;
- surface disturbance and excavation would occur within potentially suitable habitats and could impact unidentified plants (including in areas where surveys have not been completed); and
- indirect effects, including potential changes in hydrology and soil characteristics, introduction and spread of invasive plants and noxious weeds, alterations to vegetation cover and species composition of associated habitat, and effects from fugitive dust, could impact documented or suspected plants and habitat outside the construction ROW, but within 30 meters of the Project pipeline.

Critical habitat has not been designated for Applegate's milk-vetch.

Gentner's Fritillary (Federally Endangered Species, State Endangered Species)

FWS listed Gentner's fritillary (*Fritillaria gentneri*) as endangered on December 10, 1999 (FWS 1999). Gentner's fritillary is found in small, scattered locations in the Rogue and Klamath River watersheds in Jackson and Josephine Counties in Oregon (FWS 2003c; 2016d). This species is highly localized, with populations occurring within a 30-mile radius of Jacksonville Cemetery in Jacksonville, Oregon (FWS 2003c). Since the 2003 publication of the recovery plan, nine new Gentner's fritillary populations (approximately 131 flowering plants within 1.6 acres) have been detected outside of the four recovery unit boundaries (FWS 2016d). It is difficult to census populations of Gentner's fritillary because this species does not flower every year and individuals can remain dormant for one or more years underground.

Gentner's fritillary is often found on the edge of dry woodland and forests where the overstory can be dominated by Oregon white oak, madrone, Douglas-fir, and ponderosa pine; it also occurs in open chaparral and grassland environments. It occurs at a wide range of elevations, from 1,000 to 5,100 feet, and is usually associated with shrubs that provide protection from the wind and sun (FWS 2003c).

The Pacific Connector Project crosses the plant's range between approximately MP 113 through MP 155. Surveys for Gentner's fritillary have occurred within suitable habitat near the pipeline from 2007 through 2018. Surveys are expected to continue to complete recommended second year survey efforts, where necessary. Additionally, surveys will be initated in other areas that receive survey permission. Since 2007, survey efforts have identified Gentner's fritillary individuals in five locales: (1) approximately 0.38 mile north of MP 128.0 near Indian Creek and 50 feet below a four-wheel drive road; (2) 21 feet from TEWA 128.01-W; (3) 100 feet from proposed access road EAR-128.05; (4) near MP 129.1 approximately 54 feet from TEWA 128.96-N; and (5) within 21 feet of TEWA 142.07-N near MP 142.1. Of these five sites, three are located within the analysis area. Direct impacts on known individuals of Gentner's fritillary would be avoided; however, unidentified *Fritillaria* plants near MP 142.1 that could be Gentner's fritillary occur within the pipeline ROW and would be impacted if a reroute of the pipeline alignment is not implemented (additional details to be provided in our pending BA). Additionally, unidentified *Fritillaria* plants near MP 129 that could be Gentner's fritillary occur within the analysis area and could be indirectly affected.

Additionally, Project surveys of all suitable habitat have not been completed for Gentner's fritillary; therefore, additional plants could potentially be encountered and affected by the Project. The FWS will require two-year protocol surveys in unsurveyed, potentially suitable habitat and in suitable habitat where surveys are older than 10 years. However, indirect impacts on known individuals could be eliminated with minor modifications to the construction ROW. Therefore, **we recommend that:**

- **<u>Prior to end of the draft EIS comment period</u>, Pacific Connector should file with the Secretary revised alignment sheets that eliminate or relocate TEWA 128.01-W, TEWA 128.96-N, TEWA 142.07-N. and EAR-128.05.**

Below is the determination of effects summary for Gentner's fritillary; more details will be provided in our pending BA.

The Project **may affect** Gentner's fritillary because:

- suitable habitat is available within the analysis area; and
- individual plants have been located within the analysis area during survey efforts.

The Project is **likely to adversely affect** Gentner's fritillary because:

- approximately 240.9 acres of potential suitable habitat that has not been surveyed occurs within the botanical analysis area along the pipeline route, which includes 50.4 acres within the pipeline ROW; therefore, it is possible that unidentified plants occur within the construction ROW and workspace;

- *Fritillaria* spp. have been identified within and adjacent to areas that would be affected by the Project;
- Gentner's fritillary can remain dormant underground for one year or longer, does not flower every year, and has been documented to not flower for several years; therefore, it is possible that protocol surveys conducted for the Project did not locate this species; and
- indirect effects, including potential changes in hydrology and soil characteristics, introduction and spread of invasive plants and noxious weeds, alterations to vegetation cover and species composition of associated habitat, and effects from fugitive dust, could impact documented or suspected plants and habitat outside the construction ROW, but within 30 meters of the Project pipeline.

Critical habitat has not been designated for Gentner's fritillary.

Western Lily (Federally Endangered Species, State Endangered Species)

FWS listed the western lily (*Lilium occidentale*) as endangered on August 17, 1994 (FWS 1994b). This lily is currently known from 23 small populations in freshwater marshes and swamps, early successional fens (bogs), coastal scrub and prairie, openings in coastal, Sitka spruce–dominated coniferous forests, as well as other poorly drained soils along the coast of southern Oregon and northern California (FWS 2009b). Western lilies have an extremely restricted distribution, and only occur along the coast within 4 miles of the Pacific Ocean. Occurrences within the Coos Bay area are reported to occur in Blacklock soils; however, it also grows in soils that are well drained that have a substancial layer of organic soil (SHN 2013c).

The closest known western lily occurrence in relation to the Project is approximately 1 mile south of the Myrtlewood Off-site Park & Ride at the Hauser Bog (ORBIC 2017b). However, the Myrtlewood Off-site Park & Ride is located completely in the paved parking lot and does not contain suitable habitat for the western lily. There are no other known occurrences within two miles of the Project (ORBIC 2017b). There are no records of western lily north of Hauser, and the FWS typically considers Hauser the northern extent for the species along the Oregon coast.

Surveys for western lily within potential habitat in the analysis area (i.e., poorly drained bogs with acidic organic soils and within six miles of the coast below 300 feet elevation) were conducted between 2006 and 2017 (SHN 2013c; SBS 2008a, 2012, 2013, 2014, 2017a). Jordan Cove conducted surveys at the LNG terminal site in 2006, 2012, and 2013 and surveys were conducted by SBS for Pacific Connector between 2007 and 2017. No occurrences of western lily were detected during these surveys, and only limited areas of potential suitable habitat were identified. More details will be provided in our pending BA.

Although no plants were identified in the area that would be affected by the Project and potential occurrence of this species in this area is low, surveys of all potential habitat in the area have not been completed for this species; therefore, western lily could potentially be encountered and affected by the Project. Additionally, this species is difficult to detect when not flowering, and surveys may overlook western lily juveniles or vegetative adults, especially non-flowering individuals growing within dense vegetation (FWS 2008b). Below is the determination of effects summary for western lily and critical habitat.

The Project **may affect** the western lily because:

- known populations occur within 1 mile of the botanical analysis area; and
- potential suitable habitat is available within the analysis area.

The Project is **not likely to adversely affect** the western lily because:

- surveys of potential western lily habitat at the Jordan Cove site and associated facilities and along the pipeline route did not document western lily and potential suitable habitat within the botanical analysis area is limited;
- surveys in potentially suitable habitat would occur prior to ground-disturbing activities; if plants are identified, conservation measures developed to avoid or minimize effects on any documented plants would be implemented; and
- consultations with the FWS would be reinitiated if this species is found to be present in the area and effects cannot be avoided.

Critical habitat has not been designated for the western lily.

Large-Flowered Meadowfoam (Federally Endangered Species, State Endangered Species)

The large-flowered meadowfoam (*Limnanthes pumila* ssp. *grandiflora*) was federally listed as endangered on November 7, 2002 (FWS 2002b). It is an endemic species restricted mostly to the Agate Desert area in the Rogue River Valley of southern Oregon. It grows on the wetter, inner edges of vernal pools at elevations between 1,220 and 1,540 feet. The plant is capable of self-fertilization and self-pollination. In the Rogue River Valley, large-flowered meadowfoam is often found in the same vernal pool habitats as Cook's lomatium (*Lomatium cookii*) and the vernal pool fairy shrimp.

In 2010, FWS designated eight CHUs (5,840 acres) for the large-flowered meadowfoam in the Agate Desert complex in Jackson County, Oregon. Two of the units designated are shared by the designated habitat for Cook's lomatium. All designated CHUs are currently occupied (or expected to be occupied; FWS 2010b). Within the vicinity of White City, Oregon, where multiple pipe storage yards would be located, CHUs RV6 (6A through 6H) and RV8 have been designated. Industrial parks surround all units. Unit RV6C is across an existing paved road from the Burrill Lumber pipe storage yard, and Unit RV6D is 590 feet northeast of this pipe storage yard. RV8 is over 1.8 miles west of the proposed Rogue Aggregates and the other three pipe storage yards.

Botanical surveys were conducted within identified suitable habitat for this species where access was permitted, during the flowering season in April 2007. In 2007, survey efforts documented approximately 36 large-flowered woolly meadowfoam plants approximately 850 to 1,165 feet east of the proposed Burrill Lumber pipe storage yard. Additionally, ORBIC (2017a) has reported several other subpopulations of large-flowered woolly meadowfoam (approximately 16,200 plants) near proposed pipe storage yards, including within the Ken Denman State Game Management Preserve across an existing paved road east of the Burrill Lumber pipe storage yard.

No surveys have been permitted within Avenue F & 11th Street and WC Short pipe storage yards; however, off-site observations identified approximately 0.48 acre of highly modified, low-quality vernal pool habitat within 250 feet of the Avenue F & 11th Street and WC Short pipe yards. This area is associated with active industrial sites or previously disturbed industrial areas and is not expected to provide high-quality vernal pool habitat or support individuals of large-flowered woolly meadowfoam. Additionally, no direct or indirect effects on potential vernal pool habitat are expected from use of the Avenue F & 11th Street and WC Short pipe storage yards.

The Project **may affect** large-flowered woolly meadowfoam because:

- the pipeline occurs near occupied, large-flowered woolly meadowfoam habitat.

The Project is **not likely to adversely affect** large-flowered woolly meadowfoam because:

- surveys of potentially suitable habitat at proposed pipe storage yards in Jackson County and along the Project did not document large-flowered woolly meadowfoam plants;
- the 0.48-acre of unsurveyed potential habitat within the Avenue F and 11th and WC Short pipe storage yards consists of low-quality vernal pool habitat within active industrial sites or previously disturbed industrial areas and is unlikely to contain large-flowered woolly meadowfoam;
- Pacific Connector would avoid using portions of the pipe storage yards within 250 feet (indirect effect) of this species or potentially suitable vernal pool habitat;
- effects on suitable habitat are likely to be discountable to the point where no meaningful measurement, detection, or evaluation of effects would be possible (i.e., effects would not reach a level where individual plants would be lost);
- sedimentation barriers would be used, as appropriate, to prevent run-off and changes in hydrology;
- conservation measures have been developed to avoid or minimize effects on any plants identified during surveys prior to construction; and
- construction of the pipeline is not expected to adversely modify hydrology in nearby suitable habitat areas within 250 feet of proposed pipe storage yards.

The Project **may affect** designated critical habitat for large-flowered woolly meadowfoam because:

- the Project occurs adjacent to large-flowered woolly meadowfoam critical habitat.

The Project is **not likely to adversely affect** large-flowered woolly meadowfoam critical habitat because:

- Construction of the pipeline is not expected to adversely modify designated critical habitat areas within 250 feet of pipeline components (i.e., subunit RV6C); existing features (i.e., paved Agate Road) and proposed conservation measures would provide sufficient protection from adjacent development and invasive plant and noxious weed sources; and

- The Burrill Lumber pipe yard is hydrologically disconnected from subunit RV6D due to topography (flow is away from RV6D) and distance (greater than 590 feet) and is hydrologically isolated from subunit RV6C by the raised Agate Road.

Cook's Lomatium (Federally Endangered Species, State Endangered Species)

Cook's lomatium was listed as federally endangered on November 7, 2002 (FWS 2002b). Its range is on seasonally wet soils limited to two areas: (1) along vernal pools in the Agate Desert area of the Rogue River Valley, Jackson County, and (2) in seasonally wet serpentine-derived grassland meadows, sloped mixed-conifer forest openings, and and along roadsides edges in shrub dominated plant communities or adjacent to meadows within the Illinois River Valley area near Cave Junction, Josephine County. The Jackson County populations occur along the margins and bottoms of vernal pool habitats within a 20,510-acre landform known as the Agate Desert. The plant flowers from late March to May and is pollinated entirely by insects. In the Rogue River Valley, Cook's lomatium is often found in the same vernal pool habitats as the large-flowered meadowfoam and the vernal pool fairy shrimp.

In 2010, the FWS designated 16 units (6,289 acres) of critical habitat for the Cook's lomatium, including three CHUs in Jackson County, totaling 2,282 acres. Two of the designated units in Jackson County are shared by the designated habitat for large-flowered woolly meadowfoam. All designated CHUs are currently occupied (FWS 2010b). CHUs RV6 (A, F, G, and H) and RV8 have been designated within the vicinity of White City, Oregon, where multiple pipe storage yards would be located. Industrial parks surround these units. CHUs RV6A and RV6H are located approximately 0.5 mile south and 0.8 mile southeast, respectively, of the Avenue F & 11th Street and WC Short pipe storage yards.

Four pipe storage yards, Burrill Lumber, WC Short, Avenue F & 11th Street, and Rogue Aggregates, occur within the Agate Desert near White City in proximity to known occupied vernal pools. No vernal pool habitat or individuals of Cook's lomatium were observed during surveys of the Burrill Lumber and Rogue Aggregates pipe storage yards, and no potential vernal pools were located within 250 feet of the Burrill Lumber pipe storage yard. Although the layout for the Rogue Aggregates pipe storage yard has been reconfigured since surveys in 2007, unsurveyed portions do not contain suitable soil types for Cook's lomatium. Several patches of Cook's lomatium have been documented in the Denman Wildlife Management Area and Agate Desert Preserve, 0.5 mile south of the Avenue F & 11th Street and WC Short pipe storage yards (Friedman 2006, ORBIC 2017a). Surveys have not been conducted within the Avenue F & 11th Street and WC Short pipe storage yards because access has not been granted; however, based on aerial photography and off-site observation in April 2018, Avenue F and 11th and WC Short pipe storage yards do not appear to contain suitable habitat for Cook's lomatium. A long drainage ditch running along the northern edge of the Avenue F and 11th pipe storage yard, which could provide low-quality habitat for Cook's lomatium, was observed during these off-site surveys.

Below is the determination of effects summary for Cook's lomatium and critical habitat; more details will be provided in our pending BA.

The Project **may affect** Cook's lomatium because:

- suitable, occupied habitat is available within the vicinity of the Project.

The Project is **not likely to adversely affect** Cook's lomatium because:

- surveys of suitable habitat at pipe storage yards in Jackson County and along the pipeline did not document Cook's lomatium;

- Pacific Connector would avoid using portions of pipe storage yards within 250 feet of high-quality vernal pool habitat, as well as areas with potential vernal pool habitat;
- effects on suitable habitat are likely to be discountable to the point where no meaningful measurement, detection, or evaluation of effect would be possible (i.e., effect would not reach a level where individual plants would be affected);
- sedimentation barriers would be used, as appropriate, to prevent run-off and changes in hydrology;
- conservation measures have been developed to avoid or minimize effects on any plants identified during surveys prior to pipeline construction;
- known sites within the vicinity of the Project are farther than 0.5 mile from pipe storage yards; and
- unsurveyed habitat is low-quality vernal pool habitat located over 0.25 mile from known sites with no apparent hydrologic connectivity.

The Project would have **no effect** on designated Cook's lomatium critical habitat because:

- the pipeline is over 0.5 mile from the nearest critical habitat subunit RV6A; and
- the proposed action is not expected to adversely modify habitat areas that provide buffer protection from adjacent development and weed sources, continuous nonfragmented habitat, and intact hydrology (PBFs 1 and 4).

Kincaid's Lupine (Federally Threatened Species, State Threatened Species)

Kincaid's lupine was listed as federally threatened on January 25, 2000 (FWS 2000b). It is a long-lived perennial herb inhabiting native prairies and foothills (FWS 2000b). In Douglas County, Oregon, it occupies sites that are more shaded, occurring in areas with tree (i.e., Douglas-fir, California black oak, Pacific madrone, ponderosa pine, incense cedar, hairy manzanita, and poison oak) and shrub canopy cover of 50 to 80 percent (FWS 2006f). About 600 acres have been designated as critical habitat for this species; however, all of these designated habitats are located outside of areas that would be disturbed by the Project.

The pipeline is located within known or historical Kincaid's lupine range between MPs 46.8 and 99.3. Multiple populations of lupine have been identified in the Project's botanical analysis area within Douglas County, including 11 sites within 2.5 miles of the pipeline (ORBIC 2017a). Surveys in 2007 identified three populations of Kincaid's lupine in the vicinity of the pipeline: 1) within and adjacent to the construction ROW on private land between approximately MPs 57.84 and 57.92; 2) on private land near MP 59.60 (approximately 300 feet north of MP 59.60; 67 and 222 feet to the north and west of TEWA 59.30-N; and approximately 40 and 85 feet to the south and west of EAR 59.62); and 3) and on private land within the construction ROW and along proposed access roads between MPs 96.48 to 96.90.

Pacific Connector has modified the pipeline route to avoid the population located within the construction ROW between MP 57.84 and MP 57.92. No direct impacts are anticipated to the population near MP 59.60, as plants are located at least 67 feet from pipeline facilities. The two sites, near MP 57.84-57.92 and 59.60, were revisited in 2017, and both populations appeared to be stable or slightly increasing (SBS 2017b).

Pacific Connector also modified the construction ROW between MP 96.48 and 96.90 to avoid direct impacts on the Kincaid's lupine individuals identified during surveys in 2007. Additionally, the population between MP 96.48 and 96.90 was burned during the 2015 Stouts Creek fire. This population was revisited in 2016 to determine the affect of the fire, associated fire-suppression activity, and subsequent logging activities. Kincaid's lupine was observed in only 2 of the original 28 subpopulations documented in the area during surveys in 2007, and no viable plants were observed in the pipeline ROW or within proposed access roads (SBS 2016). Although no plants were relocated along the construction ROW between MP 96.48 and 96.90 in 2016, it is possible that construction of the pipeline and use of access roads could affect this population if plants resprout in this area. Pacific Connector would conduct additional surveys within the Stouts Creek fire area (MP 96.48 to 96.9) prior to ground disturbance.

No additional plants have been documented in other areas of the pipeline route, where access was granted, during subsequent surveys. However, not all suitable habitats within the Project area have been surveyed to date, indicating that additional unknown populations may be present within areas that could be affected by the Project. If other Kincaid's lupine populations are identified during additional surveys, Pacific Connector would implement applicable mitigation measures, such as necking down the construction right-of way, excluding a portion of an identified TEWA or pipe storage yard, and erecting a protective fence or barrier, to avoid or minimize impacts on newly observed populations. Persisting subpopulations at MPs 96.48 to 96.9 would be flagged/fenced to minimize potential disturbance.

The Project could affect unknown populations of Kincaid's lupine within and adjacent to the pipeline ROW. The *Federally-listed Plant Conservation Plan* contains a Kincaid's Lupine Mitigation Plan that specifically addresses mitigation that would be implemented for Kincaid's lupine; however, the FWS may require additional mitigation for these potential impacts as part of their BO (including additional survey, seed collection, and salvage requirements). Below is the determination of effects summary for Kincaid's lupine and critical habitat.

The Project **may affect** Kincaid's lupine because:

- suitable habitat is present within the analysis area; and
- individual plants have been located within the analysis area during survey efforts.

The Project is **likely to adversely affect** Kincaid's lupine because:

- approximately 991.6 acres of potential suitable habitat that has not been surveyed occurs within the botanical analysis area along the pipeline route, which includes 448.7 acres within the pipeline ROW; therefore, it is possible that unidentified plants occur within the construction ROW and workspace;
- surface disturbance and excavation would occur within potentially suitable habitats, and could impact unidentified plants (including in areas where surveys have not been completed);
- indirect effects, including potential changes in hydrology and soil characteristics, alterations to vegetation cover and species composition of associated habitat, and effects from fugitive dust, could impact documented or suspected plants and habitat outside of the construction ROW, but within 30 meters of the Project pipeline and along access roads; and

- trenching activities associated with the pipeline could affect below-ground stems, and the expected effect to extant plants is unknown.

The Project would have **no effect** on Kincaid's lupine critical habitat because:

- the pipeline does not occur within designated Kincaid's lupine critical habitat.

Rough Popcornflower (Federally Endangered Species, State Endangered Species)

The rough popcornflower was federally listed as endangered on January 25, 2000 (FWS 2000c). It is found in seasonal wet meadows or wet prairies in poorly drained clay or silty clay loam soils at elevations ranging from 100 to 900 feet. This plant occurs mostly on private lands in the Umpqua River drainage near Sutherlin and Yoncalla in northern Douglas County (FWS 2003d). As of 2010, there were 14 extant populations of rough popcornflower distributed from Yoncalla Creek near Rice Hill, south to Sutherlin Creek near Wilbur, of which five populations have been introduced (FWS 2010c). Six populations are considered protected and have a documented occupancy of at least 5,000 plants (FWS 2010c).

The closest known occurrences of rough popcornflower to the Project include multiple subpopulations approximately 1.7 miles north of the Winchester pipe storage yard and 17.5 miles north of the pipeline ROW at MP 68 (ORBIC 2017a, 2017c). Surveys for rough popcornflower have been conducted in potential habitat between MPs 51.7 and 67.0. To date, no individuals of rough popcornflower have been documented during surveys. However, Pacific Connector has not been granted access to approximately 99.83 acres of potentially suitable rough popcornflower habitat within the analysis area, the majority of which is associated with the Winchester pipe storage yard.

Due to the potential for the plant to occur within areas of potential habitat that have not been surveyed by Pacific Connector and may be disturbed by construction activities, the Project may affect rough popcornflower. Below is the determination of effects summary for rough popcornflower and critical habitat.

The Project **may affect** rough popcornflower because:

- populations occur near a pipe storage yard; and
- potential suitable habitat might be present within the 98-foot (30-meter) botanical analysis area.

The Project is **not likely to adversely affect** rough popcornflower because:

- where access has been granted, surveys for the Project have not documented individuals of rough popcornflower; surveys in potentially suitable habitat identified within the Winchester pipe storage yard would occur prior to ground-disturbing activities; if plants are identified, Pacific Connector would not use either the pipe storage yard or portions of the yard where plants are documented;
- surveys within potential habitat along the pipeline ROW would occur prior to ground disturbing activities; if any plants are identified, conservation measures developed to avoid or minimize effects on documented plants would be implemented; and
- consultation with the FWS would be reinitiated if this species is found to be present in the area and effects cannot be avoided.

Critical habitat has not been designated for rough popcornflower.

4.6.1.7 Conclusions and Recommendations for Threatened and Endangered Species

Based on informal consultations with the FWS and NMFS, 34 federally listed and proposed species were identified as potentially occurring near the Project. The FERC would only authorize the Project to proceed if the FWS' and NMFS' BOs find the Project, as described, would not jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat. Further, to ensure compliance with the ESA, **we recommend that:**

- **Jordan Cove and Pacific Connector <u>should not begin construction until</u>:**

  a. the Commission staff completes formal consultations with the NMFS and FWS; and

  b. Jordan Cove and Pacific Connector have received written notification from the Director of OEP that construction and/or implementation of conservation measures may begin.

4.6.2 State-Listed Threatened or Endangered Species

In addition to species that are federally threatened or endangered, there are 13 species designated as threatened or endangered by the State of Oregon that could potentially occur in the area affected by the Project (table 4.6.2-1).

TABLE 4.6.2-1

State-Listed Species Potentially Occurring in the Area Affected by the Proposed Project

Species	FWS Status	ODFW Status	Portion of the Project Area Where Species Potentially Occur
Mammals			
Kit fox *Vulpes macrotis*	None	Threatened	Pacific Connector Pipeline
Gray Whale *Eschrichtius robustus* (Eastern North Pacific stock)	Delisted	Endangered	LNG carrier transit in the waterway, Navigation Reliability Improvements Dredge Areas
Birds			
California brown pelican *Pelecanus occidentalis*	None	Endangered	Navigation Reliability Improvements Dredge Areas, Jordan Cove terminal
Plants			
Pink sand verbena *Abronia umbellata* ssp. *Breviflora*	Species of Concern	Endangered	Jordan Cove terminal
Point Reyes bird's-beak *Cordylanthus maritimum* ssp. palustre (*C. maritimus* ssp. *palustris*)	Species of Concern	Endangered	Jordan Cove terminal; Pacific Connector pipeline
Wayside aster *Eucephalis vialis* (*Aster vialis*)	Species of Concern	Threatened	Pacific Connector pipeline
Peck's milk-vetch *Astragalus peckii*	None	Threatened	Pacific Connector pipeline
Pumice grape-fern *Botrychium pumicola*	None	Threatened	Pacific Connector pipeline
Cox's mariposa-lily *Calochortus coxii*	Species of Concern	Endangered	Pacific Connector pipeline
Umpqua mariposa-lily *Calochortus umpquaensis*	Species of Concern	Endangered	Pacific Connector pipeline

TABLE 4.6.2-1

State-Listed Species Potentially Occurring in the Area Affected by the Proposed Project

Species	FWS Status	ODFW Status	Portion of the Project Area Where Species Potentially Occur
Dwarf woolly meadowfoam *Limnanthes pumila ssp. pumila*	Species of Concern	Threatened	Pacific Connector pipeline
Silvery phacelia *Phacelia argentea*	Species of Concern	Threatened	Jordan Cove terminal Pacific Connector pipeline
Wolf's evening primrose *Oenothera wolfii*	None	Threatened	Jordan Cove terminal

4.6.2.1 Mammals

Kit Fox (No ESA Status, State Threatened Species)

The kit fox reaches its northern limit in southern Oregon. In Oregon, it is found in arid desert valleys dominated by halophytic plants like greasewood and shadscale, intermingled with sagebrush. Although the Project may affect suitable kit fox habitat, the expected distribution of this species does not include the Project area. Because kit foxes have not been recently observed within the area affected by the Project (ORBIC 2017a), the Project is not expected to affect this species.

Gray Whale (Eastern North Pacific stock; Federal Delisted Species, State Endangered Species)

The gray whale is a large baleen whale that is distributed in the northern Pacific Ocean in western and eastern stocks. The eastern stock, found along the west coast of North America, was federally delisted on June 16, 1994 (59 FR 115), but remains state endangered in Oregon. The eastern Pacific stock feeds in the summer in the Chukchi Sea, the western Beaufort Sea, and the northern Bering Sea. They migrate south from November through early February to lagoons on the Pacific coast of central and southern Baja California. Northward migration occurs after the calving and breeding season, from early February to May. These whales have the longest known migration of any mammal. Gray whales feed on infaunal benthic species that are buried in sediments (Maser et al. 1981). Gray whales are federally protected under the MMPA.

Potential effects on gray whales include injury and/or mortality due to ship strikes, underwater ship noise, construction noise (including pile driving and dredging) and potential adverse effects from a ship fuel spill at sea. Spills could indirectly affect gray whales by impacting forage species. These potential effects would be similar to the effects on federally listed whales that are discussed above, except that gray whales migrate in coastal waters north and south parallel to the Pacific Coast, making them more susceptible to ship strikes in nearshore waters during migration.

According to the Oregon Parks and Recreation Department (OPRD 2007), gray whales are the most predominant whales seen along the Oregon coast. They migrate twice a year, in winter and spring, and about 200 of them feed along the coast during the summer months. Gray whales have on occasion entered Coos Bay beyond the Jordan Cove LNG Project site and have been seen in Coos Bay at about the same frequency as killer whales. Gray whales may be encountered along the LNG carrier transit route during their southern migration from November through early February or from early February to May during the northern migration. Based on data in Pacific waters between 1999 and 2003, gray whales are struck by ships at a rate of 1.2 whales annually (Angliss and Outlaw 2007). The increase in shipping traffic resulting from LNG carriers could cause an increase in the probability of whales being struck by ships, or of being disturbed during migration. Measures that Jordan Cove would implement to avoid or minimize effects on federally listed whales (see section 4.6.1.1) would serve to avoid or minimize effects on the gray whale.

4.6.2.2 Birds

California Brown Pelican (Federal Delisted Species, State Endangered Species)

The brown pelican was listed as a federally endangered species on June 2, 1970, within California, Oregon, Texas, and Washington states, as well as Central and South America (FWS 1970). It was delisted in December 2009 (FWS 2009c); however, Oregon still considers the brown pelican an endangered species under state law (ODFW 2017h).

The California brown pelican is a primarily coastal species, rarely seen inland or far out at sea (FWS 2005b). They feed mostly in shallow estuarine waters, normally staying within 20 miles of shore (FWS 2005b). Pelicans make extensive use of sand spits, offshore sand bars, and islets for nocturnal roosting and daily loafing, especially by non-breeders and during the non-nesting season (FWS 2005b).

Brown pelicans nest in colonies, mostly on small coastal islands in California (FWS 1985, 2007e). Brown pelicans generally breed between February and October and are most abundant in Oregon during post-breeding migration (FWS 2005b). In Oregon, numbers peak in late August through October and gradually decline from October through early November as birds move south (Gilligan et al. 1994). Since brown pelicans have wettable feathers, they return to land daily to roost and dry their feathers (FWS 2005b). Sand islands within three large estuaries in Oregon and Washington serve as primary night roosts (Jaques and O'Casey 2006 as cited in FWS 2007e). The total number of brown pelicans in Oregon in 2001 was estimated to be 6,095 (Marshall et al. 2003).

Brown pelicans are regularly seen in moderate numbers during the summer months in Coos Bay, and they also occur in small numbers in the winter (Contreras 1998). Coos Bay provides excellent habitat for this species. Brown pelicans were recorded foraging near the Project site more than 500 feet from the shore and loafing across the bay in moderate numbers daily during surveys in October 2012 (SHN 2012). The species was also observed during surveys conducted in 2005-2006 until early September (LBJ 2006). The Project site provides no nesting habitat for the brown pelican. Roosting and feeding sites have been documented within the Project area, although the last observation was in 1985. Roosting was reported on the north side of Coos Bay on a sunken jetty close to the Bay mouth and on a sand spit on the North Spit of Coos Bay, as well as on dredge spoil islands around MPs 3R through 4R (ORBIC 2017a).

In the past, California brown pelicans have been affected by human disturbances at nesting colonies and roosting habitats. Existing nesting and roosting habitats within the Coos Bay Estuary and Jordan Cove LNG Project area have not been documented. If they occur within the estuary during construction and operation of the proposed action, pelicans may be associated with on-shore fish-cleaning stations where they possibly feed on offal (Marshall et al. 2003). Existing fish-cleaning stations are present at the Empire Boat Ramp, Oceanside RV Park and Bastendorff Beach County Park, both in Charleston. Fish-cleaning could also occur at the Charleston Marina, California Street Boat Ramp, and BLM Boat Ramp, though they are not designated as such.

Noise and human activities associated with construction and operation of the Project are likely to be the only direct effect to brown pelicans if they occur within one or more of the Project's analysis areas. Jordan Cove is proposing construction of its access channel in Coos Bay during the ODFW recommended in-water work window between October 1 and February 15. This schedule would minimize effects on brown pelicans because there is a gradual decline in populations in Oregon as birds move south from October through early November (Gilligan et al. 1994). However, noise created by pile driving and construction in general is likely to affect brown pelicans if present and could disrupt brown pelican feeding behavior.

Brown pelicans that forage within the vicinity of the Jordan Cove LNG Project (i.e., the estuarine analysis area) could ingest low levels of contaminants through the food web that are re-suspended from dredging activities. However, sediments at the Jordan Cove LNG Project site and pipeline route within Coos Bay are not expected to contain levels of sediment contaminants that could adversely affect brown pelicans. Access channel dredging and maintenance dredging would not occur during the period of peak pelican abundance in the lower bay. Therefore, dredging activities would not substancially disrupt normal behavior patterns for brown pelicans.

Pacific Connector is proposing construction across Coos Bay using HDD construction in two segments (MP 0.12 to MP 1.11 and MP 1.40 to MP 3.09). It is possible that the brown pelican could be present within Coos Bay and its vicinity during the time of construction (see Contreras 1998). Therefore, noise and human activities associated with construction and operation of the pipeline are likely to affect brown pelicans as sources of disturbance and disruption if they are present and could disrupt brown pelican feeding behavior.

There is some evidence in the literature that high intensity continuous anti-collision lights on structures may result in an increased number of bird strikes, especially at night or during fog and overcast conditions. The number of strikes can apparently be reduced by strobe or blinking the anti-collision lights. The LNG storage tanks would not be illuminated with high intensity lighting. The intensity and number of lights would be limited to what is required for security and operations. With the low-intensity lighting to be used, the likelihood of adverse effects on brown pelicans from collisions with the LNG storage tanks is minimal.

Brown pelicans may be encountered during any portion of the LNG carrier transit route in the waterway. There is no evidence that pelicans are struck by current cargo ships using the Port.

During operation of the Pacific Connector pipeline, aerial inspection of the pipeline route would occur within the permanent ROW. Aerial inspections would generally occur during all times of year, although inspections would not affect nesting or breeding brown pelicans since they do not nest or breed within Coos Bay. Additionally, aerial inspection should not disturb migrating, roosting, or foraging brown pelicans since air traffic is a constant disturbance within Coos Bay from the existing North Bend airport.

The proposed action would create auditory and visual disturbances that are likely to cause foraging brown pelicans to temporarily avoid areas of high activity. The proposed action area does not contain existing nesting or roosting habitat and would not affect nesting or roosting individuals. As a result, the proposed action would temporarily affect foraging individuals but is not expected to affect nesting or roosting by brown pelicans

4.6.2.3 Plants

Pink Sand Verbena (Federal Species of Concern, State Endangered Species)

The historical range of pink sand verbena (*Abronia umbellata* ssp. *breviflora*) was from northern California to Vancouver British Columbia, Canada (ODA 2017c). Its present range is along coastal beach and foredune, predominantly from Cape Blanco (Curry County), southern Oregon to Point Reyes National Seashore in Marin County, California and sporadically along Oregon's northern and central coast. Pink sand verbena only inhabits the littoral sandy beach areas and unstabilized sand dunes of the coastal strip and usually occurs on beaches in fine sand between the high-tide line and the driftwood zone, and in areas of active sand movement below the foredune (ORBIC 2010). In the northern portion of its range, most populations of pink sand verbena occur on broad beaches and/or near the mouths of creeks and rivers.

Of the 12 reported occurrences in Oregon, only 2 have more than 50 plants; many of the populations consist of only one plant and will probably not persist. Two populations of pink sand verbena documented near the mouth of Coos Bay, contained approximately 300,000 plants when surveyd in 2012 (ORBIC 2017a). Approximately 15 miles north of the entrance to Coos Bay, 19 plants were documented in 1995 within a protected (public entry prohibited) snowy plover nesting area (ORBIC 2012). There are no known occurrences of pink sand verbena within two miles of the Jordan Cove Project area (ORBIC 2017a). No pink sand verbena plants have been reported within the Pacific Connector pipeline area (ORBIC 2006a) and the pipeline route would not affect coastal sand dune habitat; therefore, Pacific Connector has not conducted botanical surveys for this species and no incidental documentations of this species has occurred.

Jordan Cove identified suitable habitat for the plant along the eastern portion of the LNG terminal in areas of actively moving dunes and European beachgrass. However, surveys conducted at the Jordan Cove Project area in 2006, 2012, and 2013 did not locate any pink sand verbena plants (SHN 2006b, 2013c). As surveys conducted within the Jordan Cove Project area, as well as historic data, indicate that pink sand verbena is not present within the Project area, the Project is not expected to affect this species.

Point Reyes Bird's-beak (Federal Species of Concern, State Endangered Species)

Point Reyes bird's-beak (*Cordylanthus maritimum* ssp. *palustre* [*C. maritimus* ssp. *palustris*]) inhabits salt marshes along the coast, sometimes growing just above tidewater in wet areas. Its habitat requirements are specific: approximately 7.5 to 8.5 feet (2.28 to 2.59 meters) above mean lower low water, soil salinity of 34 to 55 parts per thousand, sandy substrate covered by 1 to 10 cm (0.39 to 3.93 inches) organic silt, and less than 30 percent bare soil in summer. Point Reyes bird's-beak occurs along the Pacific Coast from Tillamook County, Oregon, south to Santa Clara County, California. In Oregon, the species is restricted to Netarts Bay, Yaquina Bay, and Coos Bay, with most known occurrences located in Coos Bay. Within the counties crossed by the Project, Point Reyes bird's-beak is found in Coos County.

Several occurrences of Point Reyes bird's-beak are near both the Jordan Cove LNG Project and the Pacific Connector Pipeline Project. Populations with 1,000 to 10,000 plants are located along the margins of Coos Bay and on sand salt marshes near the edge of high water marks (ORBIC 2017a). Several occurrences of Point Reyes bird's-beak are near the Jordan Cove LNG Project, and this species is known to occur within the intertidal wetland between APCO Sites 1 and 2;

however, there is no suitable habitat on APCO Site 2 as this area is dominated by upland vegetation. This species also occurs outside the LNG terminal area along the west and southeast shoreline of the South Dunes site (ORBIC 2017a) and potential habitat for this species has also been observed along the shoreline south of the South Dunes site. Jordan Cove would conduct an additional survey in this area of potential habitat prior to construction.

The area affected by the Pacific Connector Pipeline Project is within the vicinity of documented populations of Point Reyes bird's-beak and the pipeline route would cross suitable habitat. Populations with 1,000 to 10,000 plants were located in 1982 and 1999 along the margins of Coos Bay approximately 260 feet south of TEWA 0.10 (HDD pull-back) and on sand salt marshes near the edge of high water marks on the west side of Haynes Inlet approximately 815 feet north of the Jordan Cove Meter Station near the proposed HDD across Coos Bay (ORBIC 2017a). These plants are farther than 100 feet from the pipeline route and should not be affected by construction. Surveys conducted for Pacific Connector in 2007 located one population of about 1,000 Point Reye's bird's-beak plants approximately 1.7 miles south of MP 1.7 (FERC 2009). Additional surveys occurred in 2017 along the pipeline route near MPs 0.3, 1.0, and 1.47 near the edge of high water marks where the pipeline HDD exits and enters land. Approximately 30 Point Reyes bird's beak plants were located at the margin of Coos Bay near MP 0.9, approximately 475 feet northwest of the construction right-of way and 700 feet west/northwest of TEWAs 1.09-N and 1.09-W. This portion of the pipeline would be constructed by HDD and should not affect plants observed at this location.

Point Reyes bird's-beak is found within and near the Jordan Cove and Pacific Connector Project areas; however, construction of the Project should not directly affect individual plants. Additionally, Pacific Connector has committed to protecting plants adjacent to the pipeline construction ROW through the appropriate installation of safety and silt fence as determined by Pacific Connector's EIs.

Wayside Aster (Federal Species of Concern, State Threatened Species)

The wayside aster's (*Eucephalis* [*Aster*] *vialis*) range is limited to central, southern, and western Oregon and the northern California state line (ORBIC 2010). About 100 populations are known, totaling fewer than 9,000 individuals. Most populations are centered in the southern Willamette Valley of Lane County or in southern Jackson and Josephine Counties, although a few populations exist in the adjacent counties of California (ORBIC 2010). None of the known populations are protected, and many populations are along roadsides and in areas of residential development. Wayside aster occurs in areas of natural and man-made disturbance, edges and openings in woodlands and forests, in second and old-growth, and in shaded roadsides.

Several populations of wayside aster plants have recently been documented within Douglas and Jackson Counties; however, except for one site discussed below, these records are more than 0.5 mile from the Pacific Connector Project area. Botanical surveys for this species in potential habitat have been conducted by Pacific Connector in Coos Bay, Roseburg, and Medford BLM Districts; Umpqua National Forest; and Jackson County. This species was documented in 2007 adjacent to a previously proposed existing access road that would require improvements; however, this road is no longer proposed for use as an access road. This site was revisited in 2009 and additional surveys were conducted within 0.25 mile of this site; however, no plants were located.

Although the species is documented near the Project, surveys conducted by Pacific Connector for the wayside aster did not detect this plant's presence. Construction of the pipeline, including the use of access roads, is not anticipated to affect this species.

Peck's Milk-vetch (Federal Species of Concern, State Threatened Species)

Peck's milk-vetch (*Astragalus peckii*) occurs east of the Cascades Mountain range. Most populations of Peck's milk-vetch are centered in three separate areas: one in north-central Deschutes County, another in north-central Klamath County, and the third in south-central Klamath County. These populations total about 300,000 individuals. The plant occurs in very dry sites, on loose, sandy soil or pumice, often in or along dry water courses, in sagebrush or rabbitbrush openings in ponderosa pine forests (in the south) or in western Juniper woodlands (in the north), and occasionally on barren flats.

Peck's milk-vetch has not been documented within the vicinity of the Project (ORBIC 2006a). No suitable habitat for Peck's milk-vetch occurs within the areas crossed by the pipeline route; therefore, Pacific Connector did not conduct botanical surveys for this species. As this species is not expected to occur along the pipeline route, it would probably not be affected by construction and operation of the Project.

Pumice Grape-Fern (No ESA Status, State Threatened Species)

This species is one of the rarest grape-ferns, and in Oregon is found only within the Crater Lake area and Paulina Mountains in Deschutes and Klamath Counties. Most known populations are found in fine pumice gravel at elevations above 7,800 feet (2,400 meters). It has also been located within frost pockets in lodgepole pine forests with bitterbrush, in areas with deep, sterile pumice. In Oregon, pumice grape-fern *(Botrychium pumicola*) is typically associated with Brewer's sedge and buckwheat (*Eriogonum* spp.) species (Eastman 1990; ORBIC 2010).

The Project is not located near known sites of this plant, and no suitable habitat for this plant occurs within the areas crossed by the pipeline route; therefore, Pacific Connector did not conduct botanical surveys for this species. As the pumice grape-fern is not expected to occur along the pipeline route, the Project would probably have no effect on this species.

Cox's Mariposa Lily (Federal Species of Concern, State Endangered Species)

The Cox's mariposa lily (*Calochortus coxii*) is endemic to serpentine and ultramafic soils and is limited to a small area (30 square meters) along a 10-mile serpentine ridge system in Douglas County, Oregon. All known populations are on serpentine soils, mostly on shady, north-facing, mesic sites near ridgelines, typically, growing in serpentine grasslands and forest margins. Population monitoring studies on BLM land from 2011 through 2015 demonstrated relatively high interannual variation in population estimates for Cox's mariposa lily. For example, 6,966 plants were observed in 2011, whereas 13,865 individuals were observed in 2012 (Gray and Bahm 2015). Populations are also known to occur on private lands; however, surveys haven't been conducted on private lands since the early 1990s (ORBIC 2017a; Aaron Roe, Botanist Roseburg BLM District, personal communication, February 1, 2019). Threats to this species include fire exclusion, encroachment by conifers, noxious weed invasion, logging, grazing, road construction, and off-highway vehicle recreational use (Gray and Bahm 2015; BLM and FWS 2004).

Based on existing data, the Pacific Connector pipeline route would cross one population between MP 74.1 and 75.0 on lands administered by the BLM Roseburg District (ORBIC 2017a). In 2012, surveys conducted by the BLM documented approximately 1,300 plants within and adjacent (within 100 meters) to the Project, with approximately 300 plants occurring in the construction ROW (BLM 2017c). However, modifications have been made to the pipeline route subsequent to these surveys. In 2018, surveys for Cox's mariposa lily were conducted during the flowering season on approximately 65 acres between MPs 74 and 75 of the revised pipeline route. The 2018 survey data are currently under review by the BLM. Additionally, there are approximately 45.3 acres of potential suitable Cox's mariposa lily habitat on private lands within the pipeline route that have not been surveyed.

Individuals of Cox's mariposa lily occur along the pipeline route; therefore, construction and operation of the Project would directly and indirectly affect this species and this species' habitat. In addition to the direct removal of individuals, construction of the pipeline would fragment approximately 0.9 mile of of suitable Cox's mariposa lily habitat. Potential indirect effects to documented or suspected plants and habitat include potential changes in hydrology and soil characteristics, alterations to vegetation cover and species composition of associated habitat, and effects from fugitive dust.

Pacific Connector has developed a Cox's mariposa lily specific mitigation plan (included as an attachment to the *Federally-Listed Plant Conservation Plan*[141]) to avoid and minimize potential effects on this species. As described in the mitigation plan, Pacific Connector would determine if site-specific neck-downs can be incorporated into the construction ROW to minimize direct effects on the population of Cox's mariposa lily between MPs 74 and 75. The construction ROW in this area utilizes the typical 95-foot width with TEWAs because of the steep and narrow ridgeline alignment; thus, neck-downs would be dependent on site-specific conditions and would be based on species presence and the work area requirements to ensure safe pipeline installation. Appropriate barriers would be installed along areas that contain this species to ensure that the mariposa lily populations in the vicinity are not affected by sediments and debris from the ROW. In locations where individual plants cannot be avoided by construction activities, plants would be salvaged during the late summer or fall after the growing season of the year preceding actual pipeline construction. Additional mitigation techniques that would be employed to protect these populations of Cox's mariposa lily include seed collection and bulb salvage, and site restoration and monitoring. However, there has not been any research on the effectiveness of seed collection and bulb salvage as mitigation techniques for this species. Based on comments provided by the BLM, the BLM may require additional mitigation measures for the Cox's mariposa lily as part of their review of the ROW application.

Umpqua Mariposa Lily (Federal Species of Concern, State Endangered Species)

The Umpqua mariposa lily (*Calochortus umpquaensis*) is known to occur within 17 localities; none of which are protected. This plant grows in both forests and meadows on serpentine soils at elevations below 2,500 feet, but it is the most vigorous in margins between forests and meadows. In southwestern Oregon, it is associated with a diverse array of plants, and it is found in diverse soils, aspects, and slopes.

[141] Appendix J to Pacific Connector's POD filed with the FERC in January 2018.

Several large populations of this plant (5,000 to 60,000-plus) have previously been documented approximately 1.3 and 2.5 miles east of the pipeline alignment near MP 99.55, adjacent to the Green Butte (EAR 102.30) and Callahan Creek (EAR 104.24) access roads. Pacific Connector conducted botanical surveys for this species between 2007 and 2017 in potential habitat within the vicinity[142] of the pipeline in lands administered by the Roseburg BLM District and Umpqua National Forest. In 2016, seven plants were observed adjacent to EAR 102.3 and 25 feet east of the Hatchet Quarry MP 102.3 Rock Source/Disposal Site near a previously (1992) documented population. Additionally, potential suitable habitat would also be crossed by the pipeline near the site where Cox's mariposa-lily was documented (MPs 74.08 to 75.02), although no individuals of Umpqua mariposa lily were observed during surveys conducted for the pipeline in this location.

Although, Umpqua mariposa lily individuals have been documented adjacent to EARs 102.30 and 104.24, no road improvements are necessary. Additionally, plants are separated from the access roads by topography and/or Callahan Creek; therefore, it is not expected that use of the existing access roads would directly or indirectly affect these populations. The population along EAR 102.30 and 25 feet east of the Hatchet Quarry MP 102.3 Rock Source/Disposal Site may be indirectly affected by the Pacific Connector Project; however, construction of the Project should not directly affect individual plants. Additionally, Pacific Connector has committed to protecting plants adjacent to the pipeline construction ROW through the appropriate installation of safety and silt fence as determined by Pacific Connector's EIs.

Dwarf Woolly Meadowfoam (Federal Species of Concern, State Threatened Species)

Dwarf woolly meadowfoam's (*Limnanthes pumila* ssp. *pumila*) range is restricted to two small protected areas, totaling about 2 square miles with at least 10,000 individuals (ORBIC 2010). Dwarf woolly meadowfoam inhabits small depressions in thin clay soil overlying old basalt at the edges of deep vernal pools, which are dry by mid-summer and generally exposed to full sunlight. The only known occurrences are on Table Rock in Jackson County (on Lower and Upper Table Rocks); which is over 12 miles southwest of the Pacific Connector pipeline and 1.4 to 2.4 miles north of four proposed Jackson County pipe storage yards (ORBIC 2006a).

Because the dwarf woolly meadowfoam is endemic to vernal pools at Table Rocks, Pacific Connector did not conduct botanical surveys for this species. Additionally, this species was not documented incidentally during survey efforts for other vernal pool–associated species conducted for the Project. As this species is not expected to occur along the pipeline route, it would probably not be directly affected by construction and operation of the Project.

Silvery Phacelia (Federal Species of Concern, State Threatened Species)

The silvery phacelia (*Phacelia argentea*) is known from 24 occurrences, totaling 15,000 individuals, along the coastline of Coos and Curry Counties and in adjacent northern California, Del Norte County (ORBIC 2010). In March 2015, a petition was submitted to the FWS to list the silvery phacelia as a threatened or endangered species (FWS 2015a); however, the petition was denied in 2015 due to lack of substantial information that this species was a listable entity (FWS 2015b). Silvery phacelia is the only phacelia growing along the coastline in open sand or on dunes

[142] Provided in Pacific Connector's Initial Response to the FERC staff's Environmental Information Request dated January 3, 2018, filed with the FERC on January 23, 2018.

along the south coast of Oregon. It inhabits sandy beach dunes and bluffs near the coast, and some partially-stabilized or unstabilized dunes.

Silvery phacelia has not been documented in the vicinity of the Project and the closest known plants are located more than 10 miles south of the entrance to the Coos Bay Estuary (ORBIC 2017a); however, suitable habitat for this species does exist at the LNG terminal area, in regions of active and semi-active dunes where the European beachgrass and the red fescue-salt rush herbaceous vegetation associations occur (see section 4.4 of this EIS). There is marginal habitat at the APCO Site and the meteorological station, although the European beachgrass in these areas is generally too dense to support this species. Surveys conducted by Jordan Cove have not detected this species (SHN 2006b, 2012) and, due to the lack of suitable habitat, botanical surveys for this species were not conducted along the pipeline route. Based on the lack of occurrences (from both historical data as well as surveys), it is not expected that the Project would affect this species.

Wolf's Evening Primrose (No ESA Status, State Threatened Species)

Wolf's evening primrose (*Oenothera wolfii*) occurs in well-drained sandy soils with adequate moisture in coastal bluff scrub, coastal prairie, roadsides, and coastal dune habitats from Curry County in southern Oregon to the northern California coast (Tibor 2001). This species is associated with a high disturbance regime and several occurrences in California are located along roadsides with sandy soil (CNDDB 2005 as cited in FERC 2015). Wolf's evening primrose is typically associated with low elevation coastal habitats, but there have been reported occurrences in lower montane coniferous forest in California, at elevations greater than 2,500 feet (Tibor 2001).

The closest known occurrence of Wolf's evening primrose to the Project is in Port Orford, Oregon, approximately 60 miles to the south of the Jordan Cove LNG terminal site; however, suitable habitat for this species is present at the LNG terminal site. There is marginal habitat at the APCO Site and the meteorological station, although the European beachgrass in these areas is generally too dense to support this species. Surveys conducted at the LNG terminal site did not detect the Wolf's evening primrose (SHN 2006b, 2012). Considering the lack of occurrences (based on historic and recent survey data), it is not expected that the Project would affect this species.

4.6.3 Other Special Status Species

In addition to the federal and state threatened, endangered, and proposed species described above, there are species that have been given special status designations by federal or state agencies and Indian tribes that could potentially occur in the Project area (see tables I-3, I-4, and I-5 in appendix I). The FWS and NMFS maintain a list of federal species of concern, which are species whose conservation standing is of concern but for which status information is still needed. The ODFW also assigns special status to fish and wildlife species that are not listed. State special status designations include sensitive and sensitive-critical (ORBIC 2016). Sensitive refers to fish and wildlife that are facing one or more threats to their populations and/or habitats. Species or taxa with a sensitive-critical subdesignation are sensitive species of particular conservation concern. Sensitive-critical species have current or legacy threats that are impacting their abundance, distribution, diversity, and/or habitat. They may decline to the point of qualifying for threatened or endangered status if conservation actions are not taken.

In addition to the threatened and endangered plant species described above, ODA designates candidate species for listing. ODA candidate species include any plant species designated for study by the director of ODA whose numbers are believed low or declining, or whose habitat is sufficiently threatened and declining in quantity and quality, so as to potentially qualify for listing as a threatened or endangered species in the foreseeable future (ODA 2017d).

4.6.3.1 U.S. Fish and Wildlife Service and National Marine Fisheries Service

The FWS (2006d, 2006e, 2013h, 2017c) and NMFS (2006) list 69 fish and wildlife species of concern that potentially occur in counties coinciding with the Project. The list of federal species of concern includes 14 mammals, 20 birds, 3 reptiles, 10 amphibians, 10 fish, and 12 invertebrates. These species, and expected habitat for each species, are listed in tables I-3 and I-4 in appendix I of this EIS. The FWS has noted that the Umpqua chub may be present in the Umpqua River, and this species is of concern because it has rapidly decreased in abundance. This species is discussed in detail in the BE (see appendix F.7 of this EIS).

The FWS lists one plant species as a federal candidate for listing, and 52 federal plant species of concern that potentially occur in counties coinciding with the Project. These species are listed in table I-5 in appendix I of this EIS, along with expected habitat for each species.

4.6.3.2 Oregon Department of Fish and Wildlife

The ODFW (2016) identified 71 state sensitive species that potentially occur in counties coinciding with the Project area, some of which (i.e., 37) are also considered federal species of concern. This list includes 15 mammals, 28 birds, 13 fish, 2 reptiles, and 13 amphibians. The ODFW does not assign special status for invertebrates. Tables I-3 and I-4 in appendix I provide the following information for each state special status species: expected habitat and documentation within each county, BLM district, and National Forest crossed by the Pacific Connector pipeline and vicinity.

Although the state sensitive species listed in tables I-3 and I-4 may occur in counties noted by FWS (2006d, 2006e) and ODFW (ORBIC 2006a, 2012), distributions and/or habitat associations of some preclude their potential occurrence in the area that would be affected by the Project.

4.6.3.3 Oregon Department of Agriculture

The ODA identified 41 candidates for listing that potentially occur in counties coinciding with the Project area, 26 of which are also federal species of concern. Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project effects on these special status species as a result of the Project are presented in table I-5 in appendix I.

4.6.3.4 Tribal Species of Concern

The CIT identified the following plant and animal species as species of concern. According to the CIT, this list is not comprehensive, but does represent the most significant and important traditional cultural plant and animal species that are found on the Coquille Forest and other Tribal lands. A more complete list and description of plant usage can be found in "Ethnobotany of the Coquille Indians". Significant and important plants include, but are not limited to:

- Trees (bark and wood): Port Orford cedar, western red cedar, Sitka spruce, big leaf maple, myrtle, red alder, madrone, Pacific yew.

- Shrubs (wood, nuts and berries): elderberry (*Sambucus* spp.), willows, hazel, vine maple, rhododendron, azalea (*Rhododendron* spp.), manzanita, ocean spray, Labrador tea (*Ledum* spp.), huckleberry, salal, thimbleberry, salmonberry, Oregon grape.
- Flowers and vines (roots and fiber): yarrow (*Achillea millefolium*), camas (*Camassia*), tiger lily (*Lilium columbianum*), columbine (*Aquilegia* spp.), various *Lomatium* and *Brodiaeas*, iris (*Iris* spp.), trailing blackberry (*Rubus ursinus*), yerba buena (*Clinopodium douglasii*), beargrass (*Xerophyllum tenax*).
- Wet Meadow/Riparian Plants: cattail, tule (*Schoenoplectus* spp.), various sedges and ferns, skunk cabbage, various mosses.
- Marine/Estuary: eelgrass, giant kelp (*Macrocystis* spp.), bull kelp (*Nereocystis luetkeana*), sea lettuce (*Ulva* spp.), surfgrass (*Phyllospadix* spp.).

Impacts on these species would be similar to the impacts on vegetation described in section 4.4. Project effects on the wetland and estuary species of traditional-cultural importance would be as described for wetlands and waters in section 4.3. Species that are protected by federal and/or state jurisdictions (e.g., various sedges) are also addressed elsewhere in this section and in appendix I.5.

The following list of mammals, bird, and fish is also not comprehensive, but does represent many of the CIT's species of concern:

- Terrestrial: deer, elk, coyote, cougar, bear, bobcat, raccoon, beaver, squirrel.
- Marine/ Estuary: lamprey, salmon (all available species), shellfish, crab, sea mammals, rockfish, lingcod, sculpin, halibut, flounder, perch, herring, greenling, candlefish (i.e., eulachon), snails, mussels, barnacles, chiton, sea urchin, abalone (*Haliotis spp*.), dentalium (*Dentalium spp*.) (other seasonally available estuary species).
- Streams: salmon (all available species), lamprey, sturgeon, trout, mussels.
- Birds: Eagles, hawks, owls, cormorant, kingfisher, herons, osprey, flicker (*Colaptes auratus*), woodpeckers (particularly pileated), grebe, crows and ravens, and colorful neo-tropicals.

Impacts on these species would be similar to the impacts on wildlife and aquatic resources described in section 4.5. Species that are protected by federal and/or state jurisdictions (e.g., owls) are also addressed elsewhere in this section and in appendix I.3.

4.6.3.5 Assessment of Other Special Status Species

Of the other special status species identified above as potentially occuring in counties coinciding with the Project, only a subset have the potential to be affected by the Project. Table 4.6.3.5-1 identifies the number of these other special status mammals, birds, fish, amphibians, reptiles, invertebrates, and vascular plants potentially affected by the Project. For species that are also BLM and Forest Service sensitive species or the Forest Service's Survey and Manage species, occurrence and potential effects on federal lands are also described below in section 4.6.4, Environmental Consequences on Federal Lands.

TABLE 4.6.3.5-1

Numbers of Other Special Status Species Potentially Affected by the Project a/

	Federal Status	State Status	
Taxonomic Group	**FWS or NMFS Species of Concern**	**ODFW Sensitive or ODA Candidate**	**Total b/**
Mammals	12	12	16
Birds	19	24	31
Non-anadromous Fish	4	4	5
Anadromous Fish	3	5	7
Amphibians and Reptiles	7	9	9
Aquatic Invertebrates	3	N/A	3
Terrestrial Invertebrates	1	N/A	1
Vascular Plants	2	2	2

Sources: FWS (2006d, 2006e, 2017c), NMFS (2006d), ORBIC (2006a, 2006b, 2017a), ODFW 2016b.

a/ Other Special Status Species include FWS and NMFS fish, wildlife, and plant species of concern and candidate species, ODFW Sensitive fish and wildlife species, and ODA candidate species for listing. Forest Service sensitive and Survey and Manage species and BLM sensitive species are only tallied here if they meet this criteria for Other Special Status Species. Species are not tallied here if they are also federal or state listed or proposed.

b/ Rows do not sum because a species is tallied in multiple columns where it is considered special status by multiple agencies.

Descriptions of expected habitat, documented or suspected occurrences, and potential Project effects on these other special status species within the Project area are presented in tables I-3, I-4, and I-5, respectively, in appendix I. Additionally, effects on these species and proposed measures to minimize effects would be similar to the those described for general fish and wildlife in section 4.5 of this EIS.

4.6.4 Environmental Consequences on Federal Lands

The BLM and Forest Service maintain lists of sensitive species to ensure that their actions do not contribute to or cause a trend toward listing under the ESA. Additionally, until 2016, the BLM and Forest Service maintained a list of Survey and Manage species, or species that are rare and uncommon or poorly understood that are closely associated with late successional or old-growth forests within the range of the NSO (Forest Service and BLM 2001a). In August 2016, the BLM issued two RODs for two new RMPs (BLM 2016a and 2016b). These two plans supersede the NWFP on BLM lands, and eliminated requirements to survey and manage for species included on the 2001 ROD Survey and Manage species list on BLM lands. Potential effects on Survey and Manage species on NFS lands are discussed here.

Species that are on both the sensitive list and the Survey and Manage list are discussed on NFS land under section 4.6.4.3, Survey and Manage Species. Additionally, although the Forest Service and BLM include federal and state threatened, endangered, proposed, and candidate species on their species lists, these species are not discussed in this section as they are presented above.

4.6.4.1 Description of BLM and Forest Service Sensitive Species

The BLM maintains a list of Special Status Species (including BLM sensitive species) as required by BLM 6840, Special Status Species Manual, to ensure that BLM actions do not contribute to a loss of viability or cause a trend toward listing under the ESA. Like the BLM, the Forest Service is required by Forest Service Manual (FSM) 2760 to maintain a list of sensitive species for each region, including species listed as federally threatened, endangered, or proposed under the ESA, as well as species that are threatened by human activities. Activities on NFS lands must be managed to ensure that current federally listed species do not become extirpated or that activities do not result in ESA listing for other sensitive species. As required in FSM 2760, the Forest Service is obligated to evaluate Project effects on sensitive species in a BE (see appendix F.7).

The Pacific Northwest Regional Office of the Forest Service and Oregon/Washington State Office of the BLM established an interagency program for the conservation and management of special status species. New criteria for BLM Special Status Species and Forest Service Sensitive Species were jointly approved in 2015 by the Region 6 Regional Forester and BLM Oregon/Washington State Director for determination of species included within the BLM and Forest Service Sensitive Species Program. The new criteria were designed to make the BLM and Forest Service more consistent in their approaches to the development of lists of species with conservation concerns. The BLM (2015) and Forest Service (Forest Service 2015) identify federally listed, federally proposed, and sensitive species required under their respective policies. Additionally, they have identified "strategic species" that are not considered sensitive under those policies. Strategic species include species with information gaps (e.g., distribution, habitat, threats, taxonomy) that are suspected to occur on NFS or BLM lands.

According to Instruction Memorandum No. OR-2015-028, sensitive species are those that are documented or suspected endangered or threatened at the federal or state level, federal de-listed species, are Oregon Heritage List 1 or List 2, and have been documented on at least one Oregon BLM district. These species should be managed to ensure that activities on BLM lands do not contribute to their listing.

Strategic species are not classified as Special Status for management purposes. The only requirement for this group of species is to record sites found during any survey efforts. Therefore, strategic species are not discussed in this section unless observed during surveys.

Table 4.6.4.1-1 lists the BLM and Forest Service sensitive species documented or suspected to occur within the districts and forests crossed by the Pacific Connector pipeline (BLM 2015; Forest Service 2015).

Not all species documented or suspected in BLM districts and national forests crossed by the Project occur within the area affected by the Project. Many were excluded from consideration after review of range and habitat information. Other species were excluded if they were not known to occur in the Project vicinity based on special status species locations within 3 miles of the Project obtained from the BLM Geographic Biotic Observations (GeoBOB) database and Forest Service Natural Resource Information System (NRIS) database (BLM 2006a, 2012, 2017a; Forest Service 2006, 2012, 2017c; NSR 2012), and through ORBIC data requests (ORBIC 2006a, 2012, 2017a).

TABLE 4.6.4.1-1

Numbers of BLM and Forest Service Sensitive Species within the Four BLM Districts and Three National Forests Crossed by the Proposed Pacific Connector Pipeline a/

Taxonomic Group	Number in BLM Districts				Number in National Forests		
	Coos Bay	Roseburg	Medford	Lakeview	Umpqua	Rogue River-Siskiyou	Fremont-Winema
Mammals	4	5	4	6	5	6	5
Birds	8	7	9	13	11	9	12
Reptiles	1	1	1	1	1	1	1
Amphibians	1	1	3	2	1	3	2
Non-anadromous Fish	1	1	2	10	2	0	10
Anadromous Fish	5	3	4	0	3	4	0
Invertebrates	14	10	16	7	14	21	21
Fungi	13	12	14	0	11	16	4
Non-vascular Plants	34	17	18	5	26	27	12
Vascular Plants	35	36	91	44	31	99	49

Note: A species is tallied in multiple columns where it occurs and is sensitive on multiple BLM Districts or National Forests.
a/ Source: BLM 2015; Forest Service 2015

Pacific Connector conducted surveys from 2007 through 2018 for special status species, including BLM and Forest Service sensitive species. Special status mollusks, fungi, and vascular and non-vascular plants not detected during these complete, targeted surveys were determined to not be present, and thus not affected by the Project. Forest Service and BLM sensitive species that are documented or suspected to occur on BLM districts and/or national forests crossed by the Project, but were dropped from further consideration due to a lack of habitat or because they were not detected during targeted field surveys are listed in tables I-3, I-4, and I-5 in appendix I. Information provided for each of these species in appendix I includes expected habitat, county, national forest, and BLM district distribution, known occurrences in relation to the Project, and effects determination and rationale for this determination.

BLM and Forest Service sensitive species that may be affected by the Project are listed below in table 4.6.4.1-2, excluding the state and federally listed, proposed, and candidate species discussed above, and the Survey and Manage species on NFS land discussed below. Where suitable habitat was documented for a species, but species-specific surveys were not conducted, presence was assumed, and potential effects on these species are discussed here.

TABLE 4.6.4.1-2

BLM and Forest Service Sensitive Species with the Potential to be Affected by the Project a/

Common Name	Scientific Name	Forest Service Sensitive	BLM Sensitive
Mammals			
Pallid bat	*Antrozous pallidus*	X	X
Townsend's big-eared bat	*Corynorhinus townsendii*	X	X
Fringed myotis	*Myotis thysanodes*	X	X
Pacific marten	*Martes caurina*	X	X
Pacific fisher	*Pekania pennanti*	X	X
Birds			
Grasshopper sparrow	*Ammodramus savannarum*	X	
Red-necked grebe	*Podiceps grisegena*	X	X
Horned grebe	*Podiceps auritus*	X	X
American white pelican	*Pelecanus erythrorhynchos*	X	X
Snowy egret	*Egretta thula*		X
Aleutian Canada goose	*Branta canadadnsis leucopareia*		X
Harlequin duck	*Histrionicus histrionicus*	X	X

TABLE 4.6.4.1-2 (continued)

BLM and Forest Service Sensitive Species with the Potential to be Affected by the Project a/

Common Name	Scientific Name	Forest Service Sensitive	BLM Sensitive
Bufflehead	*Bucephala albeola*	X	
Franklin's gull	*Larus pipixcan*		X
White-tailed kite	*Elanus leucurus*	X	X
Upland sandpiper	*Bartramia longicauda*	X	
Bald eagle	*Haliaeetus leucocephalus*	X	X
American peregrine falcon	*Falco peregrinus anatum*	X	X
Greater sage-grouse	*Centrocercus urophasianus*	X	X
White-headed woodpecker	*Picoides albolarvatus*	X	X
Lewis' woodpecker	*Melanerpes lewis*	X	X
Purple martin	*Progne subis*	X	X
Oregon vesper sparrow	*Pooecetes gramineus affinis*		X
Tricolored blackbird	*Agelaius tricolor*	X	X
Reptiles			
Western pond turtle (formerly Pacific pond turtle)	*Actinemys marmorata*	X	X
Amphibians			
Foothill yellow-legged frog	*Rana boylii*	X	X
Terrestrial Invertebrates			
Oregon shoulderband	*Helminthoglypta hertleini*	X (also Survey and Manage)	X
Traveling sideband	*Monadenia fidelis celeuthia*	X	X
Siskiyou hesperian	*Vespericola sierranas*	X	X
Franklin's bumblebee	*Bombus franklini*	X	X
Western bumblebee	*Bombus occidentalis*	X	X
Siskiyou short-horned grasshopper	*Chloealtis aspasma*	X	X
Gray-blue butterfly	*Plebejus podarce*	X	X
Johnson's hairstreak	*Callophrys johnsoni (Mitoura johnsoni)*	X	X
Insular blue butterfly	*Plebejus saepiolus littoralis*	X	X
Mardon skipper	*Polites mardon*	X	X
Coronis fritillary	*Speyeria coronis coronis*	X	X
Aquatic Invertebrates			
Western ridgemussel	*Gonidea angulata*	X	X
California floater	*Anodonta californiensis*	X	X
A caddisfly (no common name)	*Namamyia plutonis*	X	X
Montane Peaclam	*Pisidium ulttramontanum*	X	X
Pacific walker	*Pomatiopsis californica*	X	X
Archimedes springsnail	*Pyrgulopsis archimedis*	X	
A caddisfly (no common name)	*Rhyacophila chandleri*	X	X
Lined ramshorn	*Vorticifex effusa diagonalis*	X	X
caddisfly (no common name)	*Rhyacophila leechi*		X
Non-anadramous Fish			
Umpqua chub	*Oregonichthys kalawatseti*	X	X
Millicoma dace	*Rhinichthys catarctae* ssp.		X
Anadramous Fish			
Pacific lamprey	*Entosphenus tridentata*	X	X
Chinook Salmon Southern Oregon Coast/California Coast ESU, Fall-run, Spring-run	*Oncorhynchus tshawytscha*	X	X
Steelhead Klamath Mountains Province ESU Summer/winter run	*Oncorynchus mykiss*	X	X
Steelhead Oregon Coast ESU	*Oncorynchus mykiss*	X	X

TABLE 4.6.4.1-2 (continued)

BLM and Forest Service Sensitive Species with the Potential to be Affected by the Project a/

Common Name	Scientific Name	Forest Service Sensitive	BLM Sensitive
Vascular Plants			
Rogue Canyon rockcress	*Arabis modesta*	X	X
Bensonia	*Bensoniella oregana*	X	X
Bristly sedge	*Carex comosa*	X	X
Coastal lip-fern	*Cheilanthes intertexta*	X	X
Pine woods cryptantha	*Cryptantha simulans*	X	
California globe-mallow	*Iliamna latibracteata*	X	X
Bellinger's meadowfoam	*Limnanthes floccosa* ssp. *bellingeriana*	X	X
Lichens			
no common name	*Bryoria subcana*	X	X

a/ Excluding state and federally listed, and select proposed and candidate species and Survey and Manage species, which are discussed in other sections of this EIS.

Excluding federal and state threatened, endangered, and select proposedand candidate species (discussed above), and Survey and Manage species on NFS lands (discussed below), a total of 60 BLM and Forest Service sensitive species have the potential to be affected by the Project: 5 mammal, 19 bird, 1 reptile, 1 amphibians, 20 invertebrate, 6 fish, 7 vascular plant, and 1 lichen species(table 4.6.4.1-2). Tables I-3, I-4, and I-5 in appendix I provide habitat descriptions for these species. Forest Service sensitive species that would potentially be affected by the proposed action are additionally addressed in the BE (appendix F.7), and Survey and Manage species that would potentially be affected by the proposed action on NFS lands are addressed in more detail in the Survey and Manage Report (appendix F.5 of this EIS).

4.6.4.2 Assessment of BLM and Forest Service Sensitive Species

BLM and Forest Service sensitive species that may be present and potentially affected by construction of the pipeline on federal lands are described here. If species were documented during targeted surveys, those locations and potential effects are also described.

Mammals

There are five BLM and Forest Service sensitive mammals that may be present and potentially affected by construction of the pipeline on federal land: the pallid bat (*Antrozous pallidus pacificus*), Townsend's big-eared bat (*Corynorhinus townsendii*), fringed myotis (*Myotis thysanodes*), marten (*Martes caurina*), and fisher (*Pekania pennanti*). Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project effects on these special status species within the Project area are presented in table I-3 in appendix I. As all five of these species are Forest Service sensitive, they are additionally addressed in the BE if effects are anticipated on NFS lands (appendix F.7). Marten and fisher are also discussed above as federal proposed threatened species.

Birds

There are 19 BLM and/or Forest Service sensitive birds that may be present and potentially affected by construction, maintenance, and operation of the pipeline on federal land. Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project effects on these special status species as a result of the Project are presented in table I-3 in appendix

I. Forest Service sensitive birds that would potentially be affected by the proposed action are additionally addressed in the BE (appendix F.7).

Fish

There are six BLM and/or Forest Service sensitive fish species that may be present along the LNG carrier transit route, in the waters of Coos Bay potentially affected by construction of the pipeline, or in waters crossed by the pipeline. Of these species, four are anadromous and two are non-anadromous. Descriptions of life histories, expected habitat, and potential occurrences of these special status fish species within the Project area are presented in table I-4 in appendix I. Forest Service sensitive fish that would potentially be affected by the proposed action are additionally addressed in the BE (appendix F.7).

Amphibians and Reptiles

There are two BLM and Forest Service sensitive amphibians and reptiles that may be present and potentially affected by construction of the pipeline on federal land: western pond turtle (*Actinemys marmorata*) and foothill yellow-legged frog (*Rana boylii*). Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project effects on these special status species within the Project area are presented in table I-3 in appendix I. As both species are Forest Service sensitive, they are additionally addressed in the BE (appendix F.7).

Invertebrates

Aquatic

There are nine BLM and Forest Service sensitive aquatic invertebrates that may be present and potentially affected by construction of the pipeline on federal land. All these species are associated with freshwater environments. Table I-4 in appendix I summarizes the life history, habitat associations, and occurrence of these invertebrates. Eight of these species are Forest Service sensitive aquatic invertebrates, and thus are additionally addressed in the BE if effects are anticipated on NFS lands (appendix F.7).

Terrestrial

There are 11 BLM and Forest Service sensitive terrestrial invertebrates that may be present and potentially affected by the construction of the pipeline on federal land. Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project effects on these special status species within the Project area are presented in table I-3 in appendix I. As all 11 species are Forest Service sensitive terrestrial invertebrates they are additionally addressed in the BE (appendix F.7).

Approximately 20 acres of the ROW near known populations of two Forest Service sensitive terrestrial invertebrates (Mardon skipper and short-horned grasshopper) on the Dead Indian Plateau would be restored with grasses (including *Festuca* sp.) preferred by these species in addition to the rehabilitation required under BMP guidelines. This mitigation on the Rogue River National Forest has the potential to increase the habitat and local range for these two species.

Three BLM and Forest Service sensitive mollusk species were located during surveys for the Project: Siskiyou hesperian, traveling sideband, and Oregon shoulderband. These three species are discussed in the following paragraphs; Siskiyou hesperian and traveling sideband are additionally addressed in the BE as they were observed on NFS lands during surveys (appendix F.7).

Field Survey Locations and Potential Effects

Traveling sideband is a BLM and Forest Service sensitive species (BLM 2015; Forest Service 2015) and an Oregon endemic terrestrial snail. During surveys in 2007 and 2010, this species was observed at nine locations on the Rogue River and Winema National Forests (between MP 154.9 and 175.4), and at six locations on BLM land in the Lakeview and Medford BLM Districts (MPs 116.3 to 176.9). Shells and live individuals were located within and outside the ROW, as well as within proposed TEWAs and UCSAs (SBS 2008a, 2011b). During surveys in 2012 and 2015, this species was observed at five locations on the Rogue River and Umpqua National Forests (between MP 104.9 and 162.5) and four locations on BLM land in the Roseburg and Medford BLM Districts (MPs 91.7 to 116.9), adjacent to the ROW and TEWAs.[143]. Direct mortality could occur to this species if they are within the ROW during Project clearing or construction due to their low mobility. Clearing of the ROW could affect habitat by removing forest overstory, potentially making the area unsuitable for this species. Indirect effects could result from the alteration of composition and structure of vegetation resulting in changes in microclimate. Realignments following the 2007 and 2010 surveys resulted in avoidance of some but not all the sites observed during Project surveys. As currently proposed, Pacific Connector would directly affect 5 of the 14 sites observed during Project surveys on NFS lands, and 4 of the 10 sites observed during Project surveys on BLM-managed lands. Indirect effects are expected to the traveling sideband sites observed even if direct effects on these sites are avoided because 5 and 4 of the sites are within approximately 100 feet of Project disturbance on NFS lands and BLM-managed lands, respectively, and thus would be affected by changes in microclimate conditions.

Siskiyou hesperian is a BLM and Forest Service Sensitive species (BLM 2015; Forest Service 2015) and a riparian associated terrestrial snail. During Project surveys in 2007, 2008, and 2010, this species was observed at 14 locations on the Rogue River and Umpqua National Forests (between MPs 110.2 and 164.7), and 10 locations in the Medford and Roseburg BLM Districts (MPs 79.8 to 151.5). In 2011, 2012, and 2014, this species was observed at nine locations within the Rogue River and Winema National Forests (between MPs 154.5 and 168.9), and two locations in the Medford BLM District (MP 148.7 and 153.5). Shells and live individuals were observed within and outside the ROW, as well as proposed TEWAs and UCSAs (SBS 2008, 2011b; April 27, 2015 response to FERC data request). During surveys in 2015, this species was observed at eight locations on the Rogue River National Forest (between MP 155.7 and 160.6) and one location on BLM land in the Medford BLM District (MP 128.8), within and adjacent to the ROW and TEWAs.[144] During surveys in 2017, active individuals were observed at one location on the Rogue River National Forest (MP 154.6; Tona 2018). Direct mortality to individuals could occur if they are located within the ROW during Project clearing or construction. Another potential direct effect is destruction or alteration of hydrology of riparian, wetland, or aquatic habitats used by this species. Indirect effects could result from the alteration of composition and structure of vegetation resulting in changes in microclimate. The increase in sun exposure could reduce moisture levels

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[143] See Table D.3-10 in Pacific Connector's Resource Report 3, included as part of their September 2017 filing with the FERC.
[144] See Table D.3-10 in Pacific Connector's Resource Report 3, included as part of their September 2017 filing with the FERC.

and potential decrease dispersal between populations or suitable habitat. As currently proposed, Pacific Connector would directly affect 11 of the 31 sites observed during Project surveys on NFS lands, and 6 of the 13 sites observed during Project surveys on BLM-managed lands. Indirect effects are expected to the Siskiyou hesperian sites observed even if direct effects on these sites are avoided as 16 and 5 of the sites on NFS lands and BLM-managed lands, respectively, are within approximately 100 feet of Project disturbance, and thus would be affected by changes in microclimate conditions.

Oregon shoulderband is a BLM and Forest Service sensitive species (BLM 2015; Forest Service 2015) and a terrestrial snail endemic to northern California and southwest Oregon. This species is also managed as a Survey and Manage species on NFS lands; however, it was not observed on NFS lands during surveys for the Project. During Project surveys in 2007, this species was observed at five locations in the Roseburg BLM District (MPs 64.6 to 76.0). Shells and live individuals were observed within and outside the ROW (SBS 2008a). Direct mortality to individuals could occur if they are located within the ROW during Project clearing or construction. Clearing of the ROW could affect habitat by removing forest overstory, potentially making the area unsuitable for this species. Indirect effects could result from the alteration of composition and structure of vegetation resulting in changes in microclimate. The increase in sun exposure could reduce moisture levels and potential decrease dispersal between populations or suitable habitat. As currently proposed, Pacific Connector would directly affect two of the five sites observed during Project surveys on BLM-managed lands. Indirect effects are expected to the Oregon shoulderband sites observed even if direct effects on these sites are avoided as two of the sites on BLM-managed lands are within approximately 100 feet of Project disturbance, and thus would be affected by changes in microclimate conditions.

Plants and Fungi

A total of 270 BLM and/or Forest Service sensitive bryophyte, lichen, fungus, and vascular plant species were identified as potentially occurring within the Project area (see table I-5 in appendix I). Between 2007 and 2018, SBS surveyed for special status fungi and vascular and non-vascular plant species in suitable habitat, where access was granted, within 50 feet (non-federal lands) or 100 feet (federal lands) of the ROW, TEWAs, UCSAs, and access roads (note that surveys continued through 2018). Plant and fungus species documented on federal lands during surveys are described below. Descriptions of expected habitat, documented or suspected occurrences, and potential Project effects on all species within the area affected by the Project are presented in table I-5 in appendix I. Forest Service sensitive plants and fungi that would potentially be affected by the proposed action are additionally addressed in the BE (appendix F.7).

Of the 41 BLM and/or Forest Service sensitive bryophytes identified as potentially occurring within the area affected by the Project, none were documented during surveys of the currently proposed route. Two strategic bryophyte species (*Andreaea nivalis* and *Orthotrichum euryphyllum*) were documented during surveys. See table I-5 in appendix I for a list of sensitive and strategic bryophyte species identified as potentially occurring within the area affected by the Project, descriptions of their expected habitat, and documented or suspected occurrences, including documented occurrences of the two strategic species observed during Project surveys.

Lichens

There are 16 BLM and/or Forest Service sensitive lichens identified as potentially occurring within the area affected by the Project. Potential Project effects on lichens include trampling or killing of individual plants. One BLM and Forest Service sensitive species, *Bryoria subcana*, was documented during surveys of the currently proposed route. This species is also an Survey and Manage species under the 2001 ROD list (Forest Service and BLM 2001a).

Bryoria subcana is a BLM and Forest Service Sensitive coastal lichen species and was observed during Project surveys in the BLM Coos Bay District, approximately 100 feet of the ROW near MP 21.88BR. The species was observed just east of the area affected by the Project and may be avoided by activities within the corridor; however, construction would disturb vegetation and soils within 200 feet of the site and could modify microclimate conditions around the observation. The removal of trees and woody debris could negatively affect *Bryoria subcana* in adjacent areas by removing its habitat and affecting its association with the trees, affecting site persistence even if the entire site is not disturbed. In addition, modification of shading, moisture, and habitat conditions within 200 feet of the observation as a result of the Project construction and operation would likely make habitat within the site no longer suitable for the species. Restored portions of the corridor and TEWAs would be dominated by early seral vegetation for approximately 30 years, which would result in long-term changes to habitat conditions. A portion of the corridor would be maintained in low-growing vegetation for pipeline maintenance and would not provide habitat for the species during the life of the Project. *Bryoria subcana* is not likely to persist at the site following Project implementation; however, remaining sites of this species would continue to provide a reasonable assurance of species persistence.

Five BLM and/or Forest Service strategic lichen species (*Collema curtisporum, Collema quadrifidum, Leptogium platynum, Peltula euploca,* and *Sclerophora amabilis*) were also observed during Project surveys. See table I-5 in appendix I for a list of sensitive and strategic lichen species identified as potentially occurring within the Project area, descriptions of their expected habitat, and documented or suspected occurrences, including documented occurrences of the one sensitive and five strategic lichen species observed during Project surveys.

Fungi

Of the 25 BLM and/or Forest Service sensitive fungi identified as potentially occurring within the Project area, none were documented during surveys. Thirteen Forest Service and BLM strategic fungi were observed during surveys. See table I-5 in appendix I for the locations of these observations in relation to the Project.

Vascular Plants

There are 188 BLM and/or Forest Service sensitive vascular plants identified as potentially occurring within the Project area, 10 of which were documented during Project surveys: Rogue Canyon rockcress (*Arabis modesta*), Bensonia (*Bensoniella oregana*), Cox's mariposa lily, Umpqua mariposa lily, bristly sedge (*Carex comosa*), coastal lip fern (*Cheilanthes intertexta*), pine woods cryptantha (*Cryptantha simulans*), clustered lady's slipper (*Cypripedium fasciculatum*), California globe-mallow (*Iliamna latibracteata*), and Bellinger's meadowfoam. Two of these species—Cox's mariposa lily and Umpqua mariposa lily—are also state-listed species and are discussed above in section 4.6.2.3. One of these species, clustered lady's slipper, is a Forest Service Survey and Manage species and is discussed below under section 4.6.4.3. Potential effects on Umpqua mariposa lily, pine woods cryptantha, California globe-mallow, and Bellinger's meadowfoam on NFS lands are additionally discussed in the BE (appendix F.7 of this EIS).

Field Survey Locations and Potential Effects

Rogue Canyon rockcress is a regional endemic found within chaparral and lower montane coniferous forests in northern California and southern Oregon (CNPS 2018). In Oregon, it is only known from Jackson and Josephine Counties (NRCS 2018). This species has been found on dry, serpentine soils on exposed slopes and rocky cliffs in the Rogue River canyon at elevations between 490 and 1,480 feet (NatureServe 2018). Two sites of Rogue Canyon rockcress were observed during Project surveys in 2017 on state forest lands 24 feet and 90 feet north/northwest of TEWA 124.30-N. This species was not observed on BLM or Forest Service land during Project surveys.

Bensonia is found mainly within the Siskiyou Mountains of southwestern Oregon in Curry and Josephine Counties, with a few small disjunct populations in adjacent Humboldt County, California (NatureServe 2018). The rhizomatous species grows in wet meadows and edges near bogs and springs. Populations seem to be associated with cloud or fog banks that blanket the mountain tops at certain times of year. Most plants are in meadows on gentle slopes, and they thrive on partial shade. The species has been found at elevations between 2,000 to 4,750 feet (Hoover and Holmes 1998). One bensonia site was noted near the Project in 2011 in the Roseburg BLM District, approximately 100 feet east of the existing Signal Tree Road Quarry at MP 47. Pacific Connector surveyed this area in 2013 and no special status species were observed, including bensonia. Due to the distance between this site and the Project, no effects are anticipated.

Bristly sedge is found from Quebec to Minnesota and south, as well as in the Pacific Northwest and Montana (NatureServe 2018). This species habitat includes marshes, lakeshores, and wet meadows. In Oregon, this species is known from Columbia, Klamath, and Multnomah Counties; although it is believed to be extirpated or possibly extirpated in Columbia and Multnomah Counties (NatureServe 2018). One population of bristly sedge was documented in 2012 on private land 66 feet south of TEWA 184.30. This species was not observed on BLM or Forest Service land during Project surveys.

Coastal lip fern grows in crevices and bases of rocks and is found mainly in California, although it also occurs in Oregon and Nevada (The Jepson Herbarium 2018). In Oregon, this species is known from Douglas and Jackson counties (NRCS 2018). Two observations of coastal lip fern site were noted near the Project in the Medford BLM District. One observation is located approximately 65 feet west of the pipeline ROW near MP 148.9 and the other observation is greater than 100 feet from the pipeline ROW near MP 149.9. Due to the distance between these sites and the Project, direct effects are not anticipated; however, the Project could potentially indirectly affect individuals and/or habitat of this species.

Pine woods cryptantha is found in dry gravelly sites, disturbed areas, and open conifer forests from elevations between 820 and 8,530 feet (The Jepson Herbarium 2018). This species' range includes California north to Washington and east to Idaho (NRCS 2018). Five observations of pine woods cryptantha were documented during Project surveys in 2017. One site was located in the Rogue River-Siskiyou National Forest approximately 96 feet northwest of MP 155.8. One site was located on the Fremont-Winema National Forest pm the edge of Clover Creek Road and 10 feet from the pipeline ROW near MP 175.3, and two sites were located in the Lakeview BLM District:

1) within the ROW near MP 176.96 and 2) on the edge of Clover Creek Road near MP 176.98. Because this species was observed within the pipeline ROW, the Project may directly and indirectly affect individuals and habitat of this species.

California globe mallow is found in southwestern Oregon, extending into Humboldt County in northern California (Malaby 2005). This species inhabits moist forests, streamsides, lower montane coniferous forests, and montane chaparral; often in recently burned areas (Malaby 2005; CNPS 2018). In Oregon, California globe mallow is found in coastal ranges in Coos and Douglas counties and is also known from Curry, Jackson, Josephine, and Linn Counties. Three observations of California globe mallow were observed during Project surveys in 2017: one in the Roseburg BLM District and two in the Umpqua National Forest. The observation in the Roseburg BLM District was located within the pipeline ROW near MP 99.9, within the are burned during the Stouts Creek fire in 2015. The sites in the Umpqua National Forest are in the pipeline ROW near MP 106.2 and MP 106.7; both sites were in recently burned areas. Because this species was observed within the pipeline ROW, the Project may directly and indirectly affect individuals and habitat of this species.

Bellinger's meadowfoam (*Limnanthes floccosa* ssp. *bellingeriana*) is associated with vernally wet meadows or vernal pools and is generally found on basalt scablands at elevations between 1,000 and 4,000 feet in Jackson and Klamath Counties, Oregon, and Shasta County, California. Six Bellinger's meadowfoam populations were located in the Project area. Two populations were in the Rogue River-Siskiyou National Forest: within the pipeline ROW near MP 154.1 and within the pipeline ROW between MP 154.71 to 154.82. The other four populations were in the Medford BLM District: near MPs 120.3, MP 128.8, and MP 129.0, and TEWA 128.79-N. All these observations are located greater than 100 feet from the pipeline route, except for the observation in TEWA 128-79. Six hundred plants were observed in and near TEWA 128.79-N during Project surveys in 2017.

In 2010, 30,000 plants within less than one acre were documented between MPs 154.8 and 154.7, near Heppsie Mountain (SBS 2011a), also within the Rogue River National Forest. Potential effects on this site include removal of individuals, temporary disturbance, and permanent loss or alteration of habitat including changes in hydrology. The site is in a vernally moist scabland meadow within the ROW and a TEWA and therefore would be disturbed by the Project (SBS 2011a; Rolle 2014). Measures to avoid this site considered but excluded to avoid a rare fungus, *Gymnomyces abietis*, which was also found at the same location on the north end of the meadow at MP 154.8. *Gymnomyces abietis* is a Forest Service Survey and Manage species, discussed below in section 4.6.4.3. Although Project activities would affect the local population at MP 154.7, the species would not likely be eliminated from the site as it is able to grow on disturbed soil (Rolle 2014). Conservation measures at this site include recontouring, reseeding, and controlling for noxious weeds. Additionally, although the site that would be affected is one of only a few Bellinger's meadowfoam sites on NFS land, a large number of sites are known from BLM and private land in eastern Jackson County. More undocumented sites are likely to occur on unsurveyed private lands (Rolle 2014). Consequently, the expected loss of individuals and habitat at this site is not expected to affect the viability of Bellinger's meadowfoam over the broader geographic area of the low mountains and foothills of eastern Jackson County (Rolle 2014).

4.6.4.3 Survey and Manage Species

The BLM and Forest Service first identified Survey and Manage species in 1994 as rare amphibians, mammals, bryophytes, mollusks, vascular plants, fungi, lichens, and arthropods that occupy LSOG forests in the range of the NSO (see Forest Service and BLM 1994a, the NWFP ROD). The agencies established standards and guidelines for management of these rare species in the *Standards and Guidelines for Management for Late-Successional and Old-Growth Related Species in the Range of the Northern Spotted Owl* (Forest Service and BLM 1994b). The NWFP ROD established overall objectives for managing Survey and Manage species populations that were referred to as "persistence objectives." These objectives were based on the Forest Service viability provision in the 1982 National Forest System Land and Resource Management Planning Regulation for the National Forest Management Act of 1976.

In 2001, the Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines (2001 ROD; Forest Service and BLM 2001a) modified the management direction provided in the NWFP ROD for Survey and Manage species and amended BLM and Forest Service land management plans in the range of the NSO accordingly. The management direction for Survey and Manage species varies based on its assigned category, which establishes varying levels of surveys and management of known sites (refer to the 2001 ROD and appendix F.5 to this EIS for additional details on the categories). For the Survey and Manage Standards and Guidelines, the major elements were retained with some restructuring for clarity, and the 1994 list of Survey and Manage species was modified to remove 72 species in all or part of their range because new information indicated they were secure or otherwise did not meet the basic criteria for Survey and Manage. Based on the history of the Survey and Manage rule, it should be noted that by definition, there is a general concern for persistence for any of the species listed in the 2001 ROD. That concern is the basic reason species are listed in the Survey and Manage Standards and Guidelines.

In 2004 and again in 2007, the BLM and Forest Service issued a ROD to eliminate the Survey and Manage requirements of the 2001 ROD and to provide protection for species on the Survey and Manage lists by managing them under the agencies' special-status species programs. In 2014, the Court issued a remedy order in the case of *Conservation Northwest et al. v. Bonnie et al.*, No 08-1067-JCC (W.D. Wash.)/No. 11-35729 (9th Circ.). As the latest step in the ongoing litigation challenging the 2007 ROD, this remedy order vacated the 2007 ROD to remove or modify the Survey and Manage mitigation measure standards and guidelines, which returned the agencies to the status quo in existence prior to the 2007 ROD. Thus, the 2001 ROD was reinstated, including any amendments or modifications to the 2001 ROD that were in effect as of March 21, 2004, returning the species to the category assigned in the 2001 ROD.

In accordance with the 2014 Court decision, this assessment was completed using the 2001 ROD Survey and Manage Standards and Guidelines, with the 2003 Annual Species Review (ASR) modifications for the species list and category assignments (excepting the 2003 ASR red tree vole removal).

In 2016, the BLM approved two new RMPs, including the Northwestern and Coastal Oregon RMP and the Southwestern Oregon RMP (BLM 2016a, 2016b). All lands managed by the BLM that occur in the Pacific Connector Project are within the revised RMPs' management areas. The past RMPs were developed consistent with the 1994 NWFP and thereby included Survey and Manage species measures. The 2016 RMPs revises the past RMPs in their entirety and removes all measures for Survey and Manage species, although Forest Service Survey and Manage species identified as BLM sensitive species would continue to receive protections consistent with BLM's sensitive species management program.

Although some species covered by the Survey and Manage Standards and Guidelines also occur on private land, land managed by the BLM, and areas outside the NSO range, the requirements of the 1994 NWFP and 2001 ROD apply only to lands managed by the Forest Service within the range of the NSO.

The NWFP ROD and the 2001 ROD do not prescribe a well-defined process for evaluating effects on species persistence or viability from a proposed activity. The 2001 ROD states "instead, common sense and agency expertise must be used in making determinations of compliance with the viability provision" (Standards and Guidelines). The Forest Service has embraced this approach for evaluating effects of the Project on the persistence of affected Survey and Manage species in the NSO range. The Standards and Guidelines and 2001 ROD are intended to "provide a reasonable assurance of species persistence" for all the Survey and Manage species. If the Project is constructed, it would affect numerous known sites of Survey and Manage species. This assessment seeks to determine, should the Project be constructed, whether there would be a reasonable assurance of species persistence for those Survey and Manage species affected by the Project in the NSO range. The evaluation of species persistence is presented in appendix F.5 to this EIS, and this section summarizes the results of the evaluation. Attachment A to appendix F.5 lists the Survey and Manage species considered in the persistence evaluation.

This section is organized by taxonomic group and includes a brief overview of the species considered in the persistence evaluation; a summary of the distribution of sites of the species in the NSO range; an analysis of the effects of the Project on the sites; and breakdowns of the number of sites of each species in the NSO range, the number of affected sites of each species across the analysis area, and the number of affected sites on the Umpqua, Rogue River-Siskiyou, and Fremont-Winema National Forests. Details on the methodology used for the persistence evaluation (e.g., establishment of sites for each species, mapping of general habitat and site distribution, analysis of effects on sites) and a glossary of key terms used in the evaluation available in appendix F.5. The factors used to evaluate the Project effects are outlined in appendix F.5 and were derived from the 2001 ROD criteria for species persistence and relative rarity. This persistence evaluation is not intended to serve as an annual species review or an evaluation of the relative rarity of the species. This analysis is focused only on the effects on the species that could result from implementation of the Project and is intended to provide sufficient information to support subsequent findings by the Forest Service.

This assessment provides a conservative site-specific analysis of effects on sites, which consist of the recorded observations of Survey and Manage species from agency geodatabases and a surrounding protection buffer, and generally assumes that site persistence would not be maintained following Project implementation if a site falls within the analysis area. This conservative approach was considered sufficient if Project-related effects on the sites would not substantially alter the distribution of the species across the NSO range (e.g., the species would still be well distributed or locally abundant near the Project area). However, if the initial analysis revealed that remaining sites (i.e., those not affected by the Project) may not provide a reasonable assurance of species persistence, a closer evaluation of the effects on each site was conducted to further assess effects of the Project and determine if site persistence would be maintained at any of the sites following Project implementation, or if measures would be needed to protect or avoid the site(s). Additional details on the methodology used to evaluate effects are presented in appendix F.5.

Incomplete or Unavailable Information

CEQ regulations 40 CFR 1502.22 require a discussion of incomplete or unavailable information. Information is incomplete or unavailable for:

- **Total populations of Survey and Manage species beyond those represented in the geodatabases of the agencies used in this report.** Although a statistically reliable region-wide survey has been completed for most of the Survey and Manage species (Forest Service and BLM 2007: 142), the results of those surveys have not been biologically interpreted, and the final results have not yet been published. In absence of a published interpretation of the results of those regional surveys, this assessment relies on the known sites of affected species that have been inventoried and recorded in the known site geodatabases of the BLM and Forest Service. These data constitute "best available information" for populations of Survey and Manage species and provide sufficient information to make a reasoned choice between the alternatives and to make an informed decision related to the persistence standards of the 2001 Survey and Manage ROD. A total population estimate is not necessary to make a reasoned choice between the alternatives.
- **Total acres of the specialized microsites and habitats used by certain Survey and Manage species.** This analysis was completed using geodatabase records of observations (i.e., "known sites"), regionally available vegetation inventory data, and evaluation criteria developed from the 2001 ROD. In many cases, Survey and Manage species rely on specialized habitats that may not be catalogued in agency geodatabase records or vegetation inventories. This is one of the reasons why pre-Project surveys are required for Survey and Manage species. Habitat requirements for each of the species considered are discussed in detail in appendix F.5. In this assessment, estimates are provided of the general areas where specialized habitats may be found, but these should not be interpreted as the actual acres of available specialized habitats; the actual acres of available specialized habitats are typically a fraction of the general habitat description. For example, some mollusks rely on moist microsites found in late-successional coniferous forests. A regional inventory of late-successional coniferous forests is available, but a regional inventory of moist microsites is not; there are many, many more acres of late-successional forests than there are acres of moist microsites within those forests. This assessment identifies known sites and broad habitat classifications such as "late-successional coniferous forests below 6,000 feet" where specialized habitats and the species in question may be found, but makes no estimates of, nor does the analysis rely on, estimates of specialized habitats that may exist within those broad vegetation categories. The cost of acquiring such an inventory of microsite environments over the entire area of the NWFP would be exorbitant and is not essential to making a reasoned choice between the alternatives. As noted in the Final Supplemental EIS for Survey and Manage Species, "the likelihood that an activity modifying late-successional forest will occur within the range of a truly rare or localized species population must be viewed in light of the relatively conservative degree of modification of late-successional forest projected to occur within the NWFP area. For example, management activities (timber harvest and prescribed fire) are projected to

modify approximately 3 percent of the late-successional forest within the area over the next decade" (Forest Service and BLM 2000: 180). Pre-Project survey data and existing known sites of Survey and Manage species within the area of the NWFP provide sufficient information to determine whether there is a "reasonable assurance of species persistence," which is the standard of the 2001 Survey and Manage ROD.

- **Recovery of occupied sites after disturbance.** Survey and Manage species are associated with LSOG forests on NFS lands. The construction corridor and TEWAs will be reforested and replanted with native vegetation similar to what occupied the Project area prior to disturbance. It will be at least 80 years before those areas provide late-successional habitat. A 30-foot-wide maintenance corridor centered along the pipeline route would be maintained in low growing brush and grass vegetation (no trees) for the life of the Project. When the Project is decommissioned, it would be at least an additional 80 years before this strip provides late-successional stand characteristics. Information is not generally available as to how effectively the affected Survey and Manage species will reoccupy these areas. This analysis presumes that if the "site" is within the construction clearing or TEWAs, the Project would result in a long-term loss of that site. This analysis does not speculate on when or if the affected species may reoccupy the site. Since sites are presumed lost if affected, and that provides the basis for the assessment, data related to recovery or reoccupation of sites are not essential to the decision to be made or the choice between alternatives.

Survey and Manage Species Surveys and Evaluations

Surveys conducted for the Project in and near the Project area through 2016 resulted in numerous observations of Survey and Manage species. These survey results in combination with results from prior surveys conducted near the Project area were used to identify the Survey and Manage species that could be affected by the Project. Observation data stored in agency geodatabases were converted to "sites" or "known sites" using a standardized mapping protocol based on buffer distances described in the 2001 ROD. Species evaluated include those that have sites on NFS lands in or near the Project area. The species considered include 31 fungi, 2 lichens, 1 vascular plant, 2 mollusks, 1 mammal, and 1 bird.

Fungi

The diverse fungi of the Pacific Northwest include several hundred saprobic (decomposers), parasitic, and symbiotic (mutualistic) macro- and micro-fungi species. The 2003 list includes 194 species of fungi under the Survey and Manage Standards and Guidelines. Of these species, 31 are considered in this evaluation of the Project because they have been documented on NFS lands in or near the Project area. Appendix F.5 of this EIS presents additional details on each species, while the key information used to evaluate Project-related effects is summarized in this section.

The fungi considered in this analysis consist primarily of mycorrhizal or symbiotic species, which include truffles, false truffles, chanterelles, boletes, coral fungi, and gilled mushrooms. Some of the species are saprobic gilled mushrooms or parasitic fungi. The mycorrhizal fungi form symbiotic relationships with vascular plants to exchange nutrients and water for photosynthate. The saprobic species are found on dead or decaying wood, including snags. The fungi fruit at different times of year, and many do not fruit annually, although they may still be present in the soil. Although surveys have been conducted across the Project area and in other parts of the NSO range, the difficulty in detecting fungi when fruiting bodies are not present has limited the ability to fully describe the range and distribution of many species within the NSO range. The fungi species considered in this analysis are listed in table 4.6.4.3-1 with the currently known number of sites in the NSO range. Many of these species are likely more abundant than currently documented, and more survey effort would be expected to locate additional sites of the species.

TABLE 4.6.4.3-1

Regional Site Count of Fungi Species Potentially Affected by the Project

Species	Total Sites in NSO Range a/	Sites on NFS Lands in NSO Range b/	Sites in NFS Reserves in NSO Range c/
Albatrellus ellisii	112	72	33 (46%)
Arcangeliella crassa	26	21	2 (10%)
Boletus pulcherrimus	60	34	21 (62%)
Choiromyces alveolatus	21	17	11 (65%)
Clavariadelphus occidentalis	177	63	21 (33%)
Clavariadelphus sachalinensis	273	35	20 (57%)
Clavariadelphus truncatus	332	127	56 (44%)
Collybia bakerensis	149	145	64 (44%)
Collybia racemosa	71	24	13 (54%)
Cortinarius magnivelatus	47	28	8 (29%)
Cortinarius olympianus	73	44	27 (61%)
Cortinarius verrucisporus	52	32	5 (16%)
CCudonia monticola	82	35	9 (26%)
Galerina atkinsoniana	96	68	55 (81%)
Gastroboletus subalpinus	91	81	36 (44%)
Gomphus clavatus	189	102	53 (52%)
Gomphus kauffmanii	159	99	53 (54%)
Gymnomyces abietis	21	18	10 (55%)
Hygrophorus caeruleus	56	47	14 (30%)
Mycena overholtsii	205	201	94 (47%)
Polyozellus multiplex	87	83	40 (38%)
Ramaria araiospora	152	69	26 (38%)
Ramaria coulterae	67	19	26 (32%)
Ramaria rubrievanescens	143	105	53 (50%)
Ramaria rubripermanens	231	103	35 (34%)
Rhizopogon truncatus	210	70	26 (34%)
Sarcodon fuscoindicus	74	38	18 (46%)
Sedecula pulvinata	3	3	2 (67%)
Sparassis crispa	106	51	9 (18%)
Spathularia flavida	194	81	52 (64%)
Tremiscus helvelloides	318	62	34 (55%)

a/ Total site count reflects the number of sites generated by the 8/2/17 FME extract.
b/ Site count reflects only those sites on NFS lands using land ownership data for the NSO range (dated October 2011).
c/ Site count reflects only those sites on NFS lands and in reserve land allocations based on 1994 ROD reserve land allocations for the NSO range (data dated December 2002 and September 2009) and National Hydrography Dataset, v. 2.1.0 to represent "Riparian Reserves" across the NSO range. These counts underestimate the number of sites in reserves, but regionally mapped reserve data are not available. The percentage represents the estimated proportion of sites in NFS reserves to total sites on NFS lands.

Habitat for these species varies and has generally been classified as coniferous, mixed hardwood-coniferous, and/or hardwood forests, including the LSOG component of these forests. Forests that may provide suitable habitat have been mapped using available data for the NSO range that were also used for the NWFP Effectiveness Monitoring 15-year report to map LSOG forests (Moeur et al. 2011). The data are the best available data on forest types across the NSO range but likely overestimate the amount of potential habitat available in the region for many of the species considered in this analysis, particularly those with microsite conditions that have not been mapped at a regional scale. The extent of potential habitat for each species varies based on its distribution across the NSO range and its habitat preferences, and additional details on habitat are presented in appendix F.5.

The Project could affect site persistence of 31 Survey and Manage fungi at one or more sites in or near the Project area. Vegetation removal and grading activities in the construction corridor and in TEWAs would disturb vegetation and soil within sites and could result in the removal of populations or individuals of fungi. Construction of the Project would create an open corridor, which would be dominated by early seral vegetation for approximately 30 years. This is a long-term effect that could modify microclimate conditions around populations or individuals adjacent to the corridor during the early seral vegetation phase, although not all species are affected by open corridors or change in forest age (e.g., *P. fallax*, *P. piceae*, *P. sipei*, and *P. spadicea*). The removal of coniferous, mixed hardwood-coniferous, and hardwood forests, including the LSOG component of these forests, and disturbance to soil, understory substrate (e.g., rocks, downed logs), and roots of trees could negatively affect the fungi in adjacent areas by removing their habitat, disturbing soil or duff around trees or roots of trees, and affecting mycorrhizal associations with the trees or other relationships between the fungi and their hosts, potentially affecting site persistence even if the entire site is not disturbed. For some species that are found in more open habitats (e.g., *C. olympianus*, *H. caeruleus*, *S. flavida*), these microclimate changes may not affect site persistence. In addition, modification of shading, moisture, and habitat conditions as a result of the corridor and TEWAs could make habitat within the sites no longer suitable for the species. Material storage within UCSAs would disturb understory habitat in some sites, which could also modify microhabitats near extant populations or individuals, potentially making the habitat no longer suitable for the species. Road improvements and establishment could remove habitat and extant populations or individuals of the fungi. The specific effects on sites in and near the Project area vary by species and depend on where the sites are in proximity to the corridor and other activities. Table 4.6.4.3-2 presents a summary of the number of sites of each species that would be affected by the Project; additional details for each species are included in appendix F.5.

TABLE 4.6.4.3-2

Fungi Sites Potentially Affected by the Project

Species	Total Affected NFS Sites a/	Affected Sites in NFS Reserves	Remaining Sites on NFS Lands in NSO Range	Remaining Sites on all Lands in NSO Range
Albatrellus ellisii	10	3	62	102
Arcangeliella crassa	1	—	21 b/	26 b/
Boletus pulcherrimus	7	—4	31 b/	57 b/
Choiromyces alveolatus	1	—	17 b/	21 b/
Clavariadelphus occidentalis	1	—	62	171
Clavariadelphus sachalinensis	7	2	28	258
Clavariadelphus truncatus	10	4	117	311
Collybia bakerensis	2	—	143	147
Collybia racemosa	1	—	23	70
Cortinarius magnivelatus	5	—	24 b/	43 b/
Cortinarius olympianus	5	4	40 b/	69 b/
Cortinarius verrucisporus	5	—	29 b/	49 b/
Cudonia monticola	1	—	34	81
Galerina atkinsoniana	1	—	67	95
Gastroboletus subalpinus	2	—	79	89
Gomphus clavatus	3	1	99	186
Gomphus kauffmanii	7	6	91	152
Gymnomyces abietis	1	1	18 b/	21 b/

TABLE 4.6.4.3-2 (continued)

Fungi Sites Potentially Affected by the Project

Species	Total Affected NFS Sites a/	Affected Sites in NFS Reserves	Remaining Sites on NFS Lands in NSO Range	Remaining Sites on all Lands in NSO Range
Hygrophorus caeruleus	6	—1	846 b/	55 b/
Mycena overholtsii	2	1	199	203
Polyozellus multiplex	1	1	82	86
Ramaria araiospora	3	—	67	149
Ramaria coulterae	3	1	17	65
Ramaria rubrievanescens	2	—	103	141
Ramaria rubripermanens	7	—	96	223
Rhizopogon truncatus	6	1	64	203
Sarcodon fuscoindicus	1	—	37	72
Sedecula pulvinata	1	1	3 b/	3 b/
Sparassis crispa	1	—	50	104
Spathularia flavida	5	4	76	189
Tremiscus helvelloides	1	1	61	310

a/ Affected sites are those on NFS land that would be directly or indirectly affected by Project activities based on the analyses presented in appendix F.5.

b/ Although one or more sites would be affected by the Project, individuals within some of the sites would not be affected, and site persistence would be maintained for those sites following project implementation. The remaining site count includes sites that may be affected, but for which site persistence is expected to be maintained. Only sites for which site persistence would be affected were removed from the remaining site count.

The species listed below appear to be more common than previously documented or are relatively common across the NSO range based on new information available from surveys for the Project and/or other sources since these species were listed in the 2001 ROD. For these species, the Project would affect individuals or habitat at one or more sites and could affect site persistence, but the remaining sites in the NSO range would continue to provide a reasonable assurance of species persistence:

Clavariadelphus occidentalis
Clavariadelphus sachalinensis
Clavariadelphus truncatus
Collybia bakerensis
Cortinarius olympianus
Cudonia monticola
Galerina atkinsoniana
Gastroboletus subalpinus
Gomphus clavatus
Gomphus kauffmanii
lbatrellus ellisii
Mycena overholtsii
Polyozellus multiplex
Ramaria araiospora
Ramaria coulterae
Ramaria coulterae
Ramaria rubrievanescens
Ramaria rubripermanens
Ramaria rubripermanens
Ramaria stuntzii
Rhizopogon truncatus
Rhizopogon truncatus
Sparassis crispa
Spathularia flavida
Tremiscus helvelloides

The species listed below are not necessarily more common than previously documented despite new information available from pre-disturbance surveys for the Project and/or other sources since these species were listed in the 2001 ROD. For these species, the Project would affect individuals or habitat at one or more sites and could affect site persistence, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence:

Arcangeliella crassa
Boletus pulcherrimus

Choiromyces alveolatus
Collybia racemose
Cortinarius magnivelatus
Cortinarius verrucisporus
Gymnomyces abietis
Hygrophorus caeruleus
Sedecula pulvinata

The species listed below is not necessarily more common than previously documented despite new information available from pre-disturbance surveys for the Project and/or other sources since these species were listed in the 2001 ROD. For this species, the Project would affect site persistence at one or more sites, and the remaining sites in the NSO range may not provide a reasonable assurance of species persistence. These species are known from a low number of sites within a part of the NSO range, has limited habitat requirements, and has a distribution pattern in which every site may be important for dispersal opportunities to ensure the persistence of the species in the NSO range:

Sarcodon fuscoindicus

The Project would affect a portion of one site where two observations of this species have been documented on NFS lands. This site is located in the Trail Creek watershed on the ridge just east of the South Fork Cow Creek watershed between MPs 111.5 and 111.6. Approximately 1.2 acres (30 percent of the site) is associated with the construction corridor (0.8 acres) and associated UCSA (0.4 acres). The location of this site is illustrated in appendix F-5 (Section 2.27, Figure SAFU-5).

The Project would result in ground disturbance and vegetation removal in the eastern half of the site near MP 111.5. The two recorded observations within the site may be avoided by construction activities within the corridor, but fruiting bodies, if present, could be disturbed in one of the observations during material storage within a UCSA (see Figure SAFU-5). The species would also be subject to indirect effects associated with the Project based on the proximity of project activities to the observations.

Establishment of the 95-foot wide construction corridor would disturb vegetation and soils within the site. The area within the site is mostly forested, and the establishment of the corridor could modify microclimate conditions around the recorded observations. The removal of forests and host trees and disturbance to soil could negatively affect *S. fuscoindicus* in adjacent areas by removing its habitat, disturbing soil or duff around trees or roots of trees, and affecting its mycorrhizal association with the trees, potentially affecting site persistence even if the entire site is not disturbed. In addition, modification of shading, moisture, and habitat conditions within 100 feet of an observation as a result of the corridor could make habitat within the site no longer suitable for the species. Restored portions of the corridor would be dominated by early seral vegetation for approximately 30 years, which would result in long-term changes to habitat conditions. A 30-foot wide portion of the corridor would be maintained in low-growing vegetation for pipeline maintenance and would not provide habitat for the species during the life of the Project. Material storage within UCSAs could damage individuals and would disturb understory habitat within the site, which could modify microhabitats near individuals that are not removed or damaged, potential making the habitat no longer suitable for the species.

Based on this analysis of the site on NFS lands, *S. fuscoindicus* is not likely to persist following Project implementation. The site is the only site on NFS lands in the local area and the nearest sites on NFS lands are approximately 45 miles to the northeast and 75 miles to the southwest.

Lichens

Lichens are distinct symbiotic organisms that consist of a fungus and an algae or cyanobacterium, which make them members of two or three biological kingdoms. They play a major ecological role, particularly in old-growth forests, by cycling nutrients and producing biomass. Lichens tend to be dispersal limited and grow slower than vascular plants. The 2001 Survey and Manage ROD including the 2003 ASR modifications to the species list includes 45 lichen species. Of these, two are considered in this evaluation because they have been documented on NFS lands in or near the Project area. Appendix F.5 presents additional details on each species, while the key information used to evaluate Project-related effects is summarized in this section.

Both lichens considered in this analysis are epiphytic lichens, which grow directly on trees or shrubs. *Chaenotheca subroscida* commonly occurs on pine trees in upland habitats and *Leptogium teretiusculum* tends to be associated with riparian habitat.

Although surveys have been conducted across the Project area and in other parts of the NSO range, the difficulty in detecting some lichens because of their size has limited the ability to fully describe the range and distribution of some species within the NSO range. The lichen species considered in this analysis are listed in table 4.6.4.3-3 with the currently known number of sites in the NSO range, and the distributions of the species are briefly discussed after the table.

TABLE 4.6.4.3-3

Regional Site Count of Lichen Species Potentially Affected by the Project

Species	Total Sites in NSO Range a/	Sites on NFS Lands in NSO Range b/	Sites in NFS Reserves in NSO Range c/
Chaenotheca subroscida	396	110	73 (66%)
Leptogium teretiusculum	267	16	9 (56%)

a/ Total site count reflects the number of sites generated by the 8/2/17 FME extract.
b/ Site count reflects only those sites on NFS lands using land ownership data for the NSO range (dated October 2011).
c/ Site count reflects only those sites on NFS lands and in reserve land allocations based on 1994 ROD reserve land allocations for the NSO range (data dated December 2002 and September 2009) and National Hydrography Dataset, v. 2.1.0 to represent "Riparian Reserves" across the NSO range. These counts underestimate the number of sites in reserves, but regionally mapped reserve data are not available. The percentage represents the estimated proportion of sites in reserves to total sites on NFS lands.

Habitat for these species has been classified as coniferous, mixed hardwood-coniferous, and/or hardwood forests, including the LSOG component of these forests. Forests that may provide suitable habitat have been mapped using available data for the NSO range that were also used for the NWFP Effectiveness Monitoring 15-year report to map LSOG forests (Moeur et al. 2011). The extent of potential habitat for each species varies based on its distribution across the NSO range and habitat preferences. Additional details on habitat for these species are presented in appendix F.5.

The Project could affect site persistence of two Survey and Manage lichens at one or more sites on NFS lands in or near the Project area. Vegetation removal and grading activities in the construction corridor and in TEWAs would disturb vegetation and soil within sites and could result in the removal of populations or individuals of lichens. Construction of the Project would create an open corridor, which would be dominated by early seral vegetation for approximately 30 years. This is a long-term effect that could modify microclimate conditions around populations or individuals adjacent to the corridor during the early seral vegetation phase. The removal of coniferous, mixed hardwood-coniferous, and hardwood forests, including the LSOG component of these forests, and disturbance to soil, understory substrate (e.g., rocks, downed logs), and roots of trees could negatively affect the lichens in adjacent areas by removing their habitat, disturbing soil or substrate around trees or roots of trees, and affecting associations with the trees or other substrate, potentially affecting site persistence even if the entire site is not disturbed. In addition, modification of shading, moisture, and habitat conditions as a result of the corridor and TEWAs could make habitat within the sites no longer suitable for the species. Material storage within UCSAs would disturb understory habitat in some sites, which could also modify microhabitats near extant populations or individuals, potentially making the habitat no longer suitable for some of the species. Road improvements and establishment could remove habitat and extant populations or individuals of the lichens. The specific effects on sites in and near the Project area vary by species and depend on where the sites are in proximity to the corridor and other activities. Table 4.6.4.3-4 presents a summary of the number of sites of each species that would be affected by the Project; additional details for each species are included in appendix F.5.

TABLE 4.6.4.3-4

Lichen Sites Potentially Affected by the Project

Species	**Total Affected NFS Sites a/**	**Affected Sites in NFS Reserves**	**Remaining Sites on NFS Lands in NSO Range**	**Remaining Sites on all Lands in NSO Range**
Chaenotheca subroscida	6	4	104	382
Leptogium teretiusculum	1	1	15	261

a/ Affected sites are those that would be directly or indirectly affected by Project activities based on the analyses presented in appendix F.5. Using the spatial analysis process described in appendix F.5, these sites may be clipped by the Project area or fall outside the Project area, but within the analysis area.

The two lichen species analyzed appear to be more common than previously documented or are relatively common across the NSO range based on new information available from surveys for the Project and/or other sources since these species were listed in the 2001 ROD. The Project would affect site persistence at one or more sites, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence.

Measures incorporated into the Project as design features would be implemented to minimize soil and vegetation disturbance in the Project area and restore areas following construction, which could minimize adverse effects on all Survey and Manage lichens in and near the Project area. The Forest Service will prepare and implement a monitoring plan that describes specific protocols to monitor affected sites and habitat adjacent to the sites over the long term.

For lands directly affected by the Project, the Forest Service would waive implementation of Management Recommendations for Survey and Manage species through amendment of the land management plans for the National Forests that encompass the Project area. Table 4.6.4.3-5 lists the lichen species and the number of affected sites on each National Forest.

TABLE 4.6.4.3-5

Affected Lichen Sites by National Forest

	Number of Sites Affected a/		
Species	**Umpqua**	**Rogue River-Siskiyou**	**Fremont-Winema**
Chaenotheca subroscida	—	5	1
Leptogium teretiusculum	—	1	—

a/ All sites are directly affected (i.e., are located in the Project area).

Vascular Plants

Vascular plants are the most dominant organism in LSOG forests and serve an essential role by providing a food source and cover or shelter for animals and influencing microclimate conditions for other species, such as fungi and lichens. Vascular plants include seed-bearing plants, such as flowering plants and conifer trees, and spore-bearing forms, such as ferns, horsetails, and clubmosses. The Survey and Manage 2001 ROD including 2003 ASR modifications includes 12 plant species. Of the 12 species, clustered lady's slipper (*Cyripedium fasciculatum*) is evaluated for this Project because it has been documented on NFS lands in or near the Project area. Appendix F.5 presents additional details on the species, while the key information used to evaluate Project-related effects is summarized in this section.

Surveys for vascular plants have been conducted in much of the NSO range, and the results of these surveys have contributed information to characterize the known extent of the plants in the NSO range. Additional surveys for Survey and Manage species were conducted for the Project as recently as the fall of 2018.[144] Table 4.6.4.3-6 includes the currently known number of *C. fasciculatum* sites in the NSO range. The range of *C. fasciculatum* in the NSO range is relatively well known, and more survey effort would be expected to locate additional sites of the species within its currently known range.

TABLE 4.6.4.3-6

Regional Site Count of Plant Species Potentially Affected by the Project

Species	**Total Sites in NSO Range a/**	**Sites on NFS Lands in NSO Range b/**	**Sites in NFS Reserves in NSO Range c/**
Cypripedium fasciculatum	1,392	1540	198 (37%)

a/ Total site count reflects the number of sites generated by the 8/2/17 FME extract.
b/ Site count reflects only those sites on NFS lands using land ownership data for the NSO range (dated October 2011).
c/ Site count reflects only those sites on NFS lands and in reserve land allocations based on 1994 ROD reserve land allocations for the NSO range (data dated December 2002 and September 2009) and National Hydrography Dataset, v. 2.1.0 to represent "Riparian Reserves" across the NSO range. These counts underestimate the number of sites in reserves, but regionally mapped reserve data are not available. The percentage represents the estimated proportion of sites in reserves to total sites on NFS lands.

C. fasciculatum is well distributed across most of its known range in the NSO range. Sites are distributed in two general groups in the Klamath Mountains and Cascade Range in Oregon and California and the eastern Cascade Range in Washington. The species appears to be well distributed in the Klamath Mountains in California and Oregon.

General habitat for this species consists of coniferous and mixed hardwood-coniferous forests, including the LSOG component of these forests, across each species' currently known range. Forests that may provide suitable habitat have been mapped using available data for the NSO range that were also used for the NWFP Effectiveness Monitoring 15-year report to map LSOG forests (Moeur et al. 2011). The extent of potential habitat for each species varies based on its distribution across the NSO range and habitat preferences, and additional details on habitat are presented in appendix F.5.

The Project could affect site persistence of *C. fasciculatum* at one site on NFS land in the Project area. The site occurs on the Umpqua National Forest. Vegetation removal and grading activities in the construction corridor and in TEWAs would disturb vegetation and soil within sites and could

[144] Results from these will be incorporated into the final EIS.

result in the removal of populations or individuals of plants. Construction of the Project would create an open corridor, which would be dominated by early seral vegetation for approximately 30 years. This is a long-term effect that could modify microclimate conditions around populations or individuals adjacent to the corridor during the early seral vegetation phase. The removal of coniferous and mixed hardwood-coniferous forests, including the LSOG component of these forests, and disturbance to soil could negatively affect the plants in adjacent areas by removing their habitat, potentially affecting site persistence even if the entire site is not disturbed. In addition, modification of shading, moisture, and habitat conditions as a result of the corridor and TEWAs could make habitat within the sites no longer suitable for the species. Material storage within UCSAs would disturb understory habitat in some sites, which could also modify microhabitats near extant populations or individuals, potentially making the habitat no longer suitable for some of the species. Road improvements and establishment could remove habitat and extant populations or individuals of the plants. The specific effects on sites in and near the Project area vary by species and depend on where the sites are in proximity to the corridor and other activities. Table 4.6.4.3-7 presents a summary of the sties that would remain after the single site is affected by Project activities; additional details for each species are included in appendix F.5.

TABLE 4.6.4.3-7

Vascular Plant Sites Potentially Affected by Project

Species	**Total Affected NFS Sites a/**	**Affected Sites in Reserves**	**Remaining Sites on NFS Lands in NSO Range**	**Remaining Sites on all Lands in NSO Range**
Cypripedium fasciculatum	1	1	1,539	1,390

a/ Affected sites are those that would be directly or indirectly affected by Project activities based on the analyses presented in appendix F.5. Using the spatial analysis process described in appendix F.5, these sites may be clipped by the Project area or fall outside the Project area, but within the analysis area.

Cypripedium fasciculatum appears to be more common than previously documented based on new information available from surveys for the Project and/or other sources since these species were listed in the 2001 ROD. Many sites have been documented in southwest Oregon since the 2001 ROD was published. Should the Project be constructed, it is unlikely that the loss of one site from Project effects would affect the status of *C. fasciculatum* in the NSO range. The Project would affect site persistence at one site on NFS lands, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence.

Measures incorporated into the Project as design features would be implemented to minimize soil and vegetation disturbance in the Project area and restore areas following construction, which could minimize adverse effects on Survey and Manage plants in and near the Project area. The Forest Service will prepare and implement a monitoring plan that describes specific protocols to monitor affected sites and habitat adjacent to the sites over the long term.

For lands directly affected by the Project, the Forest Service would waive implementation of Management Recommendations for Survey and Manage species through amendments to the land management plans for National Forests that encompass the Project area.

Mollusks

Approximately 350 species of mollusks, including land snails, aquatic snails, slugs, and clams, are found in the Pacific Northwest (Forest Service and BLM 2000). Slugs and snails are found in colonies, which may consist of hundreds to many thousands of individuals. Most mollusks are found in moist forests and riparian areas near streams, springs, and seeps. The 2001 ROD including 2003 ASR modifications includes 38 species of mollusks. Of these species, two are considered in this evaluation of the Project because they have been documented on NFS lands in or near the Project area. Appendix F.5 presents additional details on each species, while the key information used to evaluate Project-related effects is summarized in this section.

The mollusk species considered in this analysis include evening fieldslug (*Deroceras hesperium*) and Chace sideband (*Monadenia chaceana*). *Deroceras hesperium* is a land slug that requires high moisture environments and is found along the forest floor. A recent study on the molecular characteristics of *D. hesperium* revealed that the mollusk is likely a variant of the more common *D. laeve* (Roth et al. 2013), and *D. hesperium* may no longer belong on the Survey and Manage list, pending an annual species review. Since the species is on the 2003 list, it is evaluated like other Survey and Manage species on the list in this assessment. *Monadenia chaceana* is a land snail that is found in talus or under rocks in moist forests. Both mollusks may be associated with Riparian Reserves.

Surveys for mollusks have been conducted in parts of the NSO range, and the results of these surveys have contributed information to characterize the known extent of the mollusks in the NSO range. Surveys for the Project resulted in several observations of both species. The mollusk species considered in this analysis are listed in table 4.6.4.3-8 with the currently known number of sites in the NSO range. The ranges of these species in the NSO range are relatively well known, and more survey effort would be expected to locate additional sites of the species within their currently known ranges.

The distribution of the species and their ranges within the NSO range vary. *Deroceras hesperium* has a distribution pattern with limited potential for connectivity between isolated sites or site clusters. Sites are found in four general areas in Oregon, including a relatively large cluster of sites located in the southern Cascade Range, and other clustered sites located in the northern Cascade Range and southern Coast Range. Scattered sites are in the northern Cascade Range, and several isolated sites are in other areas. *Monadenia chaceana* has multiple sites or clusters of sites that are nested within a web of potential interconnections. Sites are primarily found in a large group of several clusters in the eastern Klamath Mountains and southern Cascade Range in Oregon and extreme northern California.

TABLE 4.6.4.3-8

Regional Site Count of Mollusk Species Potentially Affected by the Project

Species	Total Sites in NSO Range a/	Sites on NFS Lands in NSO Range b/	Sites in NFS Reserves in NSO Range c/
Deroceras hesperium	54	27	13 (48%)
Monadenia chaceana	258	246	34 (14%)

a/ Total site count reflects the number of sites generated by the 8/2/17 FME extract.
b/ Site count reflects only those sites on NFS lands using land ownership data for the NSO range (dated October 2011).
c/ Site count reflects only those sites on NFS lands and in reserve land allocations based on 1994 ROD reserve land allocations for the NSO range (data dated December 2002 and September 2009) and National Hydrography Dataset, v. 2.1.0 to represent "Riparian Reserves" across the NSO range. These counts underestimate the number of sites in reserves, but regionally mapped reserve data are not available. The percentage represents the estimated proportion of sites in reserves to total sites on NFS lands.

General habitat for these species consists of a subcomponent (e.g., moist riparian areas, shaded rocky areas) of coniferous, mixed hardwood-coniferous, and hardwood forests, including the LSOG component of these forests, across each species' currently known range. Forests that may provide suitable habitat have been mapped using available data for the NSO range that were also used for the NWFP Effectiveness Monitoring 15-year report to map LSOG forests (Moeur et al. 2011). The extent of potential habitat for the species varies based on its distribution across the NSO range and habitat preferences, and additional details on habitat are presented in appendix F.5.

The Project could affect site persistence of two Survey and Manage mollusk species at one or more sites in or near the Project area. Vegetation removal and grading activities in the construction corridor and in TEWAs would disturb vegetation and soils within sites and could result in injury or mortality to individuals of mollusks. Construction of the Project would create an open corridor, which would be dominated by early seral vegetation for approximately 30 years. This is a long-term effect that could modify microclimate conditions around populations or individuals adjacent to the corridor during the early seral vegetation phase. The removal of forests and understory components could negatively affect the mollusks in adjacent areas by removing their habitat, potentially affecting site persistence even if the entire site is not disturbed. In addition, modification of shading, moisture, and habitat conditions as a result of the corridor could make habitat within sites no longer suitable for the species. Material storage within UCSAs could disturb understory habitat in sites, which could remove rocks, logs, or woody debris, potentially making the habitat unsuitable for the species or injuring individuals.

The specific effects on sites in and near the Project area vary by species and depend on where the sites are in proximity to the corridor and other activities. Table 4.6.4.3-9 presents a summary of the number of sites of each species that would be affected by the Project; additional details for each species are included in appendix F.5.

TABLE 4.6.4.3-9

Mollusk Sites Potentially Affected by the Project

Species	Total Affected NFS Sites a/	Affected Sites in NFS Reserves	Remaining Sites on NFS Lands in NSO Range	Remaining Sites on all Lands in NSO Range
Deroceras hesperium	1	1	26	53
Monadenia chaceana	9	9	249	396

a/ Affected sites are those that would be directly or indirectly affected by Project activities based on the analyses presented in appendix F.5. Direct effects are those that would take place within the Project area, such as from ground disturbance, vegetation removal, or removal of individuals. Indirect effects are those that would take place outside of the Project area, such as from edge effects or increased open canopy. Using the spatial analysis process described in appendix F.5, these sites may be clipped by or fall outside the Project area, but within the analysis area.

Deroceras hesperium is not necessarily more common than previously documented despite new information available from pre-disturbance surveys for the Project and/or other sources since this species was listed in the 2001 ROD. The Project would affect site persistence at one site, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence. Although this species has a somewhat limited distribution in the NSO range, the affected site is part of a large cluster of sites in the southern Cascade Range in Oregon. The distribution and connectivity of the species would likely remain the same despite the loss of one site.

Monadenia chaceana appears to be more common than previously documented based on new information available from surveys for the Project and/or other sources since this species was listed in the 2001 ROD. The Project would affect site persistence at nine sites, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence.

Measures incorporated into the Project as design features would be implemented to minimize soil and vegetation disturbance in the Project area and restore areas following construction, which could minimize adverse effects on Survey and Manage mollusks in and near the Project area. The Forest Service will prepare and implement a monitoring plan that describes specific protocols to monitor affected sites and habitat adjacent to the sites over the long term.

For lands directly affected by the Project, the Forest Service would waive implementation of Management Recommendations for Survey and Manage species through amendments to the land management plans for the National Forests that encompass the Project area. Table 4.6.4.3-10 lists the mollusk species and the number of affected sites in each National Forest.

TABLE 4.6.4.3-10

Affected Mollusk Sites by National Forest

	Number of Sites Affected a/		
Species	**Umpqua**	**Rogue River=Siskiyou**	**Fremont-Winema**
Deroceras hesperium	—	—	1
Monadenia chaceana	—	3 (5)	1

a/ First number presents sites directly affected (i.e., in Project area), number in parentheses presents sites indirectly affected (i.e., sites wholly in analysis area). a

Vertebrates

A diverse array of vertebrate species, including mammals, birds, amphibians, and reptiles, inhabit the forests of the Pacific Northwest and provide essential functions in the ecosystem, such as dispersing fungal spores and lichens and serving as a food source for predators. The 2001 ROD including the 2003 ASR modifications to the species list includes seven vertebrate species. Two vertebrate species are considered in this evaluation of the Project because they have been documented on NFS lands in or near the Project area. Appendix F.5 presents additional details on each species, and the key information used to evaluate Project-related effects is summarized in this section.

The vertebrate species considered in this analysis include red tree vole (*Arborimus longicaudus*) and great gray owl (*Strix nebulosa*). *Arborimus longicaudus* is a small arboreal rodent that lives in tree canopies of coniferous and mixed hardwood-coniferous forests and seldom goes to the forest floor (Forest Service and BLM 2001b). It is a primary prey item of the northern spotted owl, as well as other predators found in coniferous forests. *Strix nebulosa* is a forest owl that uses existing stick nests constructed by other raptors and large corvids, and nests between March 1 and July 31 (Williams 2012). It forages in natural forest openings, typically larger than 10 acres, and nests in coniferous and mixed hardwood-coniferous forests.

Surveys for the vole and owl have been conducted across much of the NSO range, and the results of these surveys have contributed information to characterize the known extent of the species in the NSO range. Surveys for the Project resulted in multiple observations of both species in the surveyed areas. The vertebrate species considered in this analysis are listed in table 4.6.4.3-11 with the currently known number of sites in the NSO range, and the distributions of the species are briefly discussed after the table. The ranges of these species in the NSO range are relatively well known, and more survey effort would be expected to locate additional sites of the species within their currently known ranges.

TABLE 4.6.4.3-11

Regional Site Count of Vertebrate Species Potentially Affected by the Project

Species	Total Sites in NSO Range a/	Sites on NFS Lands in NSO Range b/	Sites in NFS Reserves in NSO Range c/
Arborimus longicaudus	34,946	1,524	624 (34%)
Strix nebulosa	177	55	16 (12%)

a/ Total site count reflects the number of sites generated by the 8/2/17 FME extract.
b/ Site count reflects only those sites on NFS lands using land ownership data for the NSO range (dated October 2011).
c/ Site count reflects only those sites on NFS lands and in reserve land allocations based on 1994 ROD reserve land allocations for the NSO range (data dated December 2002 and September 2009) and National Hydrography Dataset, v. 2.1.0 to represent "Riparian Reserves" across the NSO range. These counts underestimate the number of sites in reserves, but regionally mapped reserve data are not available. The percentage represents the estimated proportion of sites in reserves to total sites on NFS lands

The distribution of the species and their ranges within the NSO range vary. Both species have multiple sites or clusters of sites that are nested within a web of potential interconnections. Most *A. longicaudus* sites are found in the Klamath Mountains in Oregon, where sites are abundant and close together in large clusters or groups. Sites are more scattered in the western Cascade Range in Oregon, although they are still relatively abundant. *Arborimus longicaudus* appears to be well distributed within its range in Oregon. Most *S. nebulosa* sites are found in a large group in the southern Cascade Range and eastern Klamath Mountains, where the species appears to be well distributed.

General habitat for *A. longicaudus* consists of LSOG coniferous and mixed hardwood-coniferous forests across the species' currently known range in Oregon. General habitat for *S. nebulosa* consists of coniferous and mixed hardwood-coniferous forests, including the LSOG component of these forests, with a subcomponent of natural forest openings (e.g., meadows) that are used for foraging. Forests that may provide suitable habitat have been mapped using available data for the NSO range that were also used for the NWFP Effectiveness Monitoring 15-year report to map LSOG forests (Moeur et al. 2011). The extent of potential habitat for the species varies based on its distribution across the NSO range and habitat preferences, and additional details on habitat are presented in appendix F.5.

The Project could affect site persistence of two Survey and Manage vertebrates at more than one site or habitat area in or near the Project area. Vegetation removal in the construction corridor and TEWAs and along roads could result in the removal of trees that support *A. longicaudus* nests or cause injury or mortality to individuals. Construction of the Project would create an open corridor, which would be dominated by early seral vegetation for approximately 30 years. This is a long-term effect that could modify microclimate conditions around populations or individuals adjacent to the corridor during the early seral vegetation phase. The removal of forests and potential nest trees could negatively affect *A. longicaudus* in adjacent areas by removing its habitat and opening the tree canopy, potentially affecting site persistence at the habitat areas even if the entire habitat area is not disturbed. In particular, modification of shading and habitat conditions as a result of the corridor, TEWAs, and roads could make entire habitat areas no longer suitable for the species because of the preference for closed canopy habitats. Activities within the corridor and TEWAs would result in extensive noise disturbance during vegetation clearing, grading, and pipeline installation and could result in *S. nebulosa* nest abandonment and loss of young during the nesting season. No active *S. nebulosa* nest sites were documented in the Project area; therefore, direct effects on the owl (e.g., removal of active nests, injury to owls) are not anticipated. Vegetation removal across the Project area would also result in a long-term loss of habitat that may be suitable for the species. Conversely, if constructed, the construction corridor would also create an early seral plant community suitable for foraging by great grey owls.

The specific effects on sites in and near the Project area vary by species and depend on where the sites are in proximity to the corridor and other activities. Table 4.6.4.3-12 presents a summary of the number of sites (habitat areas for *A. longicaudus*) of each species that would be affected by the Project; additional details for each species are included in appendix F.5.

Both species appear to be more common than previously documented based on new information available from surveys for the Project and/or other sources since these species were listed in the 2001 ROD. The Project would affect site persistence at multiple sites or habitat areas of each species, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence.

TABLE 4.6.4.3-12

Vertebrate Sites Potentially Affected by the Project

Species	Total Affected NFS Sites a/	Affected Sites in NFS Reserves	Remaining Sites on NFS Lands in NSO Range	Remaining Sites on All Lands in NSO Range
Arborimus longicaudus	525 (55) b/	10 (24)	1,469 c/	4,843
Strix nebulosa	1	1	54	171

a/ Affected sites are those that would be directly or indirectly affected by Project activities based on the analyses presented in appendix F.5. Direct effects are those that would take place within the Project area, such as from ground disturbance, vegetation removal, or removal of individuals. Indirect effects are those that would take place outside of the Project area, such as from edge effects or increased open canopy. Using the spatial analysis process described in appendix F.5, these sites may be clipped by or fall outside the Project area, but within the analysis area.
b/ *A. longicaudus* sites are habitat areas (55 sites were converted to 25 habitat areas in the analysis area), as mapped in accordance with the management recommendations for the species (Forest Service and BLM 2001b).
c/ The total of remaining sites is based on site data, not habitat areas. Habitat areas were not produced for the entire regional area, just the analysis area.

Measures incorporated into the Project as design features would be implemented to minimize vegetation disturbance in the Project area and restore areas following construction, which could minimize adverse effects on Survey and Manage vertebrates in and near the Project area. The Forest Service will prepare and implement a monitoring plan that describes specific protocols to monitor affected sites and habitat adjacent to the sites over the long term.

For lands directly affected by the Project, the Forest Service would waive implementation of Management Recommendations for Survey and Manage species through amendments to the land management plans for the National Forests that encompass the Project area. Table 4.6.4.3-13 lists the vertebrate species and the number of affected sites or habitat areas in each National Forest.

TABLE 4.6.4.3-13

Affected Vertebrate Sites by National Forest

	Number of Sites Affected a/		
Species	**Umpqua**	**Rogue River-Siskiyou**	**Fremont-Winema**
Arborimus longicaudus b/	125	—	—
Strix nebulosa	—	0 (1)	—

a/ First number presents sites directly affected (i.e., in Project area), number in parentheses presents sites indirectly affected (i.e., sites wholly in analysis area).
b/ *A. longicaudus* sites are habitat areas, as mapped in accordance with the management recommendations for the species (Forest Service and BLM 2001b).

In conclusion, the Project could affect site persistence of 38 Survey and Manage species at one or more sites or habitat areas in or near the Project area. The remaining sites of 37 of these 38 species, however, would provide a reasonable assurance of these species persistence. The Project as proposed would affect site persistence of the fungi *Sarcodon fuscoindicus* at one or more sites, and the remaining sites may not provide a reasonable assurance of this species persistence. However, above we have recommended that Pacific Connector avoid affecting the *Sarcodon fuscoindicus* site by incorporating a pipeline route variation that avoids this site into the proposed action (see chapter 3). Therefore, the analysis summarized in this section, supported by the information presented in appendix F.5, indicate that construction and operation of the Project would provide a reasonable assurance of persistence of Forest Service Survey and Manage species that would be affected.

4.6 THREATENED, ENDANGERED, AND OTHER SPECIAL STATUS SPECIES

This section analyzes the effects of the Project on special status species. In addition to species listed as threatened or endangered under the federal ESA[133] and Oregon ESA[134], agencies and organizations such as the FWS, BLM, Forest Service, ODA, and ODFW maintain lists of species that are considered special concern, sensitive, rare, or are otherwise offered protections under agency planning documents. These species are broadly defined in this assessment as "special status species."[135] Although the term "special status species" is used differently by various agencies, for the purposes of this assessment, the term "special status species" includes:

- species that are listed or proposed for listing by the federal government as endangered or threatened, or are candidates for listing;
- species that are identified by the BLM or Forest Service as "sensitive species" or "strategic species";
- species listed by the State of Oregon as endangered, threatened, or are candidates for listing; and
- species identified by federal or state agencies as rare or protected by federal or state planning documents (e.g., Standards and Guidelines in resource management plans such as "Survey and Manage" species identified in the NWFP).

Using data from the Oregon Biodiversity Information Center (ORBIC),[136] FWS, NMFS, discussions with Forest Service and BLM specialists, and information reviews of published and unpublished information, the applicants prepared lists of threatened, endangered, proposed,

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[133] Federal agencies are required by Section 7 of the ESA (Title 19 U.S.C. Part 1536[c]), as amended (1978, 1979, and 1982), to ensure that any actions authorized, funded, or carried out by the agency do not jeopardize the continued existence of a federally listed endangered or threatened species, or result in the destruction or adverse modification of designated critical habitat of a federally listed species. The action agency (e.g., the FERC) is required to consult with the FWS and/or the NMFS to determine whether federally listed endangered or threatened species or designated critical habitat are found in the vicinity of the Project, and to determine the proposed action's potential effects on those species or critical habitats. For actions involving major construction activities with the potential to affect listed species or designated critical habitat, the federal agency must submit its BA to the FWS and/or NMFS and, if it is determined that the action may adversely affect a listed species, the federal agency must submit a request for formal consultation to comply with Section 7 of the ESA. In response, the FWS and/or NMFS would issue a BO as to whether or not the federal action would likely jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Jordan Cove and Pacific Connector filed an applicant-prepared draft BA (APDBA) in December 2017, and a revised APDBA in September 2018. We are reviewing the revised APDBA and will prepare a BA and EFH Assessment, which will be submitted to the FWS and NMFS.

[134] Oregon has its own ESA that requires state agencies to protect and promote the recovery of state-listed threatened and endangered species. At the state level, consultation is conducted with the ODA for state listed plant species and the ODFW for fish and wildlife species. However, state regulations pertaining to the protection of botanical resources are limited to ORS 564 and OAR Chapter 603, Division 73. Oregon regulations regarding state endangered and threatened plants only apply on non-federal public lands (e.g., state, county, city, etc. lands).

[135] The term "special status species" is also used by the BLM, but in a narrower agency-specific definition than in this assessment. BLM "special status species" include species listed as threatened or endangered under the ESA, species that are proposed for listing under the ESA, species that are candidates for listing under the ESA, and species designated by the BLM as "sensitive" under criteria in BLM Manual 6840. The Forest Service uses similar designations. For the Forest Service, "Survey and Manage" are managed under specific criteria provided in the Northwest Forest Plan rather than the agency "special status species" programs. Several species are designated as both "special status species" for the Forest Service and "Survey and Manage species." Those species are noted in the assessment and are analyzed here under criteria for both programs.

[136] Formerly known as the Oregon Natural Heritage Information Center (ORNHIC).

candidate, and special status species that potentially occur near the proposed Project, as described in the following sections. Species that were initially considered but were dropped from further consideration due to a lack of habitat or because they were not detected during targeted field surveys are listed in tables I-3, I-4, and I-5 in appendix I.

4.6.1 Federally Listed Threatened and Endangered Species

Table 4.6.1-1 lists the federally endangered, threatened, and proposed species that potentially occur in the Project area and are discussed below. Additional species (beyond those listed in table 4.6.1-1) are federally listed in Oregon (i.e., the Canada lynx, bull trout Klamath River DPS, yellow-billed cuckoo Western DPS, streaked horned lark, and slender Orcutt grass); however, these species are not known or expected to occur within the Project area and are not discussed further in this document (Canada lynx: Verts and Carraway 1998, McKelvey et al. 2000, ORBIC 2006b; bull trout Klamath River DPS: FWS 1998a, 2002a, ORBIC 2006b; yellow-billed cuckoo: FWS 2013b; streaked horned lark: FWS 2017b; SBS 2008a, 2012, 2013, 2014, 2017a; and slender Orcutt grass: ORBIC 2017b, FWS 2006b). In addition, the North American wolverine occurs in Oregon and has been proposed for listing as threatened under ESA; wolverines have been occasionally documented in Oregon, most recently in the Wallowa-Whitman National Forest in Northeast Oregon during 2011-2012 (Magoun et al. 2013), but no evidence for a reproducing, self-sustaining population has been found in the state. There appears to be an extremely remote chance of a wolverine dispersing into southwest Oregon, but that is not foreseeable during the construction of the proposed action, and as a result, the North American wolverine is not discussed further in this document. The Eastern DPS of the Steller sea lion, which occurs on the west coast of the U.S. and within the Project area, was delisted on December 4, 2013 (78 FR 66139), and thus is not discussed in this section.

Table 4.6.1-1 lists all potentially affected federally listed and proposed species, indicates the portion of the Project area where they may occur, and provides our preliminary determination of effect.

TABLE 4.6.1-1

Federally Listed and Proposed Species Potentially Occurring in the Project Area

Species	Federal Status	State Status	Portion of the Project Area Where Species May Occur	Effect of Proposed Project on Species, Critical Habitat a/
Mammals				
gray wolf *Canis lupus*	Endangered	Delisted	Pacific Connector pipeline	NLAA
Pacific fisbher (West Coast DPS b/) *Pekania pennanti*	Proposed Threatened	Sensitive	Pacific Connector pipeline	NJ/LAA c/
Pacific marten (Coastal DPS b/) *Martes caurina*	Proposed Threatened	Sensitive	Jordan Cove terminal, navigation reliability improvements dredge area	NJ/NLAA c/
lue whale *Balaenoptera musculus*	Endangered	Endangered	LNG carrier transit in the waterway	NLAA
fin whale *Balaenoptera physalus*	Endangered	Endangered	LNG carrier transit in the waterway	NLAA
killer whale –Eastern North Pacific Southern Resident stock *Orcinus orca*	Endangered – Critical Habitat	No listing	LNG carrier transit in the waterway	NLAA, NE
humpback whale *Megaptera novaeangliae*	Endangered	Endangered	LNG carrier transit in the waterway	NLAA
Sei whale *Balaenoptera borealis*	Endangered	Endangered	LNG carrier transit in the waterway	NLAA

TABLE 4.6.1-1 (continued)

Federally Listed and Proposed Species Potentially Occurring in the Project Area

Species	**Federal Status**	**State Status**	**Portion of the Project Area Where Species May Occur**	**Effect of Proposed Project on Species, Critical Habitat a/**
sperm whale *Physeter macrocephalus*	Endangered	Endangered	LNG carrier transit in the waterway	NLAA
North Pacific right whale *Eubalaena glacialis*	Endangered – Critical Habitat	Endangered	LNG carrier transit in the waterway	NLAA, NE
gray whale (Western North Pacific Stock) *Eschrichtius robustus*	Endangered	No listing	LNG carrier transit in the waterway, navigation reliability improvements dredge area	NLAA
Birds				
short-tailed albatross *Phoebastria albatraus*	Endangered	Endangered	LNG carrier transit in the waterway	NLAA
Western snowy plover *Charadrius alexandrinus nivosus*	Threatened – Critical Habitat	Threatened	Jordan Cove terminal, navigation reliability improvements dredge area	NLAA, NLAA
marbled murrelet *Brachyrampus marmoratus*	Threatened – Critical Habitat	Threatened	LNG carrier transit in the waterway Jordan Cove terminal, navigation reliability improvements dredge area Pacific Connector pipeline	LAA, LAA
Northern spotted owl *Strix occidentalis caurina*	Threatened – Critical Habitat	Threatened	Jordan Cove terminal Pacific Connector pipeline	LAA, LAA
Fishes				
North American green sturgeon (Southern DPS) *Acipenser medirostris*	Threatened – Critical Habitat	Sensitive Critical	LNG carrier transit in the waterway Jordan Cove terminal	LAA, LAA
Coho salmon (South OR/North CA Coast ESU) *Oncorhynchus kisutch*	Threatened – Critical Habitat	Sensitive	LNG carrier transit in the waterway Pacific Connector pipeline	LAA, LAA
Eulachon (Southern DPS) *Thaleichthys pacificus*	Threatened– Critical Habitat	No listing	LNG carrier transit in the waterway Jordan Cove terminal Pacific Connector pipeline	LAA, NE
Coho salmon (Oregon Coast ESU) *Oncorhynchus kisutch*	Threatened – Critical Habitat	Sensitive	LNG carrier transit in the waterway Jordan Cove terminal Pacific Connector pipeline	LAA, LAA
Lost River sucker *Deltistes luxatus*	Endangered – Critical Habitat	Endangered	Pacific Connector pipeline	LAA, NLAA
shortnose sucker *Chasmistes brevirostris*	Endangered – Critical Habitat	Endangered	Pacific Connector pipeline	LAA, NLAA
Amphibians and Reptiles				
green turtle *Chelonia mydas*	Threatened – Critical Habitat	Endangered	LNG carrier transit in the waterway	NLAA, NE
leatherback turtle *Dermochelys coriacea*	Endangered – Critical Habitat	Endangered	LNG carrier transit in the waterway	NLAA, NLAA
Olive Ridley turtle *Lepidochelys olivacea*	Threatened	Threatened	LNG carrier transit in the waterway	NLAA
loggerhead turtle *Caretta caretta*	Endangered	Threatened	LNG carrier transit in the waterway	NLAA
Oregon spotted frog *Rana pretiosa*	Threatened –Critical Habitat	Sensitive Critical	Pacific Connector pipeline	NLAA, NLAA
Invertebrates				
vernal pool fairy shrimp *Branchinecta lynchi*	Threatened – Critical Habitat	No listing	Pacific Connector pipeline	LAA, NLAA

TABLE 4.6.1-1 (continued)

Federally Listed and Proposed Species Potentially Occurring in the Project Area

Species	Federal Status	State Status	Portion of the Project Area Where Species May Occur	Effect of Proposed Project on Species, Critical Habitat a/
Plants				
Applegate's milk-vetch *Astragalus applegatei*	Endangered	Endangered	Pacific Connector pipeline	LAA
Gentner's fritillary *Fritillaria gentneri*	Endangered	Endangered	Pacific Connector pipeline	LAA
Western lily *Lillium occidentale*	Endangered	Endangered	Jordan Cove terminal Pacific Connector pipeline	NLAA
large-flowered woolly meadowfoam *Limnanthes pumila* ssp. *grandiflora*	Endangered – Critical Habitat	Endangered	Pacific Connector pipeline	NLAA, NLAA
Cook's lomatium *Lomatium cookii*	Endangered – Critical Habitat	Endangered	Pacific Connector pipeline	NLAA, NE
Kincaid's lupine *Lupinus suphureus* var. *kincaidii*	Threatened –Critical Habitat	Threatened	Pacific Connector pipeline	LAA, NE
rough popcornflower *Plagiobothrys hirtus*	Endangered	Endangered	Pacific Connector pipeline	NLAA

a/ Effects Key:
NLAA = Not likely to adversely affect, LAA = Likely to adversely affect, NE = No effect, NJ = not likely to jeopardize the continued existence for proposed species

b/ DPS=Distinct Population Segment

c/ This represents a provisional effect determination for this ESA proposed species. This provisional effect determination would apply if the species becomes listed prior to the completion of consultaion on the Project.

4.6.1.1 Mammals

Gray Wolf (Federal Endangered Species, State Delisted)

The federal ESA in Oregon protects gray wolves west of highways 395-78-95 (ODFW 2017e). Gray wolves were delisted from the Oregon ESA in 2015 (ODFW 2017f). Wolves are habitat generalists that only require the presence of ungulate prey and absence of excessive human-caused mortality (FWS 2013c). Wolf pack territory size is a function of prey density and can range from 25 to 1,500 square miles (FWS 2013c). Both male and female wolves disperse, sometimes greater than 600 miles (FWS 2013c).

A radio-collared male (i.e., OR7) dispersing from a pack in northeastern Oregon has been documented in southwestern Oregon and northern California since 2011, including near the Project in Jackson, Douglas, and Klamath Counties (ODFW 2013b). In 2014, a female joined the male, and they produced their first litter that year consisting of three pups (ODFW 2014e). This was the first evidence of wolves breeding in the Oregon Cascades since the early twentieth century (ODFW 2014d). The den was located within the Rogue River National Forest, between Crater Lake and Mount McLoughlin (Young 2014), approximately 6 miles from the pipeline route. Additional pups were born in 2015, 2016, and 2017 (ODFW 2018b). The Area of Known Wolf Activity (AKWA) initially mapped by ODFW for OR7 in 2014 (ODFW 2014c) is crossed by the pipeline route. The AKWA for OR7 and the Rogue Pack has shifted in size and shape since 2014. As currently mapped, it is less than 5 miles from the pipeline route in Jackson and Klamath Counties.

A second AKWA (Keno) was established in southwest Oregon in 2014 with limited evidence that three wolves inhabited an area approximately 280 square miles. ODFW recently removed the AKWA designation for the Keno wolves and is designating it as no longer active, but possibly used as a corridor for wolves moving between Oregon and California (ODFW 2018b). Approximately 2.48 miles of the pipeline route would pass through this area.

Three other radio-collared wolves dispersed from northeastern Oregon to southwest Oregon. One single male wolf (OR25) dispersed in 2015 and established an AKWA spanning northern Klamath County with portions in adjacent Jackson County and Lake County. A radio-collared female wolf (OR28) dispersed in late 2015 and was joined by a collared male (OR3) to establish the Silver Lake AKWA which coincides with the Silver Lake Wildlife Management Unit in western Lake County. The pair produced one pup in 2016 but the male was killed in 2016 (ODFW 2017g).

Given the occurrence of gray wolves in the areas affected by the Project, potential direct and indirect effects from construction and operation of the pipeline include the following:

- Construction-related noise. Construction would produce noise. Wolves appear most vulnerable to human disturbance in and around denning and rendezvous sites. No active denning sites are known within 1 mile of the pipeline.
- Locally concentrated human activities. Available evidence has shown that wolves subjected to increased vehicular traffic will avoid roads and will move pups if disturbed during denning. Wolves disturbed during winter indicated a physiological stress response to snowmobile stimuli.
- Increased risk of collision with construction vehicles along Project area roadways. Vehicles have killed a small number of wolves; overall, 80 percent of all wolf mortalities in the Northern Rocky Mountain population (which includes wolves in the Project area) are caused by humans but only 3 percent are due to accidental human interactions including vehicle collisions and capture mortality (FWS 2012a).
- Wildland fire as an indirect effect associated with increased human presence. The possibility of ignition in conifer and sagebrush/grass fuel types could range from low to extreme depending on weather conditions and patterns, current fire risk rating, moisture conditions, and fuel loadings. There is some possibility of human-caused fire, whether related to pipeline activities or to Project-induced increase of human presence in the area.
- Habitat alteration. Construction would remove forested habitat that might be used by some species that are preyed upon by wolves. However, corridors created within forested habitats are used for movement and foraging by big game species, which are prey for wolves.

Below is a determination of effects summary for this species and critical habitat. More details will be provided in the pending BA.

The Project **may affect** the gray wolf because:

- dispersing and resident wolves have been documented recently near the Project area;
- the OR7 wolf family den was near the pipeline route in 2014;
- construction noise could disturb wolves if present near the pipeline; and
- increased human presence associated with construction activities could affect wolf behavior and movements, including the chance of collisions with vehicles.

However, the Project is **not likely to adversely affect** the gray wolf because:

- the OR-7 den within the Rogue River National Forest is at least 6 miles from the pipeline;
- Project-related noises are not likely to be substantially different from noises produced by existing recreation and logging activities that wolves have been shown to tolerate;
- during pipeline construction, trash would be removed daily, and roadside carrion is expected to be present as an existing condition, and not substantially increased by the Project; and
- following construction, the restored and revegetated pipeline corridor is likely to increase habitat diversity and forage used by ungulates such as deer (Brusnyk and Westworth 1985; Forman 1995), which are prey for gray wolves.

No critical habitat has been designated or proposed for the gray wolf.

Pacific Marten-Coastal DPS (Federal Proposed Threatened Species, State Sensitive Species)

On October 9, 2018, the FWS proposed to list the coastal DPS of Pacific marten *(Martes caurina)* as a threatened species under the ESA (83 FR 150576). Should the rule for this species be finalized as proposed, it would be protected under ESA. The most current information for this species is provided in an updated species status assessment report, and provides a comprehensive account of the species, its life history needs, and stressors to the overall viability and extinction risk for the coastal marten (FWS 2018a). The coastal marten is a mammal in the weasel family and is native to forests of coastal Oregon and coastal California. They occur primarily in older forests, although there is one remnant population occupying the coastal dune forest of central Oregon. Coastal marten historically ranged throughout coastal Oregon and coastal northern California but have not recently been detected throughout much of the historical range, despite extensive surveys. The species exists in four small populations and is absent from the northern and southern ends of its historical range. In Oregon, there are two identified isolated small extent population areas: Central Coastal and Southern Coastal. The Jordan Cove LNG Project falls within the southern portion of the Central Coastal population area and the Pacific Connector pipeline crosses its historical range.

The Central Coastal Oregon population centers on the coastal forest of the Oregon Dunes National Recreation Area (ODNRA) and is managed by the Siuslaw National Forest. Most of this area comprises coastal forest that is less than 70 years old, and consists of shore pine and transitional shore pine/Douglas–fir–hemlock forests within the ODNRA. These forests grow on nutrient-poor sandy soils, dominated by young stands of shore pine and Sitka spruce. The dense understory is dominated by willow (*Salix hookeri*), Pacific waxmyrtle (*Myrica californica*), and berry-producing ericaceous shrubs such as evergreen huckleberry (*Vaccinium ovatum*) and salal (G*aultheria shallon*). These shore pine forests have a variable tree overstory; however, the common denominator with this habitat and older forest habitats is the presence of dense, spatially extensive ericaceous shrub understories and diverse and abundant prey. Coastal martens have a generalist diet that changes seasonally with prey availability. Overall, their diet is dominated by mammals (primarily voles in Central Coastal population area), but birds, insects, and fruits are seasonally important.

Reports by Zielinski et al. (2001) and Moriarty et al. (2016) noted a relatively high incidence of road kills in the last 30 years (i.e., 17) and it was assumed that animals were abundant. Linnell et al. (2018) used recent surveys to refine the extent of the Central Coastal population size of fewer than 87 adults divided into two subpopulations; however, there is no information at this time on long–term trends in population size. The 2018 species status assessment further divides this population into two subpopulations of approximately 30 adults each, separated by the Umpqua River, a relatively large barrier to movement and dispersal. Martens in this population occur in the highest densities reported for any North American marten subspecies (1.13 per square kilometer; Linnell et al. 2018). The Southern Coastal population area in Oregon is located over 40 miles to the south and would not be affected by the Project.

The 2018 species status assessment identifies various factors (stressors) that are directly and indirectly affecting what the coastal marten needs for long-term viability. These include loss of habitat due to wildfire, timber harvest, and vegetation management. Trapping, collisions with vehicles, and rodenticides are all impacting marten individuals, and the threat of disease carries the risk of further reducing populations. Changes in vegetation composition and distribution have also made coastal martens more susceptible to predation from larger carnivores. These threats are expected to be exacerbated by the species' small and isolated populations. Linnell et al. (2018) suggest that small population size, consistent annual human-caused mortality (primarily trapping and road kills), and isolation indicate this coastal marten population is likely to remain vulnerable to extirpation.

Section 4.4 describes five forested and two woodland vegetation types that may be suitable habitat for marten and would be affected by the construction and operation of the Jordan Cove LNG Project. The vegetation types are shown on figures 4.4-1a and 4.4-1b. Table 4.4.1.5-1 estimates that approximately 76 acres and 62 acres of forested and woodland vegetation would be cleared for the LNG facilities and temporary construction areas, respectively.

Given that the Project falls within the southern portion of the Central Coastal population area and the occurrence of marten habitat within the area of the proposed Project footprint, potential direct and indirect effects from construction and operation of the Project include the following:

- <u>Construction-related noise.</u> Construction would produce noise; and martens appear most vulnerable to human disturbance in and around denning and resting habitat. No active denning sites are currently known in the vicinity of the Project site.
- <u>Locally concentrated human activities.</u> Available evidence has shown that martens are subject to road kills and increased vehicular traffic has the potential to increased vehicle collision mortality.
- <u>Habitat alteration</u>. Construction would remove forested habitat that might be used by martens or species that are preyed upon by martens, or otherwise increase fragmentation within suitable habitat. However, much of the forested portions within the Jordan Cove Project boundaries are already in a disturbed state.
- <u>Wildland fire as an indirect effect associated with increased human presence</u>. The possibility of ignition in conifer and sagebrush/grass fuel types could range from low to extreme depending on weather conditions and patterns, current fire risk rating, moisture conditions, and fuel loadings. There is some possibility of human-caused fire, whether related to construction activities or to Project-induced increase of human presence in the area.

Below is a determination of effects summary for Pacific marten- coastal DPS. At this time, no critical habitat has been proposed or designated for this species. More details will be provided should this species become listed as threatened under ESA, including potential exceptions and/or any designation of critical habitat.

The Project **will not jeopardize the continued existence** of the Pacific marten- coastal DPS; however, in the event that Pacific marten- coastal DPS becomes listed prior to completion of the Project, a provisional effect determination is provided.

The Project **may affect** the Pacific marten- coastal DPS because:

- marten historically used the entire Oregon coastal region;
- the southern portion of the Central Coast population area overlaps with the Jordan Cove LNG Project;
- the Project would remove suitable habitat for the coastal DPS population; and
- increased human presence associated with construction activities could affect marten behavior and movements, including the chance of collisions with vehicles.

However, the Project is **not likely to adversely affect** Pacific marten-coastal DPS because:

- there is a relatively low potential for the coastal DPS individuals to occur based on historical accounts and the current low estimated number of individuals south of the Umpqua River;
- project-related noises are not likely to be substantially different from noises produced by existing recreation and logging activities that martens have been shown to tolerate;
- during Project construction, trash would be removed daily to reduce the potential for predator species; and
- construction-related vehicles and equipment would operate at slower speeds, and therefore not substantially increase the potential for vehicle collisions.

Pacific Fisher-West Coast DPS (Federal Proposed Threatened Species, State Sensitive-Critical Species)

The FWS proposed to list the West Coast DPS of the Pacific fisher as threatened under the ESA on October 7, 2014 (79 FR 60419). In April 2016, the FWS determined that the fisher does not warrant listing under the ESA (81 FR 22710). However, on September 21, 2018, the decision to deny the fisher protected status was rescinded and the comment period for the proposed rule to list the West Coast DPS of the fisher was reopened (84 FR 644). The FWS is scheduled to issue a new finding by March 22, 2019.

Fishers occur in the northern coniferous and mixed forests of Canada and the northern United States (69 FR 18770). The West Coast DPS includes fishers in Washington, Oregon, and California. In Oregon, this species is currently known to occur in Curry, Douglas, Jackson, Josephine, and Klamath Counties (Aubry and Lewis 2003; Aubry pers. comm. 2007 as cited in FWS 2014b). Currently, there are two documented populations of fisher in southern Oregon, one in the northern Siskiyou Mountains and one in the southern Cascade Range, that were believed to be genetically isolated from each other (FWS 2014b). However, recent research shows that the two populations are not genetically isolated (Barry et al. 2018).

Fisher habitat consists of mature, closed canopy coniferous and mixed conifer and hardwood forests at low to middle elevations, including riparian corridors with continuous canopies, and large stands with low levels of fragmentation and a high percentage of dead and downed timber (ODFW 2019; FWS 2016a). Fishers prefer large tracts of contiguous interior forest and typically avoid thinned or open forests, including areas where there is substancial human disturbance. A variety of large conifer tree species are used for denning and resting, including Douglas-fir, white fir, incense cedar, red fir, sugar pine, western white pine, ponderosa pine and lodgepole pine (Aubry and Raley 2006; Cummins et al. 2018). In the southern Oregon Cascades, average home range sizes for females were approximately 9.7 square miles and between 24 square miles for males during the non-breeding season and 57 square miles for males during the breeding season, based on locations of radio telemetered study animals (Aubry and Raley 2006).

Loss and fragmentation of habitat due to timber harvest and thinning, roads, urban development, recreation, and wildfire are the main reasons for the decline of the fisher in the west (FWS 2018b). Habitat loss, modification, and fragmentation continue to occur as a result of forest management practices and stand replacing wildfire, and appear to pose a substantial threat to fishers (FWS 2012b). In addition to removing forage, rest, and den sites, fragmentation can increase predation risk, impede movements, and affect prey species composition, abundance, and availability (FWS 2012b). Fragmentation can also increase energetic costs to fishers, which may result in nutritional stress that can reduce animal condition, ultimately affecting survival, reproduction, and recruitment (Lofroth et al. 2010). Additionally, linear infrastructure such as roads, power lines, and pipelines can also affect fisher populations and their habitat (FWS 2016a). As well as being sources of mortality from vehicle collision, these linear infrastructure features can result in permanent removal or alteration of potential fisher habitat and can disrupt movement patterns (FWS 2016a). However, linear infrastructure is considered to be a low-level impact to fishers currently and in the future (FWS 2016a).

Recent telemetry studies in the southern Oregon Cascades identified fisher home ranges that overlap with the Project on the Winema National Forest (Cummins 2018). Location databases show one observation within 1 mile and one observation within 1 to 3 miles of the Project on the Winema National Forest. These observations, together with the availability of suitable habitat within the pipeline ROW, indicate that there is potential for fishers to be present within the analysis area.

Section 4.5 discusses the various wildlife habitat types (from Johnson and O'Neil 2001) crossed by the Project. Late successional and old-growth forest within five forest and woodland habitat types crossed by the pipeline may provide habitat for the fisher. These habitat types include Westside Lowland Conifer-Hardwood Forest, Montane Mixed Conifer Forest, Southwest Oregon Mixed Conifer-Hardwood Forest, Westside Riparian-Wetlands, and Eastside Riparian-Wetlands. Table 4.5.1.2-5 estimates that approximately 657.9 acres of these habitat types would be cleared for the construction of the pipeline.

Given the potential for occurrence of fishers in the areas affected by the Project, potential direct and indirect effects from construction and operation of the pipeline include the following:

- <u>Construction-related noise.</u> Construction would produce noise. Fishers are vulnerable to human disturbance and fishers have been documented within 1 mile of the pipeline.

- Locally concentrated human activities. Construction activities could affect fishers by disturbing animals. Fishers are sensitive to disturbance and avoid areas used by humans (CBD 2000).
- Increased risk of collision with construction vehicles along Project area roadways. Human-caused mortality from vehicle collisions are listed as one of the threats to fisher populations (FWS 2018b).
- Habitat alteration and fragmentation. Construction would remove forested habitat and would modify habitat, particularly by removing large trees, snags, and large woody debris that are used for fisher den and rest sites. The cleared ROW could also fragment habitat, which is detrimental to fishers because they prefer large areas of contiguous, unfragmented forest (CBD 2000).
- Wildland fire as an indirect effect associated with increased human presence. The possibility of ignition in conifer, hardwood, and sagebrush/grass fuel types could range from low to extreme depending on weather conditions and patterns, current fire risk rating, moisture conditions, and fuel loadings. There is some possibility of human-caused fire, whether related to pipeline activities or to Project-induced increase of human presence in the area.

Below is a determination of effects summary for Pacific fisher-West Coast DPS. At this time, no critical habitat has been proposed or designated for this species. More details will be provided should this species become listed as threatened under the ESA, including potential exceptions and/or any designation of critical habitat.

The Project **will not jeopardize the continued existence** of the Pacific fisher-West Coast DPS; however, in the event that Pacific fisher-West Coast DPS becomes listed prior to completion of the Project, a provisional effect determination is provided.

The Project **may affect** the fisher because:

- fishers have the potential to occur in the fisher analysis area;
- suitable habitat is available within the fisher analysis area and would be impacted by the pipeline;
- construction noise could disturb fishers if present near the pipeline; and
- increased human presence associated with construction activities could affect fisher behavior and movements, including the chance of collisions with vehicles.

The following determination is warranted to receive a conference opinion of **may affect, likely to adversely affect** because:

- Recent telemetry studies in the southern Oregon Cascades identified fisher home ranges that overlap with the Project;
- 657.9 acres of suitable LSOG habitat, including snags, would be removed due to pipeline construction.
- Snags and large trees that could serve as fisher dens would be removed during pipeline construction.

Whales

Eight species of federally listed whales potentially occur off the coast of Oregon, including the blue, fin, southern resident killer, humpback, sei, north Pacific right, gray (Western North Pacific Stock) and sperm whales. All these whale species are federally protected under the MMPA. These species tend to feed during the summer in the northern latitudes and migrate to the tropical southern latitudes in the winter for breeding. However, whales could be encountered off the coast of Oregon throughout the year. Two killer whales were documented near the Project area in May 2017 during marine mammal surveys for the Project, although these were likely transient killer whales not belonging to the southern resident DPS (AECOM 2017). Gray whales have been reported in Coos Bay only on an occasional basis. Project effects on whales would be associated with LNG and construction supply vessel transits in the waterway inbound and outbound from the Jordan Cove terminal, as well as construction activities such as dredging and pile driving. Potential direct effects of the Project could include injury and/or mortality due to ship-strikes, injury or behavioral disturbance due to noise from vessels and construction activities, and potential adverse effects from a ship fuel spill. Spills could indirectly affect whales by harming or contaminating forage species. Additional details on whale densities and potential for ship strikes will be provided in the pending BA.

Below is a determination of effects summary for whales and critical habitat. More details will be provided in the pending BA.

The Project **may affect** federally listed whales because:

- federally listed whales may occur within the aquatic analysis areas (Figure 4.5-1 in section 4.5; includes the Coos Bay estuary and marine environment out approximately 12 nautical miles to the outer continental shelf) during construction and operation of the proposed action;
- vibratory sheet pile driving has the potential to exceed the NMFS interim behavioral disturbance threshold of 120 decibel (dB) re 1 microPascal (μPa) at distances of up to 1.2 miles (Deveau and MacGillvray 2017) and impact pipe pile driving has the potential to exceed the NMFS interim behavioral disturbance threshold of 160 dB re 1 μPa at 1.1 miles (O'Neill and MacGillvray 2017); and
- the proposed action would increase shipping traffic (LNG carriers) within the aquatic analysis areas.

However, the Project is **not likely to adversely affect** federally listed whales for the following reasons:

- ship strikes on whales off the Oregon coast are thought to be infrequent based on the Rockwood et al. (2018) assessment of potential whale/vessel collision mortalities for blue, humpback, and fin whales of less than 1 percent, and therefore thought to be discountable;
- 120 LNG carrier trips per year to the LNG terminal are expected to increase the potential in ship strikes to whales over known frequencies of incidents; however, Jordan Cove would provide a ship strike avoidance measures package to LNG carrier operators transporting cargo from the LNG terminal that would consist of multiple measures to avoid striking marine mammals;

- FERC does not have authority over the LNG carrier; however, the independent carrier operators would be required to follow all Coast Guard requirements regarding the operation of LNG carriers, including vessel speeds;
- noise from LNG carriers, dredgers, tugs, and other support vessels could result in behavioral disturbance to listed whales and effects of ship noise on whales could exceed NMFS interim noise exposure criteria for Level B single non-pulse noise (NMFS 2016c, 2017b, 2018c), but LNG carrier noise would not exceed existing background ship noise levels and would not cause injury;
- whales inside Coos Bay in the vicinity of the Jordan Cove LNG Project may be affected by noise from piling during construction, and the use of an impact hammer has impulsive peak source levels that are high enough to cause permantent threshold shift (PTS) (an indicator of hearing damage) in these species; however, listed whales are unlikely to occur within Coos Bay during pile driving (October 1 to February 15), and Jordan Cove has indicated that these activities would be monitored and halted if a whale was detected in the area around the sound source;
- given vessel design, on-board spill kits, safety records, and implementation of Coast Guard recommendations, it is not likely that there would be a major ship spill of hazardous materials that may adversely affect water quality or aquatic species; and
- the relative population density of whales within the marine analysis area[137] would be low enough so that Project-related effects of LNG carrier transit in the waterway would be discountable.

No critical habitat has been designated or proposed for blue, fin, humpback, sei, or sperm whales.

The Project would have **no effect** on designated critical habitat units (CHUs) for the Eastern Northern Pacific Southern Resident stock of killer whales because:

- none of the designated CHUs occur within the marine analysis area off the Oregon coast.

The Project would have **no effect** on designated critical habitat for the North Pacific right whale because:

- none of the designated critical habitat occurs within the marine analysis area off the Oregon coast.

As described above, listed whales inside Coos Bay near the Jordan Cove LNG Project may be affected by noise from pile driving during construction, and the use of an impact hammer has impulsive peak source levels that are high enough to cause PTS (an indicator of hearing damage) in these species. Therefore, **we recommend that:**

- **<u>Prior to construction,</u> Jordan Cove should file with the Secretary, for review and written approval by the Director of OEP, a *Marine Mammal Monitoring Plan* that identifies how the presence of listed whales will be determined during construction,**

[137] Whale density estimates were based on habitat specific densities for blue whales, fin whales, and humpback whales (Becker et al. 2012; Calambokidis et al. 2015). Quantified comparable estimates for other species were not available, but the existing data were examined to qualitatively determine the level of risk to these species. These data sources and analyses are further described in the Applicant Prepared Draft Biological Assessment, filed with the FERC September 14, 2018.

and measures Jordan Cove will take to minimize potential noise effects on whales and other marine mammals, and ensure compliance with NMFS underwater noise criteria for the protection of listed whales.

4.6.1.2 Birds

Short-tailed Albatross (Federal Endangered Species, No State Status)

The short-tailed albatross was listed as endangered throughout its range in the United States on July 31, 2000 (FWS 2000a). In the North Pacific, the coastal habitat for the short-tailed albatross is in high-productivity areas with expansive deep water beyond the continental shelf. Short-tailed albatross rarely occur closer to the coast, but have been documented to occur off the Oregon coast near Coos Bay (in 1961, 2000, and 2001; National Audubon Society 2013). Because the closest breeding population of short-tailed albatross is within the Hawaiian Islands, the Project should not affect recovery criteria for the species. The short-tailed albatross could potentially be encountered within the LNG carrier transit route; however, short-tailed albatross are expected to avoid LNG marine traffic. Below is a determination of effects summary for the short-tailed albatross and critical habitat. More details will be provided in our pending BA.

The Project **may affect** short-tailed albatross because:

- short-tailed albatross may occur within the marine analysis area during operation of the proposed action; and
- the proposed action would increase shipping traffic (LNG carriers) within the marine analysis area.

However, the Project is **not likely to adversely affect** short-tailed albatross for the following reasons:

- other species of albatross have infrequently collided with airplanes in flight but collisions of any albatross species with ships are unknown and are expected to be highly unlikely;
- 120 LNG carrier trips per year to the LNG terminal are expected to cause unmeasurable increase in potential ship strikes on short-tailed albatrosses;
- LNG carriers approaching Coos Bay would be traveling slowly and escorted by tractor tugs from 5 nautical miles offshore; and
- given vessel design, on-board spill kits, safety records, and implementation of Coast Guard recommendations, it is not likely that there would be a major ship spill of hazardous materials that may adversely affect water quality or aquatic species. Any oil released at sea would be in small enough quantities that potential effects on short-tailed albatrosses would be discountable.

No critical habitat has been designated or proposed for the short-tailed albatross.

Western Snowy Plover (coastal) (Federal Threatened Species with Critical Habitat, State Threatened Species)

The Pacific Coast population of western snowy plover has been listed as a threatened species under the ESA since March 5, 1993 (FWS 1993a). The Pacific coast population includes birds that nest adjacent to tidal waters, including all nesting birds on the mainland coast, peninsulas, offshore islands, adjacent bays, estuaries, and coastal rivers (FWS 1993a). The western snowy plover is a year-round, uncommon resident of the North Spit (BLM 2005); the spit supports the most productive snowy plover population segment on the Oregon coast (BLM 2008). Western snowy plovers may be encountered along the LNG carrier transit route from nearshore coastal waters to the LNG terminal. Potential effects include increased noise associated with construction of the Jordan Cove LNG Project, operation activities associated with shipping, increased recreation, increased habitat conversion, habitat degradation by human encroachment, and increased illegal harvest (Comer 1982). Conservation measures proposed to reduce effects include implementation of BMPs, education and outreach, and monitoring. CHUs OR-10 and OR-9 are located 2.6 and 6.9 miles from the LNG terminal, respectively; both units were occupied by western snowy plovers at the time of listing (1993) and in 2012. Below is a determination of effects summary for the western snowy plover and critical habitat. More details will be provided in our pending BA.

The Project **may affect** western snowy plovers because:

- the closest western snowy plover nesting habitat to the Project is on the North Spit approximately 1 mile from LNG terminal site, and contained active nests during 2016 surveys;
- temporary construction activities would occur at the Port Laydown site, which is less than 1 mile from known nesting sites;
- the meteorological station is located east of the foredune, approximately 100 feet from the northern extent of known nesting sites;
- impact hammer noise associated with the Navigation Reliability Improvement temporary facilities is expected to be above ambient levels, and may disturb wintering western snowy plovers if present along the eastern edge of the primary nesting area on the North Spit, which is within 0.25-miles of Dredge Area 1; and
- Jordan Cove terminal construction and operations personnel would likely use the North Spit for recreational purposes and increased recreational use could result in increased plover disturbance including destruction of nests by dogs, off-road vehicle traffic, inadvertent trampling, or increased predation if scavengers and predators (corvids, coyotes, striped skunk, feral cats) are attracted to nesting areas due to the presence of trash and food remains.

However, the Project is **not likely to adversely affect** western snowy plover because:

- Jordan Cove LNG Project construction noise at active nest sites (approximately 1 mile) and critical habitat (approximately 2.6 miles) is not expected be above ambient levels.
- Dredging operations would take place within the ODFW in-water work window, which is outside of the nesting period for western snowy plovers and dredging noise level is unlikely to affect wintering plovers approximately 0.25 miles away. Access to dredging areas would be by marine transport with no land-based access near primary snowy plover habitat.
- The meteorological station would be constructed outside the nesting season (March 15 to September 15) to avoid disturbance to snowy plovers and would include spikes or other deterrent measures on any potential perching surface, bird deterrent measures if guy-lines are required, and shielded security lighting to minimize glare. Operational activities would be maintenance-related and would be scheduled outside of the nesting season.
- Jordan Cove would minimize disturbance by humans, pets, vehicles or human-attracted predators through implementation of (1) BMPs to minimize predator density related to

increased human presence and habitat removal, and (2) education and outreach programs intended to train all construction and operations staff on the need for snowy plover conservation; current snowy plover regulations and recreational use restrictions; and the importance of conservation measures, including: litter control, avoidance of nesting and foraging areas, keeping pets on-leash, and remaining on established roads and trails.

Even though the northern end of CHU OR-10 on the North Spit is located approximately 2.6 miles from the Jordan Cove LNG Project, the Project **may affect** designated critical habitat for the western snowy plover because:

- temporary construction activities would occur at the Port Laydown site, which is approximately 1 mile from critical habitat;
- the Navigation Reliability Improvements Dredge Area 1 is approximately 0.25 mile from critical habitat; and
- the Project would result in a large but temporary increase in people employed on the North Spit during construction, and a much smaller long-term increase of operations staff. The additional human presence is likely to increase use of the North Spit with concomitant potential increase of pets, vehicles, and/or human-attracted predators.

However, the Project is **not likely to adversely affect** designated critical habitat for the western snowy plover because:

- dredging noise level is unlikely to affect physical or biological features (PBF) at CHU OR-10 approximately 0.25 miles away; and
- Jordan Cove would minimize potential secondary effects on the critical habitat PBF that identifies disturbance by humans, pets, vehicles or human-attracted predators through implementation of (1) BMPs to minimize predator density related to increased human presence and habitat removal, and (2) education and outreach programs intended to train all construction and operations staff on the need for snowy plover conservation; current snowy plover regulations and recreational use restrictions; and the importance of conservation measures, including: litter control, avoidance of nesting and foraging areas, keeping pets on leash, and remaining on established roads and trails.

Marbled Murrelet (Federal Threatened Species with Critical Habitat, State Threatened Species)

MAMUs in Washington, Oregon, and California were listed as threatened under the ESA on October 1, 1992 (FWS 1992a). Critical habitat for the MAMU was first designated on May 24, 1996 (FWS 1996) and subsequently revised in 2011 (FWS 2011b, 2016b). Throughout the forested portion of their range, MAMU habitat use is positively associated with the presence and abundance of mature and old-growth forests, large core areas of old-growth, low amounts of edge and fragmentation, proximity to the marine environment, and increasing forest age and height, although the presence of platforms is the most important characteristic of nesting habitat (FWS 2006c).

Through a combination of GIS data provided by the BLM and private timber companies, and field surveys conducted between 2007 and 2018, Pacific Connector identified 175 occupied and presumed occupied MAMU stands within 0.25 mile of the proposed action, or within 0.5 mile of federally-designated critical habitat that would be affected by the proposed action.

Construction of the Project would remove a total of about 806 acres of MAMU habitat (suitable, recruitment, capable), including about 78 acres of suitable habitat removed from 37 stands (18 occupied MAMU stands and 19 presumed occupied stands). There is the potential that effects could extend over a total of about 7,145 acres of suitable nesting habitat in the terrestrial nesting analysis area (i.e., the extent of disturbance/disruption of MAMU during the breeding season; FWS 2014c), where Project-related noise, primarily use of access roads, may affect MAMU behavior, including breeding activities. HDD and DP activities are not anticipated to disturb nesting MAMU as noise associated with this work would attenuate to ambient levels before reaching MAMU stands. Ten occupied and 24 presumed occupied MAMU stands occur within CHU OR-06 (b, c, and d) within the proposed terrestrial nesting analysis area. Overall, construction of the Pacific Connector Pipeline Project would remove about 4 acres of suitable MAMU nesting habitat (PBF-1) and about 12 acres of recruitment habitat and 15 acres of capable habitat (both of which make up PBF-2) within CHU OR-06-d.

Pacific Connector would implement several measures to reduce effects on MAMU habitat, including using UCSAs, and replanting conifer trees outside of the 30-foot-wide maintenance corridor on certain federal lands and non-federal lands. However, replanted trees may be harvested from non-federal lands or federal lands slated for timber harvest (i.e., Matrix lands and Harvest Land Base), and if allowed to grow would provide minimal benefit to MAMUs because it would take decades at a minimum to restore replanted forests to recruitment or suitable habitat conditions. To ensure that trees with active murrelet nests and chicks are not felled, timber would be removed outside of the entire MAMU breeding season (after September 15 but before March 31) within 300 feet of MAMU stands to avoid this direct effect on MAMU. To minimize disturbance and disruption of MAMU during operations and maintenance, vegetation maintenance activities would occur between August 1 and April 15, and Pacific Connector would apply daily timing restrictions during activities to minimize effects on MAMU during the late breeding season (August 6 – September 15).

Below is a determination of effects summary for the MAMU and critical habitat. More details will be provided in the pending BA.

The Project **may affect** MAMUs because:

- suitable habitat is available within the terrestrial nesting analysis area;
- MAMUs have been located within the terrestrial nesting analysis area during survey efforts for the proposed action; and
- MAMUs are expected to forage offshore in the marine analysis area, and within Coos Bay in the estuarine analysis area.

The Project is **likely to adversely affect** MAMUs for the following reasons:

- Disturbance associated with Pacific Connector Pipeline Project activities and construction of the Kentuck project would occur within the critical breeding season and within 0.25 mile of known MAMU stands.
- Proposed actions that generate noise above local ambient levels levels in approximately 7,145 acres of suitable habitat might disturb or disrupt MAMUs and interfere with essential nesting behaviors:

  - 82 MAMU stands (25 occupied and 57 presumed occupied) are within 0.25 mile of the pipeline that could be constructed during the breeding season.
  - 168 MAMU stands (50 occupied and 118 presumed occupied) are within 0.25 mile of access roads that could be used during pipeline construction in the breeding season.
- Blasting for the pipeline trench may occur within 0.25 mile of 11 MAMU stands between April 1 and September 30.
- Helicopter use within 0.25 mile of eight occupied MAMU stands during the breeding period (between April 1 and September 15) could occur and disturb MAMU adults and nestlings, as well as potentially blow nestlings out of the nest tree within six occupied MAMU stands from rotor wash.
- The Pacific Connector Pipeline Project would remove approximately 78 acres of suitable nesting habitat within the range of the MAMU; or approximately 0.5 percent of the 14,310 acres of suitable habitat available in the terrestrial nesting analysis area.
- The Pacific Connector Pipeline Project would remove approximately 307 acres of recruitment habitat and 421 acres of capable habitat within the range of the MAMU. These habitats do not currently support the recovery of the species.
- The Pacific Connector Pipeline Project would modify (cause other indirect effects such as increases in edge habitat and loss of interior forest habitat, including increased predation) approximately 656 acres of suitable, 2,058 acres of recruitment, and 2,449 acres of capable habitat.
- Turbidity generated during HDD if a frac-out occurred could affect local major prey species for chicks such as anchovy, sand lance, and smelt.
- LNG carrier traffic in the estuarine analysis area to the Jordan Cove terminal could cause potential behavioral effects on foraging MAMU, and fuel and lubricant spills from LNG carriers could cause injury or mortality to foraging MAMUs.

The Project **may affect** MAMU critical habitat because:

- the Project occurs within designated MAMU critical habitat; and
- the Project would affect habitat within designated critical habitat areas.

The Project is **likely to adversely affect** MAMU critical habitat because:

- the proposed action could remove or degrade individual trees with potential nesting platforms or the nest platforms themselves, resulting in a decrease in or elimination of the value of the trees for future nesting use (PBF 1, or suitable or potentially suitable habitat); and
- the proposed action could remove or degrade trees adjacent to trees with potential nesting platforms that provide habitat elements essential to the suitability of the potential nest tree or platform, such as providing cover from weather or predators (PBF 2, or recruitment/capable habitat).

As described above, construction of the pipeline (including clearing of timber, access road use, helicopter use, and blasting), as well as pipeline operation and maintenance, would occur within the MAMU breeding season and within 0.25 mile of known MAMU stands. These activities could disturb or disrupt MAMUs and interfere with essential nesting behaviors during the breeding season. Therefore, to reduce these effects during the breeding season, **we recommend that:**

- **Prior to construction, Pacific Connector shall file with the Secretary its commitment to adhere to FWS-recommended timing restrictions within threshold distances of MAMU and NSO stands during construction, operations, and maintenance of the pipeline facilities.**

The FWS timing restrictions for MAMU and NSO, as referenced in the above recommendation, were outlined in FWS (2016c).

Given the anticipated avoidance of disturbance and disruption to MAMU during the breeding season per inclusion of the recommendation above into the proposed action (i.e., implementation of distance and timing restrictions, without exception), noise and visual effects on breeding MAMU as a result of construction would be minimized. However, there would be a loss of future breeding opportunities due to the removal of suitable, recruitment, and capable habitat during construction, as there would be less suitable habitat available for nesting. Additionally, the quality of the remaining habitat would be reduced due to habitat fragmentation and the addition of edge along the pipeline corridor. Removal of suitable nesting habitat by harvest of old-growth timber has been cited as the primary reason for the species' decline (FWS 1992a). Suitable MAMU nesting habitat takes a long time to develop (more than 250 years on average); therefore, any removal of suitable habitat may affect the recovery of the MAMU. Jordan Cove has indicated an interest in working with the FWS to discuss possible mitigation and conservation measures but has not proposed compensatory mitigation. In the absence of mitigation other than avoidance and minimization, the Project would result in long-term negative effects on this this threatened species.

Northern Spotted Owl (Federal Threatened Species with Critical Habitat, State Threatened Species)

In Oregon, the NSO is found in low- and mid-elevation coniferous forest in the Coast, Siskiyou, and Cascade Ranges (Forsman 2003). Suitable habitat for NSOs provides elements necessary for nesting, roosting and foraging. NSOs generally nest in forests with multilayered, multispecies canopies with large (20–30 inches dbh or greater) overstory trees, a high basal area (greater than 240 square feet/acre), and a high diversity of different diameters of trees. NSOs have large home ranges and utilize large tracts of land containing substancial acreage to meet their biological needs and a wide array of forest types and structures are necessary to support the various life histories (FWS 2011a). Typically, a larger area is required for NSOs in more fragmented habitats (Courtney et al. 2004). NSOs remain on their home range throughout the year. As a result, NSOs have large home ranges that provide all the habitat components and prey necessary for the survival and successful reproduction of a territorial pair.

Home ranges contain three distinct use areas: 1) the nest patch, which research has shown to be an important attribute for site selection by NSOs and includes approximately 70 acres of usually contiguous forest (300-meter radius around an activity center; FWS et al. 2008), 2) the core area, which is used most intensively by a nesting pair and varies considerably in size across the geographic range, but on average encompasses approximately 500 acres around the nest site (0.5-mile radius around the activity center), and is generally made up of mostly mature/old-growth forest (FWS 2007c; Courtney et al. 2004), and 3) the remainder of the home range which is used for foraging and roosting and is essential to the year-round survival of the resident pair (FWS 2007c). NSO home range size varies by physiographic province. In the Coast Range

Physiographic Province (MP 0.00 to MP 51.74), the home range is assumed to be circular with a radius of 1.5 miles. Within the Klamath Mountains Physiographic Province (MP 51.74 to MP 122.67), the home range radius is 1.3 miles, and in the West Cascades (MP 122.67 to MP 167.76) and East Cascade Physiographic Provinces (MP 167.76 to MP 190.64) the home range radius is 1.2 miles (FWS 1992b). Surveys conducted by Pacific Connector in 2007 identified 12 NSO pairs and a resident single but no nests. In 2008, surveys found NSO pairs at 20 locations, with two nests identified, and resident singles noted at six sites. Surveys in 2015 along the Blue Ridge route did not document any NSO. In addition to NSO sites identified by these surveys, Pacific Connector also considered home range information from the BLM and Forest Service, historic home ranges, best location home ranges (alternate sites closest to proposed action), and Pacific Connector-assumed home ranges (determined by Pacific Connector's assessment of habitat maps). Taking a conservative approach, all owl sites (known, best location, and Pacific Connector-assumed) were analyzed as if occupied and reproductive.

The Project would affect habitat within 97 NSO home ranges and 9 nest patches. About 37 miles of pipeline route would cross 7 designated critical habitat sub-units. Project construction would remove a total of about 517 acres of nesting, roosting, or foraging (NRF) habitat for NSO, of which 134 acres would be permanently lost within the 30-foot-wide corridor maintained in an herbaceous state. Additionally, 214 acres of NRF habitat for NSO would be modified and used as UCSAs. Approximately 1,158 acres of dispersal habitat (high NRF, NRF, and dispersal only habitat) would be removed by the Project. Approximately 919 acres of NSO capable habitat would be removed by construction of the proposed Project, of which 216 acres would remain in a permanent herbaceous/shrub state within the 30-foot operational ROW. Approximately 13,294 acres of NSO habitat (1,307 acres of high NRF/NRF habitat, 4,147 acres of dispersal only habitat, and 5,690 acres of capable habitat) occur within 100 meters (328 feet) of habitat removal, of which 4,326 acres (or 32.5 percent of NSO habitat within 100 meters of habitat removal) of interior NSO habitat would be indirectly affected (1,586 acres of high NRF/NRF habitat, 1,388 acres of dispersal only habitat, and 1,352 acres of capable habitat). The Pacific Connector Pipeline Project would remove 442 acres from LSRs , of which 379 acres is NSO habitat or capable of becoming NSO habitat (approximately 69 acres of high NRF, 93 acres of NRF [includes about 9 acres of "post-fire" NRF], 71 acres of dispersal only habitat, and 146 acres of capable habitat).

Potential direct effects on NSOs would include the following: (1) removal of a known nest tree during the entire breeding season (March 1 through September 30), and (2) human and noise disturbance due to ROW clearing and construction during the breeding period, including noise due to blasting and helicopter support during construction, and smoke from prescribed burnings. Potential indirect effects include the following: (1) removal or modification of suitable NRF habitat, dispersal habitat, and habitat that would be capable, over the life of the Project, to achieve dispersal or NRF habitat characteristics but for the Project's effects within LSR, Riparian Reserves, or NSO home ranges; (2) habitat fragmentation; and (3) other indirect effects that occur due to Project-related increases in edge habitat and loss of interior forest habitat, including increased predation, increased competition, and effects on prey utilized by NSOs. HDD and DP activities are not anticipated to disturb nesting NSO because noise associated with this work would attenuate to ambient levels before reaching NSO sites.

Pacific Connector would minimize effects on NSO habitat using the BMPs for crossing forested lands described in section 4.4 of this EIS. Pacific Connector would reduce effects on NSO habitat by replanting conifer trees outside of the 30-foot-wide maintenance corridor on certain federal lands and non-federal lands. However, replanted trees may be harvested from non-federal lands or federal lands slated for timber harvest (i.e., Matrix lands and Harvest Land Base), and if allowed to grow would provide minimal benefit to NSOs because it would take 80 years at a minimum to restore replanted forests to suitable habitat conditions. Timber removal would occur outside the entire NSO breeding season (March 1 through September 30) within 0.25 mile of NSO activity centers, and as a result, no nest trees within activity centers would be removed during the NSO nesting period, and disturbance or disruption would also be reduced. Additionally, Pacific Connector would install the pipeline within 0.25 mile of activity centers after the critical breeding period (after July 15). However, activities from pipeline construction during the late breeding period (July 16 through September 30) could disrupt or disturb NSO at 10 NSO activity centers within 0.25 mile of the pipeline ROW, and construction activities off the ROW would occur during the entire breeding season and could disturb NSO at two known activity centers located 0.25 mile of pipeline project components, if NSO are present.

For operations and maintenance activities, Pacific Connector would not conduct vegetation maintenance activities within 0.25 mile of NSO activity centers during the entire breeding season (March 1–September 30) to minimize disturbance and disruption to NSO. Other operations and maintenance activities may occur within the breeding season. Mitigation projects such as snag creation projects proposed by the Forest Service to meet LRMP objectives would benefit NSO.

Below is a determination of effects summary for the NSO and critical habitat. More details will be provided in the pending BA.

The Project **may affect** NSOs because:

- suitable habitat is available within the Provincial Analysis Area;[138] and
- NSO pairs and resident singles have been located within the Provincial Analysis Area during survey efforts.

The Project is **likely to adversely affect** NSOs for the following reasons:

- Noise from blasting during pipeline construction within 0.25 mile of NSO sites during the late breeding season would occur and could increase the risk of predation to fledglings that are generally not as able to escape as adults during the latter part of the breeding season.
- Construction of the Pacific Connector Pipeline Project would remove approximately 517 acres of high NRF and NRF habitat (including 26 acres of "post fire NRF" within the 2015 Stouts Creek fire area) within the provincial analysis area. This would result in effects on nest patches, core areas, and home ranges of known, best location, and Pacific Connector-assumed owls, some of which are currently below thresholds needed to sustain NSOs. Once suitable NRF habitat is reduced or modified in NSOs' home ranges, there is an increased likelihood that NSOs remaining in the Project area would be subject to:
  - displacement from nesting areas;
  - concentration into smaller, fragmented areas of suitable nesting habitat that may already be occupied;

[138] The Provincial Analysis Area includes the extent of the following potential Project effects: 1) habitat removal or modification, and 2) disturbance/disruption of NSO during the breeding season

  - increased interspecific (with barred owls) and intraspecific competition for suitable nest sites and forage;
  - decreased survival due to increased predation and/or limited resource (forage) availability; and
  - diminished reproductive success for nesting pairs.
- Construction of the Pacific Connector Pipeline Project would remove and modify high NRF, NRF, dispersal only, and capable habitat for NSOs throughout the Project area, including removal of habitat within the home range of 97 NSOs, 58 of which are currently below sustainable threshold levels of suitable habitat for continued persistence in their home range and/or core area.
- Construction of the Pacific Connector Pipeline Project would bring one NSO core area (best location activity center affected by 2015 Stouts Creek fire) below the 50 percent NRF threshold, and two NSO home range (known activity centers, one of which was affected by the 2015 Stouts Creek fire) below the 40 percent NRF threshold (best location activity center).

The Project **may affect** NSO critical habitat because:

- the Project would occur within designated NSO critical habitat; and
- the Project would affect habitat within designated critical habitat areas.

The Project is **likely to adversely affect** NSO critical habitat because:

- The proposed action would remove or potentially downgrade PBFs in critical habitat sub-units ORC-6, KLE-1, KLE-2, KLE-3, KLE-4, KLE-5, and ECS-1 as defined in the Final Rule designating critical habitat for the NSO (FWS 2012b).

As described above, construction of the pipeline (including access road use, helicopter use, and blasting), as well as pipeline operations and maintenance, would occur within the NSO breeding season and within 0.25 mile of NSO activity centers. These activities would disturb or disrupt NSOs and interfere with essential nesting behaviors during the entire breeding season. Therefore, to reduce these effects during the breeding season, we have recommended that Pacific Connector adhere to FWS-recommended timing restrictions within threshold distances of NSO activity centers (FWS 2016c; see recommendation above in the MAMU section).

Given the anticipated avoidance of disturbance and disruption to NSO during the breeding season per inclusion of the recommendation above into the proposed action (i.e., implementation of distance and timing restrictions, without exception), noise and visual effects on breeding NSO as a result of construction would be minimized. However, there would be a loss of future breeding opportunities due to the removal of suitable habitat during construction, as there would be less suitable habitat available for nesting. Additionally, the quality of the remaining habitat would be reduced due to habitat fragmentation and the addition of edge along the pipeline corridor. Habitat loss and modification, whether to nesting, roosting or foraging habitats, due to forest clear-cutting has been the primary factor causing declines of the NSO (FWS 1992c). Habitat losses and habitat fragmentation have indirect effects that can affect survival and reproduction of NSOs. Jordan Cove has indicated an interest in working with the FWS to discuss possible mitigation and conservation measures but has not proposed compensatory mitigation. In the absence of mitigation other than avoidance and minimization, the Project would result in long-term negative effects on this threatened species.

4.6.1.3 Fish

In this section, we summarize the listing status, life history, and presence and determination of Project action effects on the federally listed fish species and their critical habitat that could be affected by the Project. The species addressed include the Coho Salmon-Southern Oregon/Northern California Coast ESU, Coho Salmon-Oregon Coast ESU, North American Green Sturgeon–Southern DPS, Eulachon–Southern DPS, Lost River sucker, and shortnose sucker. Project effects on waterbodies are described in section 4.3 of this EIS. Minimization measures are currently proposed to reduce effects on threatened and endangered fish species. Overall, the types, methods, and magnitude of effects on listed fish species are represented by those presented for fish in general as presented earlier in section 4.5 of this EIS.

Coho Salmon-Southern Oregon/Northern California Coast ESU (Federal Threatened Species, State Sensitive Species)

The Southern Oregon/Northern California Coast (SONCC) ESU coho salmon was listed as a threatened species on June 28, 2005, between Punta Gorda, California, and Cape Blanco, Oregon (70 FR 37160). It includes all naturally spawning populations as well as three artificial propagation programs, of which one, the Cole Rivers Hatchery (ODFW stock #52) located on the Rogue River, is within the Project area.

Critical habitat for the SONCC ESU was designated in May 5, 1999 (74 FR 24249) and includes the accessible reaches of all rivers (including water, substrate, and adjacent riparian zone of estuarine and riverine reaches) between the Mattole River in California and the Elk River in Oregon. The Pacific Connector pipeline route would cross designated critical habitat within waterbodies of the Upper Rogue HUC (17100307) below Lost Creek, Willow Creek, and Fish Lake Dams.

Major rivers, estuaries, and bays known to support coho salmon within the range of the SONCC ESU include the Rogue River, Smith River, Klamath River, Mad River, Humboldt Bay, Eel River, and Mattole River (NMFS 1999), two of which (i.e., the Rogue and Klamath Rivers) are within the Project area although this ESU is currently prevented from accessing the potential Project-affected Klamath River areas due to dam passage barriers downstream.

Direct and indirect effects on SONCC Coho salmon are not expected within the marine analysis area. Coho salmon can avoid acoustic effects from LNG carriers during transit. Potential oil and gas spills from LNG carriers in the marine analysis area are highly unlikely to occur; even if LNG spilled or leaked, it would turn to vapor and would not mix with water, and vessel response plans required to address accidental spills of LNG and other petroleum products onboard would be implemented. Effects within the riverine analysis area are expected from in-water construction activities resulting in short-term increased sediment levels that would be stressful to fish, short-term benthic food source reduction, temporary migration impedance, short-term terrestrial/riparian habitat modifications, and limited long-term reduction in LWD sources. Limited fish mortality would also occur from fish salvage.

Below is the determination of effects summary for SONCC Coho Salmon ESU and critical habitat; see the details in our pending BA.

The Project **may affect** coho salmon in the SONCC ESU because:

- several stages and activities of coho salmon (upstream adult migration, juvenile rearing, and juvenile out-migration) are expected to occur at various locations in the riverine analysis area during construction and operation of the proposed action.

The Project is **likely to adversely affect** Coho salmon in the SONCC ESU for the following reasons:

- Juveniles would be exposed to elevated TSS concentrations during standard dry open-cut construction (fluming or dam-and-pump) for 2 to 5 hours. Such an exposure could cause injury, a short-term reduction in both feeding rate and feeding success, and minor physiological stress.
- A site crossing failure while dry open-cut construction is underway could result in elevated TSS concentrations for six hours while repair of failed isolation structures occurs, which could cause moderate habitat degradation injury, a short-term reduction in both feeding rate and feeding success, impaired fish homing, and possibly major physiological stress.
- Literature-based estimates of suspended sediment effects from pipeline construction on severity of ill effect (SEV) scores suggest typical dry crossing methods could result in SEVs of 4 and 6 for Coho salmon within a few hundred feet (e.g., 150 to 500 feet) below the crossing, which may include factors ranging from short-term reduction in feeding to moderate physiological stress. If failure of sealing occurs, SEV scores for coho salmon could be as high as 8, which may include habitat degradation, major physiological stress, and long-term reduction in feeding rate or success.
- Construction-induced blasting at 13 streams (4 at streams known to contain coho) could cause mortality to fish by rupturing swim bladders, but active fish removal from area prior to blasting would reduce risk of occurrence.
- Fish salvage would occur for some dry stream crossings as discussed in Pacific Connector's *Fish Salvage Plan*.[139] Capture and handling constitutes a taking under ESA and subjects coho salmon to injury and mortality.
- Lack of LWD is a limiting factor in most streams within range of SONCC coho salmon. Removal of mid-seral riparian forest (40 to 80 years old) would have long-term effects on recruitment of LWD, and removal of LSOG forest (80 years old or older) would have permanent effects on recruitment of LWD because planted conifers would not attain those age classes within the 50-year life of the Project, plus the ongoing loss of trees within the 30-foot-wide maintance corridor.

The Project **may affect** designated critical habitat for coho salmon in the SONCC ESU because:

- the Pacific Connector pipeline crosses designated critical habitat within waterbodies of the Upper Rogue HUC (17100307) below the Lost Creek, Willow Creek, and Fish Lake Dams.

[139] Appendix L of Pacific Connector's POD filed with the FERC in January 2018.

The Project is **likely to adversely affect** designated critical habitat for coho salmon in the SONCC ESU for the following reasons:

- a failure of dry open-cut crossing could cause moderate or more severe habitat degradations in some crossing areas;
- increases in turbidity are expected to temporarily affect the water quality downstream from stream crossing sites during construction;
- food resources would potentially be affected over the short term by dry open-cut and diverted open-cut construction methods that would remove substrate and benthos at crossing sites;
- freshwater migration corridors would potentially be affected over the short term by dry open-cut and diverted open-cut construction methods that would create temporary barriers to in-stream movements; and
- approximately 17 acres of native riparian vegetation (forest, wetlands, unaltered, and nonforested habitats) and altered habitat would be removed during construction within riparian zones associated with designated critical habitat. Adverse effects on riparian zones associated with critical habitat would be long term or permanent depending on whether mid-seral riparian forests (7 acres) or LSOG riparian forests (2 acres) are removed.

Coho Salmon-Oregon Coast ESU (Federal Threatened Species, State Sensitive Species)

This Coho salmon ESU was first proposed for listing on July 25, 1995 (60 FR 38011) and subsequently listed as threatened on June 20, 2011 (76 FR 35755). The Oregon Coast ESU includes all naturally spawned populations of coho in Oregon coastal streams south of the Columbia River and north of Cape Blanco, including the Cow Creek (ODFW stock #37) coho salmon hatchery program (NMFS 1995). Critical habitat for Oregon Coast coho salmon was designated on February 11, 2008 (73 FR 7816) and includes water, substrate, and adjacent riparian zones of estuaries and rivers within the range of the Oregon Coast ESU. There are three subbasins that coincide with the Project: South Umpqua Subbasin (HUC 17100302) and Coquille Subbasin (HUC 17100305), which are crossed by the Pacific Connector pipeline; and Coos Subbasin (HUC 17100304), which includes the Coos Bay estuary where the LNG terminal, slip, navigation channel improvements, and HDD portion of the Pacific Connector pipeline route would be located contain critical habitat watersheds. Within these subbasins are eight fifth-field watersheds crossed that contain designated critical habitat. Life stage requirements of coho salmon, within freshwater habitats in the Oregon Coast ESU, are expected to be similar to those described above for Coho salmon in the SONCC ESU.

Coho salmon would be expected to avoid acoustic effects from LNG carriers during transit of marine areas, and no substantial adverse oil and gas marine spills from LNG carriers are expected. Short-term adverse effects on coho salmon in the estuarine analysis area would result from locally increased turbidity from dredging activities and LNG carrier propeller wash and ship wake, causing avoidance and short-term reduction in food supply. Entrainment and impingement of coho salmon could occur in LNG carriers' cooling water intake port during LNG carrier loading and possibly dredging. Acoustic effects would likely cause at least avoidance during LNG terminal construction. Habitat modification would occur from all dredging activity and restoration activities at the Kentuck project site. Suspended sediment released accidentally during HDD construction across Coos Bay and the Coos River would also result in elevated sediment levels.

Effects within the riverine analysis area primarily from in-water construction activities would include short-term increased sediment levels causing fish stress, reduced short-term benthic food supplies, temporary migration impedance, terrestrial/riparian habitat modifications, and limited long-term reduction in LWD sources. Limited mortality from fish salvage would also occur.

Below is the determination of effects summary for Oregon Coast Coho Salmon ESU and critical habitat; see our pending BA for details.

The Project **may affect** coho salmon in the Oregon Coast ESU because:

- several stages and activities of coho salmon (upstream adult migration, juvenile rearing, and juvenile out-migration) are expected to occur at various locations in the riverine analysis area during construction and operation of the proposed action;
- several stages and activities of coho salmon (juveniles, adults) are expected to occur within the estuarine analysis area during construction and operation of the proposed action; and
- juvenile and adult coho salmon area expected to occur within the marine analysis area during operation of the proposed action.

The Project is **likely to adversely affect** coho salmon in the Oregon Coast ESU for the following reasons:

- Short-term increase in noise associated with in-water or nearwater pile driving at various temporary construction activities throughout the bay may cause disturbance and physical injury to Oregon Coast coho if they are in proximity to the noise during construction.
- Some juvenile coho may be subject to localized entrainment by dredging associated with the access channel and Navigation Reliability Improvements, as well as ongoing maintenance dredging.
- Local short-term increases in suspended sediment in Coos Bay from in-water construction, particularly during dredging of Jordan Cove terminal access channel and navigation channel widening, may result in behavioral effects on rearing coho salmon juveniles with physiological consequences that may affect growth and survival.
- Short-term effects on the benthic community and potential food resources for Oregon Coast coho would result from dredging the proposed marine waterway modifications in Coos Bay.
- Installation of the proposed pipeline beneath Coos Bay and the Coos River using HDD construction would avoid effects on coho unless an inadvertent return of drilling fluid occurred. An inadvertent return would temporarily increase sedimentation and turbidity and likely result in behavioral avoidance of the affected area.
- Individual Coho salmon may be directly affected by local restoration activities at the Kentuck project due to short-term construction-related increases in turbidity, in-water work, and isolation measures.
- Water intakes by LNG carriers at the Jordan Cove terminal berth during engine cooling operations could entrain or impinge juvenile salmon.
- Dredging of the Jordan Cove terminal access channel in Coos Bay in the short term could remove eelgrass and benthic community that provide potential food resources and rearing habitat for Oregon Coast Coho salmon;

- Removing eelgrass from donor stocks in the bay to develop the Eelgrass Mitigation site may reduce cover and food sources for rearing juvenile coho salmon in the short term:
- Exposure to TSS concentrations during dry open-cut construction (fluming or dam-and-pump) for 2 to 6 hours could potentially cause minor physiological stress (increased coughing rate and/or increased respiration rate) in juvenile coho salmon.
- A site crossing failure while dry open-cut construction is underway could result in elevated TSS concentrations for six hours while repair of failed isolation structures could cause moderate habitat degradation, impaired homing by fish, moderate to major physiological stress, and, in very limited areas, reduced growth and reduced fish density.
- Literature-based estimates of suspended sediment effects from pipeline construction on SEV scores suggest typical dry crossing methods could result in SEVs between 4 and 6 for coho salmon within a few hundred feet (e.g., 150 to 500 feet) below the crossing, which may include factors ranging from short-term reduction in feeding to moderate physiological stress. If failure of sealing occurs, SEV scores for coho salmon could be as high as 8, which may include habitat degradation, major physiological stress, and long-term reduction in feeding rate or success.
- Blasting at 22 streams (12 known or assumed to have Coho salmon at the crossing) could cause mortality to fish by rupturing swim bladders but active fish removal from the area prior to blasting would reduce risk of occurrence.
- Fish salvage would occur within isolated construction sites, possibly when adult and juvenile coho salmon are present. Coho salmon are considered vulnerable to electrofishing, subject to injury and mortality. Seining, electrofishing, and handling during salvage may adversely affect Oregon Coast coho salmon.
- Lack of LWD is a limiting factor in most streams within range of Oregon Coast coho salmon. Removal of mid-seral riparian forest (40 to 80 years old) would have long-term effects on recruitment of LWD, and removal of LSOG forest (80 years old or older) would have permanent effects on recruitment of LWD because planted conifers would not attain those age classes within the 50-year life of the Project, plus the ongoing loss of trees within the 30-foot-wide maintance corridor.

The Project **may affect** designated critical habitat for coho salmon in the marine analysis area, the estuarine analysis area, and the riverine analysis area for the Oregon Coast ESU because:

- construction and operation of the Project would occur in or cross designated critical habitat within waterbodies of the Coos, Coquille, and South Umpqua subbasins.

The Project is **likely to adversely affect** proposed critical habitat for coho salmon in the Oregon Coast ESU for the following reasons:

- dredging of the Jordan Cove terminal access channel in Coos Bay and marine waterway modifications could remove eelgrass and benthic community that are potential food resources and rearing habitat for Oregon Coast coho salmon;
- increases in turbidity are expected to temporarily affect the water quality downstream from stream crossing sites during construction;
- TSS concentrations generated during dry open-cut construction and potential failure of isolation structures would adversely affect freshwater habitats by changing coho habitat preferences (SEV = 3) or causing moderate habitat degradations (SEV = 7 or 8);

- a failure of dry open-cut crossing lasting up to 6 hours could cause moderate or more habitat degradations in some streams;
- food resources would potentially be affected over the short term by dry open-cut and diverted open-cut construction methods that would remove substrate and benthos at crossing sites;
- freshwater migration corridors would potentially be affected over the short-term by dry open-cut and diverted open-cut construction methods that would create temporary barriers to in-stream movements; and
- approximately 88 acres of native riparian vegetation (forest, wetlands, and nonforested habitats) and altered habitat would be removed during construction within riparian zones associated with designated critical habitat associated with waterbodies within range of Oregon Coast coho ESU. Adverse effects on riparian zones associated with critical habitat would be long term or permanent depending on whether mid-seral riparian forests (14 acres) or LSOG riparian forests (4 acres) are removed.

North American Green Sturgeon – Southern Distinct Population Segment (Federal Threatened Species, State Sensitive-Critical Species)

On January 23, 2003 (NMFS 2003), NMFS determined that the North American green sturgeon comprises two DPSs that qualify as species under the ESA: (1) a northern DPS consisting of populations in coastal watersheds northward of and including the Eel River in California; and (2) a southern DPS consisting of coastal and Central Valley populations south of the Eel River, with the only known spawning population in the Sacramento River. On April 7, 2006, NMFS listed the southern DPS as federally threatened under the ESA, including spawning populations of green sturgeon south of the Eel River, principally the Sacramento River spawning population (71 FR 17757). Designated critical habitat extends from U.S. marine waters to 110 meters depth (360 feet) or 60 fathoms from Monterey Bay, California, north to Cape Flattery, Washington, including the Strait of Juan de Fuca (74[195] FR 52300 [October 9, 2009]). Critical habitat includes three components that are occupied by and are essential to different life stages of green sturgeon: (1) freshwater riverine systems, (2) estuarine areas, and (3) nearshore marine waters. No rivers in Oregon were included in the listing. However, many estuaries were part of the critical habitat proposal in Washington, Oregon, and California. Estuaries in Oregon proposed for inclusion were the Columbia River estuary, Winchester Bay, Yaquina Bay, Nehalem Bay, and Coos Bay. Large numbers of this green sturgeon DPS are within Coos Bay. Subadults and adults may occupy Coos Bay for feeding, optimization of growth, and thermal refuge, and the Bay supplies oversummer habitat. Similarly, coastal marine waters 110 meters deep or less. The North American green sturgeon (both northern and southern DPSs) occurs within Coos Bay and its adjacent waterbodies (Israel and May 2007) and is considered abundant in the bay (73 [174] FR 52084 [September 8, 2008]). This fish may also occur in the lower portions of the Coos River.

Green sturgeons spawn every three to five years in deep pools in large, turbulent river mainstems, generally from March through July (Tracy 1990; Moyle et al. 1992). Little is known about sturgeon feeding, but some studies have found that adults and juveniles feed on benthic invertebrates including shrimp, mollusks, amphipods, and even small fish (Moyle et al. 1992; Radtke 1966). Natural reproduction in this estuary is considered low (Wagoner et al. 1990). The Coos River system is not considered to provide suitable spawning habitat for green sturgeon (Whisler et al. 1999). Green sturgeon, likely less than three years of age, may utilize both shallow and deep-water habitats within the estuarine area, though there is no information relating individual occurrence to DPS membership. Green sturgeon may also occur in bottom areas along the LNG carrier transit route, in waters mostly less than 110 meters deep, which would be primarily only during entry and exit of the vessels as they would travel in deeper water during transit between ports.

Direct and indirect effects on green sturgeon in the southern DPS are not expected within the marine analysis area. Green sturgeon might detect noise from LNG carriers but would be able to avoid adverse effects from noise. Potential oil and gas spills from LNG carriers in the marine analysis area are unlikely to affect aquatic resources because they are highly unlikely to occur; if LNG spilled or leaked, it would turn to vapor, would not mix with water, and would not contaminate surface water; and vessel response plans required to address accidental spills of LNG and other petroleum products onboard would be implemented. Effects on green sturgeon in the estuarine analysis area include acoustic effects such as avoidance during terminal construction, increased turbidity sedimention affecting benthic food sources from dredging activities, bed and bank erosion from LNG carrier propeller wash and ship wake, loss of forage from removal of eelgrass and shallow water habitat, and elevated suspended sediment released from an accidental drilling mud release during HDD construction across Coos Bay and the Coos River. Effects within the riverine analysis area include increased turbidity and sedimentation causing short-term avoidance and food source reduction from in-water construction activities on Stock Slough.

Below is the determination of effects summary for the Southern DPS of green sturgeon and critical habitat. Details will be provided in our pending BA.

The Project **may affect** green sturgeon (Southern DPS) because:

- adult and/or subadult green sturgeon may occur within the estuarine analysis area during construction and operation of the proposed action;
- adult and/or subadult green sturgeons may occur within the marine analysis area during operation of the proposed action; and
- the proposed action may affect potential food resources and water quality during the short-term construction period and maintenance dredging within the estuarine analysis area.

The Project is **likely to adversely affect** green sturgeon (Southern DPS) because:

- short-term increase in noise generated from in-water and nearshore pile driving at various temporary construction sites throughout the bay may cause disturbance and physical injury to green sturgeon if individuals are in proximity to the noise during construction;
- exposure to TSS concentrations during dry open-cut construction (fluming or dam-and-pump) could potentially cause minor physiological stress, a short-term reduction in feeding rate, and short-term reduction in feeding success in the Stock Slough estuarine stream/river channel crossed by the pipeline if present there at the time of construction;
- on a localized basis, the proposed action may affect migratory and feeding behavior, potential food resources, and water quality (TSS) during the short-term construction period and periodic maintenance dredging within the estuarine analysis area;
- bottom disturbance from Project construction, navigation channel widening, and maintenance dredging may reduce the abundance and diversity of benthic food supply within Coos Bay; and

- short-term increased turbidity could cause avoidance in Coos Bay or lower Coos River HDD if frac-out were to occur.

The Project **may affect** critical habitat for green sturgeon (Southern DPS) because:

- Project activities would occur within portions of the Coos Bay estuary, Stock Slough, and coastal marine waters, which have been designated as critical habitat;

The Project is **likely to adversely affect** critical habitat for the southern DPS of green sturgeon because:

- bottom disturbance from Project construction, navigation channel widening, and maintenance dredging may disrupt local food supply and habitat usability within Coos Bay; and
- suspended sediment produced during dry open-cut crossing Stock Slough could affect water quality in freshwater riverine critical habitat.

Eulachon – Southern Distinct Population Segment (Federal Threatened, No State Status)

On March 18, 2010, the NMFS published in the Federal Register the final rule to list the southern DPS of the Pacific eulachon as threatened under the ESA (75 FR 13012 [March 18, 2010]). The NMFS has identified the eulachon southern DPS as those populations which spawn in rivers south of the Nass River in British Columbia, Canada, to and including the Mad River in California (NMFS 2008c). The southern DPS has been further segregated into four subareas: Klamath River, Columbia River, Fraser River, and British Columbia coastal rivers south of the Nass River (NMFS 2008c). A total of 16 distinct regions in Washington, Oregon, and California have been designated as critical habitat for Pacific eulachon (76 FR 65323 [October 20, 2011]). No part of the Project or its effects would occur within waterbodies included in the eulachon critical habitat designation.

Adult Pacific eulachon usually spend three to five years in saltwater before returning to freshwater to spawn from late winter though early summer in rivers (74 FR 10857 [March 13, 2009]). Fertilized eggs adhere to river bottoms and shortly after hatching, the larvae are carried downstream and dispersed by estuarine and ocean currents (74 FR 10857 [2009]). No recent spawning runs have been documented for the Coos River, although some may have occurred historically and have recently been found in Winchester Creek, a major tributary to South Slough that enters Coos Bay near the ocean (Willson et al. 2006; Wagoner et al. 1990, NMFS 2018b).

Little is known about the use of marine waters by eulachon and, due to paucity of sampling, little specific information exists on eulachon distribution off the U.S West Coast, including Oregon (Gustafson et al. 2010). Larvae and young juveniles become widely distributed in coastal waters, with fish found mostly at depths up to 15 meters (171 feet) but sometimes as deep as 182 meters (597 feet; Hay and McCarter 2000). Larger rearing fish have been reported to be in the near benthic habitats in open marine waters of the continental shelf between 20 and 150 meters (66 to 492 feet) deep (Barraclough 1964 as cited in Gustafson et al. 2010).

Adults and juveniles commonly forage at moderate depths (15 to 182 meters [50 to 600 feet]) in inshore waters, feeding on zooplankton, primarily eating crustaceans (Hay and McCarter 2000). Adults are found rarely in Coos Bay (64 FR 66601 [1999]), but have been reported to utilize both shallow and deep habitats in the estuary (64 FR 66601 [1999]). A 1971 report (Cummings and Schwartz 1971) noted their distribution only in the outer 7 miles of Coos Bay. Detailed larvae and juvenile fish sampling in Coos Bay over a 3.5-year period (1998-2001) found no eulachon (Miller and Shanks 2005). More recently, pelagic Tucker trawl samples over a 17-month period found larvae and small juveniles of a close relative, surf smelt, but no eulachon near the proposed terminal in Coos Bay (Shanks et al. 2011). However, given the limited survey effort and highly variable presence of eggs and larvae, eulachon occurrence in Coos Bay could not be ruled out (Storch and Van Dyke 2014).

Direct and indirect effects on eulachon in the southern DPS are not expected within the marine analysis area. Eulachon might detect noise from LNG carriers, but would be able to avoid adverse effects from noise. Potential oil and gas spills from LNG carriers in the marine analysis area are unlikely to affect aquatic resources because they are highly unlikely to occur; if LNG spilled or leaked, it would turn to vapor, would not mix with water, and would not contaminate surface water; and vessel response plans required to address accidental spills of LNG and other petroleum products onboard would be implemented. Effects on eulachon in the estuarine analysis area include increased turbidity from dredging activities and LNG carrier propeller wash and ship wake causing avoidance and reduced food supply, increased suspended sediment should an HDD construction failure occur in Coos Bay or the Coos River, entrainment and impingement in LNG carriers' water intake ports, acoustic effects including avoidance during terminal construction, habitat modification from dredging, and restoration activities at the Kentuck project site.

Below is the determination of effects summary for Pacific eulachon (Southern DPS) and critical habitat. Details will be provided in our pending BA.

The Project **may affect** Pacific eulachon (Southern DPS) because:

- Pacific eulachon may be present within the estuarine analysis area during construction and operation of the Project;
- Pacific eulachon may occur within the marine analysis area during operation of the proposed action;

The Project is **likely to adversely affect** Pacific eulachon (Southern DPS) because:

- Bottom disturbance and suspended sediment from Project construction, navigation channel widening, and maintenance dredging may affect the abundance and diversity of potential benthic and pelagic food resources, water quality, and suspended sediment during the short-term duration of these actions within the estuarine analysis area.
- Short-term increase in noise generated from the MOF land-based pile driving and in-water pile driving in various Coos Bay estuarine analysis areas may cause physical injury to individual eulachon at a limited distance during construction.
- Although eulachon would be rare in Coos Bay, and their large size would allow most to be able to avoid the LNG carrier cooling water intake, some limited number could be entrained during dredging and vessel loading in the bay.

The Project would have **no effect** on critical habitat for the Pacific eulachon (Southern DPS) because no designated critical habitat is present within the areas affected by the Project.

Lost River Sucker (Federal Endangered Species, State Endangered Species)

The Lost River sucker was listed as a federally endangered species on July 18, 1988, because of a variety of factors including loss of habitat and access to historical range, overfishing, degraded water quality, lack of adaquate recruitment, inadequate regulatory mechanisms, and a variety of other reasons resulting in declining populations (FWS 1988). Lost River sucker critical habitat was originally proposed in 1994 (59 FR 61744) but that proposal was never finalized. In 2011, a revised critical habitat designation was proposed and ultimately finalized in December 11, 2012 (77 FR 73739). Designated critical habitat for the Lost River sucker includes two units: the Upper Klamath Lake Unit and Lost River Basin Unit

The present distribution of the Lost River sucker includes Upper Klamath Lake and its tributaries, Clear Lake Reservoir and its tributaries, Tule Lake and the Lost River, the Klamath River, and Copco, Iron Gate, and John C. Boyle Reservoirs with no substantial change since listing (Reclamation 2007, 2012; FWS 2007d). They have also been found in Tule Lake (Reclamation 2012; FWS 2007d, 2013d). Critical habitat that could potentially be affected by construction of the Pacific Connector pipeline includes the Klamath River.

In the Upper Klamath Lake watershed, the Lost River sucker spawning runs are primarily limited to Sucker Springs in Upper Klamath Lake, and the Sprague and Williamson Rivers. Spawning runs also occur in the Wood River and in Crooked Creek in this watershed. In the Project vicinity, Lost River suckers spawn in the Lost River and are present in John C. Boyle Reservoir, downstream from the pipeline crossing at river mile (RM) 225 (NRC 2004). In addition to collections of Lost River suckers in John C. Boyle Reservoir, ORBIC (2012) cites records of collections in Lake Ewauna and in the Lost River Diversion Channel connecting the Klamath River (at RM 249.8) to the Lost River at the Lost River Diversion Dam, approximately 10 river miles downstream from the Pacific Connector pipeline crossing of the Lost River at RM 9.5.

The Pacific Connector pipeline route would cross Lost River (MP 212.07) 7.6 miles upstream of the known spawning area downstream of Anderson–Rose Dam, using a dry, open-cut method during low flows that coincide with the ODFW instream construction window extending from July 1 through March 31.

Spawning occurs within limited areas of the Lost River (FWS 2013d; Reclamation 2012), and occasional individuals have been found in this stream (NMFS and FWS 2013), which suggests it is possible that Lost River sucker occurs at the Pacific Connector pipeline crossing of Lost River at MP 212.07 during the non-spawning period. An additional 31 dry open-cut small intermittent stream crossings could also contain Lost River suckers as surveys have not been conducted for their presence.

Potential effects on the Lost River sucker are associated with pipeline stream crossings. These effects include the release of drilling mud from Klamath River HDD potential frac-out as well as potential entrainment or entrapment of fish, and increased turbidity and suspended sediment in occupied stream affecting fish avoidance and benthic food supply. Pacific Connector would install a temporary flowing stream crossing by lifting or spanning a structure from a bank so that equipment does not enter flowing waters. However, if it is not possible to do this safely, only equipment necessary to install the bridge would cross the stream. This would cause some limited short-term bottom benthic disruption and possibly elevated suspended sediment. Adults and juveniles subject to fish salvage associated with the Lost River crossing could be injured or killed if electrofishing is used, and stressed if seining is used. Incidental take of a Lost River sucker is possible, but salvage operations would follow Pacific Connector's *Fish Salvage Plan* which describes netting methods (e.g., beach seining, dip netting) that would be used before using electrofishing. There are additional salvage methods that have been specifically developed for these listed suckers to further reduce the potential effects of salvage (see the Klamath Project Operations Biological Opinion [Reclamation 2008] consistent with Reclamation's *Handling Guidelines for Klamath Basin Suckers).*

Below is the determination of effects summary for Lost River sucker and critical habitat. Details will be provided in our pending BA.

The Project **may affect** Lost River suckers because:

- Lost River suckers occur within the Upper Klamath River subbasin and Lost River subbasin, which would be affected during construction of the proposed action.

The Project is **likely to adversely affect** Lost River suckers because:

- Lost River suckers could occur in 19 waterbodies crossed by dry open-cut construction in the Lake Ewauna-Klamath River watershed and in 13 waterbodies west of MP 214.38 (including the Lost River) crossed in the Mills Creek-Lost River watershed and be indirectly affected by elevated suspended sediment levels, streambank erosion and stability, and aquatic nuisance species introductions; and
- fish salvage during the crossing of 31 ditches crossed by dry-open cuts and the Lost River crossing could result in injuring or killing of Lost River suckers if electroshocking is used, and stressing fish if seining is used.

The Project **may affect** designated critical habitat for the Lost River sucker because:

- there is a low risk of HDD failure during crossing of the Klamath River, resulting in a frac-out that releases drilling mud into the river.

However, the Project is **not likely to adversely affect** designated critical habitat for the shortnose sucker because:

- HDD crossing methods would avoid critical habitat in the Klamath River;
- the potential for hydraulic fracture during HDD drilling is so unlikely as to be discountable; and
- in the event of released bentonite, corrective actions would contain and temporally limit drill mud volumes.

Shortnose Sucker (Federal Endangered Species, State Endangered Species)

The shortnose sucker was listed as a federally endangered species on July 18, 1988 (FWS 1988). The final rule to list the shortnose sucker as endangered suggested several reasons for their decline, including the construction of dams, water diversions, overfishing, competition and predation by exotic species, water quality problems associated with timber harvest, removal of riparian vegetation, livestock grazing, lack of adaquate recruitment, inadequate regulatory mechanisms and agricultural practices. Shortnose sucker critical habitat was originally proposed in 1994 (59 FR 61744) but that proposal was never finalized. In 2011, a revised critical habitat designation was proposed and ultimately finalized in December 11, 2012 (77 FR 73739). Designated critical habitat for the shortnose sucker includes two units: the Upper Klamath Lake Unit and Lost River Basin Unit. The Klamath River is the only critical habitat for the shortnose sucker crossed by the pipeline or potentially affected by any Project actions.

Currently, shortnose suckers are present in upper Klamath Lake and tributaries, Lost River, Clear Lake Reservoir, the Klamath River, and three large Klamath reservoirs (Keno, Copco, and possibly Iron Gate Reservoirs) with no substantial change since listing (Reclamation 2007, 2012). They have also recently been found in Tule Lake and Gerber Reservoir (Reclamation 2012; FWS 2007d, 2013e).

Shortnose suckers live in lakes and spawn in rivers, streams or springs associated with the lake habitats, generally from early February through mid-April. After hatching, larval suckers migrate out of spawning substrates, which are usually gravels or cobbles, and drift downstream into lake habitats from early May to mid-June (FWS 1988, 1993b). The shortnose sucker is known to migrate out of Tule Lake to spawn in the Lost River below Anderson–Rose Dam about 7.6 miles downstream from the Lost River crossing. Therefore, the Pacific Connector pipeline would cross the Lost River where shortnose suckers could be present.

Potential effects on the shortnose sucker are associated with pipeline stream crossings. These effects include the release of drilling mud from Klamath River HDD potential frac-out as well as potential entrainment or entrapment of fish, and increased turbidity and suspended sediment affecting fish avoidance and benthic food sources in occupied streams, and fish being injured or killed during fish salvage efforts. Pacific Connector would install temporary flowing stream crossing by lifting or spanning a structure from a bank so that equipment does enter flowing waters. However, if it is not possible to do this safely, only equipment necessary to install the bridge would cross the stream. This would cause some limited, short-term bottom benthic disruption and possibly elevated suspended sediment. Adults and juveniles subject to fish salvage within the isolated construction site at the Lost River could be injured or killed if electroshocking is used and stressed if seining is used. Pacific Connector has included guidelines noted above under the Lost River sucker section in their *Fish Salvage Plan* that would be used near listed suckers. However, despite these measures, it is still possible that shortnose suckers could be killed by salvage operations and modifications to these plans may be needed to reduce this risk (see the Lost River Sucker section above).

Spawning occurs within limited areas of the Lost River (FWS 2013d; Reclamation 2012), and occasional individuals have been found in this stream region (NMFS and FWS 2013), suggesting it is possible that shortnose sucker could occur at the Pacific Connector pipeline crossing of Lost River at MP 212.07 during the non-spawning period. An additional 31 dry open-cut small intermittent stream crossings cannot be ruled out completely from potentially having shortnose sucker present because surveys have not been conducted for their presence.

The Project **may affect** shortnose suckers because:

- shortnose suckers occur within the Upper Klamath River subbasin and Lost River subbasin, which would be affected during construction of the proposed action.

The Project is **likely to adversely affect** shortnose suckers because:

- there is a possibility that shortnose suckers could occur within the Lost River when it would be crossed by the Pacific Connector pipeline and may be affected by elevated suspended sediment;
- shortnose suckers could occur in 19 waterbodies crossed by dry open-cut construction in the Lake Ewauna-Klamath River watershed and in 13 waterbodies west of MP 214.38 (including the Lost River) crossed in the Mills Creek-Lost River watershed and be indirectly affected by elevated suspended sediment levels, streambank erosion and stability, and aquatic nuisance species introductions; and
- adults and juveniles subject to fish salvage within the isolated construction site at 31 ditches crossed by dry-open cuts and the Lost River could be affected if electroshocking is used and stressed if seining is used.

The Project **may affect** designated critical habitat for the shortnose sucker because:

- there is a low risk of HDD failure during crossing of the Klamath River, resulting in a frac-out that releases drilling mud into the river.

However, the Project is **not likely to adversely affect** designated critical habitat for the shortnose sucker because:

HDD crossing methods would avoid critical habitat in the Klamath River;

- the potential for hydraulic fracture is so unlikely as to be discountable; and
- in the event of released bentonite during an HDD crossing, corrective actions would contain and temporally limit drill mud volumes.

4.6.1.4 Amphibians and Reptiles

Oregon Spotted Frog (Federally Threatened Species, Critical Habitat, State Sensitive-Critical)

On August 29, 2014, FWS listed the Oregon spotted frog as threatened (79 FR 51657). Critical habitat for the Oregon spotted frog was finalized in May 2016 and includes critical habitat in Oregon (Units 7 through 14; 81 FR 29335). This species is almost always found in or near a perennial body of water that includes zones of shallow water and abundant emergent or floating aquatic plants, which the frogs use for basking and escape cover (Corkran and Thoms 1996; FWS 2013f). The closest designated critical habitat unit to the Project is CHU 14 – Upper Klamath, which consists of 262 acres of lakes and creeks in Klamath and Jackson Counties and is currently occupied by Oregon spotted frogs (1 FR 2933). The Buck Lake population within CHU 14 is the closest occurrence of Oregon spotted frogs to the Project. This site includes seasonally wetted areas adjacent to the western edge of Buck Lake encompassing Spencer Creek downstream due west of Forest Service Road 46, three unnamed springs, and Tunnel Creek (81 FR 29335).

Oregon spotted frogs at Buck Lake have been consistently monitored from 2012 to 2016, along with other populations in the Oregon Cascades (Adams et al. 2017). Observations of frogs at two sites in Buck Lake and one in Tunnel Creek (both in CHU 14) indicate some variability in counts for each of several life stages but adults and larva or juveniles were found each year. Spencer Creek upstream of Buck Lake is almost equally subdivided into Buck Marsh, closest to Clover

Creek Road, and Buck Meadow, closest to Buck Lake (Lerum 2012). Buck Marsh is fed by several springs with evidence of beaver activity, and Buck Meadow is a pasture that often floods in the spring but does not stay flooded long enough to provide Oregon spotted frog breeding habitat. Further, soils in Buck Marsh are dense, possibly compacted by past heavy livestock use, and provide little water infiltration. Neither Buck Marsh nor Buck Meadow currently provide habitat for Oregon spotted frogs (Lerum 2012). Riparian vegetation is sparse and is unlikely to support beaver occupancy that could help to create suitable habitat (Lerum 2012).

The Project would cross Spencer Creek on the north side of Clover Creek Road, approximately 6,400 feet upstream from the CHU 14 at Buck Lake and pass within 280 feet of critical habitat in Spencer Creek downstream of Buck Lake. Potential effects on Oregon spotted frogs include changes to habitat quality and acoustic. Conservation measures proposed by Pacific Connector to minimize construction and operation effects on waterbodies and riparian zones would apply to Oregon spotted frogs.

Spencer Creek upstream of Buck Lake is not currently suitable habitat for Oregon spotted frogs and is unlikely to become suitable habitat and support Oregon spotted frogs at the time of construction. Clover Creek road separates the ROW from Spencer Creek downstream of Buck Lake so sediment from the construction ROW is not expected to enter Spencer Creek.

The Project **may affect** Oregon spotted frogs because:

- the Pacific Connector pipeline route would cross Spencer Creek, which is hydrologically connected to Buck Lake which is occupied by the frog; and
- the Pacific Connector pipeline route is within 280 feet of Spencer Creek and would cross tributaries to Spencer Creek downstream of Buck Lake, which is occupied by the Oregon spotted frog.

However, the Project **is not likely to adversely affect** Oregon spotted frogs for the following reasons:

- Buck Lake is approximately 6,400 feet downstream from where the pipeline route would cross Spencer Creek. Suspended sediment generated by the proposed action is expected to remain in the water column for 1,450 feet downstream from the construction site.
- Suspended sediment resulting from the crossing of Spencer Creek would pass through Buck Marsh, which Oregon spotted frogs do not currently inhabit. If the Oregon spotted frog does occur in Buck Marsh at the time of pipeline construction, conservation measures would limit potential effects due to acoustic shock, introduction of non-native species and/or disease, fuel and chemical spills, and herbicides.
- Future presence of Oregon spotted frogs in the Spencer Creek upstream of Buck Lake at the time of construction is extremely unlikely and considered to be discountable.
- Although the ROW occurs as close as 280 feet from Spencer Creek downstream of Buck Lake, they are not hydrologically connected because Clover Creek road separates the ROW from Spencer Creek; BMPs and erosion control measures should prevent sediment from the construction ROW from entering Spencer Creek.

The Project **may affect** designated critical habitat for the Oregon spotted frog because:

- the Pacific Connector pipeline route would be within 280 feet of proposed critical habitat within Spencer Creek downstream of Buck Lake.

The Project **is not likely to adversely affect** designated critical habitat for the Oregon spotted frog because:

- the designated critical habitat within 280 feet of the pipeline is not hydrologically connected to the ROW because it is separated by Clover Creek Road; and
- test water from the proposed hydrostatic discharge site at MP 169.52 is not expected to reach the critical habitat in Spencer Creek or Buck Lake, so effects on PBFs from changes in hydrology or introduction of nonnative species from the Project are discountable.

Sea Turtles

Four federally listed sea turtles potentially occur near the Project: green sea turtles, leatherback sea turtle, olive ridley sea turtle, and loggerhead sea turtle. All four species are federally threatened and state endangered.

Green sea turtles have been sighted from Baja California to southern Alaska, but most commonly occur from San Diego south (NMFS 2007a). Green turtles primarily use three types of habitat: oceanic beaches (for nesting), convergence zones in the open ocean, and benthic feeding grounds in coastal areas (NMFS 2007a). Reports of stranding suggest that the green turtle is a frequent visitor to the coast of California. Based on this data, green turtles are likely infrequent, transient visitors to the Oregon Coast, but may occasionally be found in the marine analysis area.

The leatherback sea turtle is the most common sea turtle in United States waters north of Mexico (NMFS and FWS 1998), and numerous sightings have been documented off the Oregon Coast. Adult leatherback turtles are highly migratory and available information indicates that eastern Pacific migratory corridors exist along the west coast of the United States (NMFS and FWS 1998). The west coast of the United States may represent some of the most important foraging habitat in the world for the leatherback turtle (NMFS and FWS 1998). Despite occasional reports of leatherbacks sighted at sea, and a growing database documenting their incidental catch in coastal and pelagic fisheries, there are very few areas where the species is routinely encountered. Exceptions include Monterey Bay, California (NMFS and FWS 1998). These data suggest that leatherback sea turtles would be present in the marine analysis area in higher densities relative to other sea turtle species, but still in low densities overall.

At-sea occurrences of olive ridley sea turtles in waters under United States jurisdiction are limited to the west coast of the continental United States and Hawaii, where the species is rare, but possibly increasing. During feeding migrations, olive ridley turtles may disperse into waters off the Pacific west coast as far north as Oregon (FWS 2013g). Based on sightings off the Oregon coast, olive ridley turtles may occasionally occur in the marine analysis area.

Loggerhead sea turtles occupy three different ecosystems during their lives—the terrestrial zone, the oceanic zone, and the neritic zone (NMFS 2007b). In the United States, occasional sightings are reported from the coasts of Washington and Oregon, but most records are of juveniles off the coast of California (NMFS 2007b). The potential importance of Oregon waters and the marine analysis area to loggerhead turtles is unknown, although two loggerhead turtles have been reported stranded in Oregon and Washington since the beginning of 1997 through 2007 (NMFS 2008d).

Direct effects of the proposed action include injury and/or mortality due to ship-strikes, underwater ship noise, and potential adverse effects from a vessel spill or ship release of LNG and fire at sea. Spills and/or release could indirectly affect federally listed sea turtles by affecting forage species. Below is a determination of effects summary for the federally listed sea turtles and critical habitat. More details will be provided in the pending BA.

The Project **may affect** federally listed sea turtles because:

- these sea turtles may occur within the marine analysis area during operation of the proposed action;
- the proposed action would increase shipping traffic (LNG carriers) within the marine analysis area; and
- the continental U.S. Pacific Coast provides important foraging habitat for leatherback turtles.

However, the Project is **not likely to adversely affect** federally listed sea turtles because:

- ship strike on sea turtles would be highly unlikely;
- Jordan Cove would provide a ship strike avoidance measures package to LNG carrier operators transporting cargo from the terminal that consists of multiple measures to avoid striking marine mammals, which should also benefit sea turtles;
- The FERC does not have authority over the LNG carrier; however, the independent carrier operators would be required to follow all Coast Guard requirements regarding the operation of LNG carriers including carrier speeds;
- noise produced by LNG carriers would contribute to overall noise levels within the marine analysis area en route to the Port of Coos Bay and effects of ship noise on sea turtles could exceed NMFS interim noise exposure criteria for Level B single non-pulse noise (NMFS 2016c, NMFS 2017b, NMFS 2018c), but would not exceed existing background ship noise levels and would not cause injury; and
- given vessel design, on-board spill kits, safety records, and implementation of Coast Guard recommendations, it is not likely that there would be a major ship spill of hazardous materials that may adversely affect water quality or aquatic species. Fuel released at sea, if any, would be in small enough quantities that potential effects on listed sea turtles would be discountable, especially given the low density of sea turtles within the marine analysis area.

No critical habitat has been designated or proposed for the olive ridley or loggerhead sea turtles. Critical habitat was established for the green turtle on Culebra Island, Puerto Rico, on September 2, 1998 (NMFS 1998); however, no critical habitat for green sea turtles occurs on the U.S. Pacific Coast, and the Project would therefore have no effect on designated critical habitat for the green turtle.

The Project **may affect** designated critical habitat for the leatherback turtle because:

- Critical habitat coincides with nearshore waters in the marine analysis area through which LNG carriers would transit to Coos Bay and the LNG terminal.

However, the Project is **not likely to adversely affect** designated critical habitat for the leatherback turtle because:

- LNG carriers and the Jordan Cove LNG Project are not likely to contribute oil, fuel, lubricants, or other contaminants to critical habitat to the extent that would adversely affect the occurrence of prey species, primarily jellyfish, of sufficient condition, distribution, diversity, and abundance to support individual as well as population growth, reproduction and development (PBF 1); and
- disturbance of benthic habitats within Coos Bay due to dredging would be of sufficiently short duration and small scale relative to the area available for settlement of larvae of the scyphozoan prey species within Area 2 that effects on PBF 1 would be unmeasurable and would therefore be discountable.

4.6.1.5 Invertebrates

Vernal Pool Fairy Shrimp (Federally Threatened Species with Critical Habitat, No State Status)

Vernal pool fairy shrimp were listed as threatened under the ESA on September 19, 1994 (FWS 1994a). This crustacean inhabits vernal pools, or seasonal wetlands that fill with water during fall and winter rains, in California and southwestern Oregon. The vernal pool fairy shrimp was identified relatively recently (in 1990) and was not discovered in Jackson County, Oregon until 1998 (FWS 2005s). As a result, it is possible that additional locations for the species will be found in Oregon in the future (FWS 2005a). Suitable vernal pool habitat occurs within and adjacent to Project facilities, some of which has not been surveyed. Additionally, a proposed pipe storage yard is in the Burrill Lumber industrial yard adjacent to the vernal pool fairy shrimp critical habitat unit VERFS 3A. Potential effects on vernal pool fairy shrimp and critical habitat include possible disturbance to pools from driving or storing equipment or pipes near or on pools or wetlands, and alteration of hydrology. Although nine vernal pools within the ROW between MPs 145.3 and 145.4 are outside the known range for vernal pool fairy shrimp, the vernal pools may provide suitable habitat for the species because the pools occur within the appropriate soils type (Agate-Winlo) for vernal pool fairy shrimp, occur near (i.e., within 8.2 miles of) the known and relatively recently (1998) expanded range of the species, and the species' absence has not been confirmed. Based on the relatively recent expansion of the known range of this species and the presence of potentially suitable habitat (including soil type) that has not been surveyed, there is potential for this species to be present within the ROW and be affected by pipeline construction.

These effects would be minimized through avoidance and minimization measures. Specifically, Pacific Connector has indicated they would avoid using areas within yards that may contain vernal pool fairy shrimp and, if this species is noted during survey efforts, they would implement proper sedimentation control barriers to minimize potential effects on the species. Below is a determination of effects summary for the vernal pool fairy shrimp and critical habitat. More details will be provided in the pending BA.

The Project **may affect** vernal pool fairy shrimp for because:

- Potentially suitable habitat for vernal pool fairy shrimp has been identified near four proposed Jackson County pipe storage yards, as well as within and adjacent to the pipeline ROW between MPs 145.30 and 145.40.

The Project is **likely to adversely affect** vernal pool fairy shrimp because:

- Effects on vernal pool fairy shrimp are possible due to the Project's crossing of potentially suitable, unsurveyed habitat within the pipeline ROW between MPs 145.30 and 145.40 (within Agate-Winlo soils).

The Project **may affect** vernal pool fairy shrimp critical habitat because:

- the Project occurs adjacent to designated vernal pool fairy shrimp critical habitat; and
- the Project may affect suitable habitat within designated critical habitat adjacent to the Project.

However, the Project is **not likely to adversely affect** vernal pool fairy shrimp critical habitat because:

- Although the proposed Burrill Lumber pipe yard occurs within 250 feet of designated vernal pool fairy shrimp critical habitat unit (VERFS 3A), it is separated from the critical habitat unit by Agate Road, which is a two-lane paved road that acts as a barrier to hydrologic connectivity that is considered a definitive boundary to the area of effects.
- Burrill Lumber pipe yard has been previously disturbed, and additional surface disturbances and/or soil compaction by heavy machinery from use within Burrill Lumber pipe storage yard should be minimal. Also, Agate Road is located between Burrill Lumber pipe yard and critical habitat unit VERFS 3A, which is raised and paved, and would serve as an existing barrier between the pipe yard and critical habitat unit. Therefore, use of the Burrill Lumber pipe storage yard is not expected to adversely modify geographic, topographic, and edaphic features potentially within 250 feet of the yard that support systems of hydrologically interconnected pools, swales, and other ephemeral wetlands and depressions within the matrix of surrounding uplands (PBF 2).
- Proposed conservation measures would reduce the potential for increased sediment mobilization, increased fugitive dust, and the potential spread of invasive species to suitable vernal pool habitats.

4.6.1.6 Plants

A botanical analysis area applies to the extent of Project-related effects on listed plant species. The botanical analysis area for this Project extends to 98 feet (30 meters) each side of the pipeline project (i.e., construction ROW, TEWAs, UCSAs, rock source and disposal sites, proposed storage yards, and aboveground facilities) as well as the footprint for the Jordan Cove LNG Project. The botanical analysis area, in general, includes the area surveyed for sensitive and listed plant species (at least 100 feet from habitat removal on federal lands and at least 50 feet from habitat removal on non-federal, private lands) and distance that indirect effects on plants would be expected. Surveys are incomplete in areas of potential habitat along the pipeline route where landowner permission was denied. Pacific Connector would survey these areas after the Project is certificated, but before construction begins (i.e., if the Project is approved and Pacific Connector gains access using eminent domain proceedings under Section 7h of the NGA). Pacific Connector identified unsurveyed areas that may contain suitable habitat for listed species, as will be discussed in our pending BA.

Pacific Connector has developed a *Federally-listed Plant Conservation Plan* to address how avoidance, minimization, propagation, restoration, and other conservation measures would be applied to protect listed plant species, as well as how potential effects on unsurveyed lands would be addressed. For example, if populations of listed plant species are identified where surveys were previously denied, Pacific Connector would apply mitigation measures that have been developed for surveyed lands to minimize and avoid effects on these species including (1) minor alignment or route adjustments; (2) narrowing or necking-down the construction ROW; or (3) eliminating or removing a portion of a TEWA or UCSA (depending on where new populations of these species were identified). Additional construction measures that would be implemented in areas that contain listed plants to minimize and avoid effects on these species, if they occur, include the following measures listed below.

- The construction ROW and TEWAs would be surveyed and flagged to clearly mark the limits of construction disturbance (i.e., clearing/grading).
- Where feasible, the EI would monitor the survey and flagging efforts and would provide additional protective buffers or neckdowns to ensure protection of adjacent plant populations or provide additional avoidance. The EI would consult with Pacific Connector's Chief Inspector and the construction contractor during construction to determine where additional buffer protections or neckdowns could be accommodated without affecting construction safety.
- Known plant populations adjacent to the construction ROW or other plants populations identified during preconstruction surveys would be protected by a safety fence and silt fence to ensure these plants are not inadvertently affected by Project activities.
- BMPs outlined in Pacific Connector's *Air, Noise and Fugitive Dust Control Plan*[140] to minimize wind erosion and fugitive dust emissions during construction and restoration activities would be implemented. Water would be used to control fugitive dust along the construction ROW (no Dustlok® would be used within 150 feet of any listed plants). Only enough water would be sprayed to control the dust or to reach the optimum soil moisture content to create a surface crust; no runoff would be generated.
- Equipment would be inspected and cleaned of potential noxious weed seed or plant parts consistent with the requirements of Pacific Connector's *Integrated Pest Management Plan*.
- Topsoil salvaging would occur within affected populations after species-specific seed, bulb, or whole plant salvage has occurred. The salvaged topsoil would be returned to its original location during restoration.
- During restoration, all areas would be regraded as closely as possible to the original contours to ensure preconstruction drainage patterns are not affected.

[140] Appendix B in Pacific Connector's POD filed with the FERC in January 2018,

- The construction ROW would be restored to its original contours and reseeded with an appropriate seed mixture recommended by FWS prior to the following growing season.
- When feasible, Pacific Connector would collect and bag seeds and/or bulbs of affected listed plants and provide these seeds and/or bulbs to a suggested repository. Upon FWS approval, the collected seeds would be replanted within or adjacent to the construction ROW on suitable federal lands where future protection can be managed or on private lands where a conservation easement has been acquired.
- Construction activities would occur in the fall and winter outside the critical growing, flowering, and seeding periods.
- Wetland mats would be used in travel areas in saturated soil areas to minimize soil rutting and soil compaction and protect existing plants that may be present.

The *Federally-listed Plant Conservation Plan* includes specific mitigation plans for Applegate's milk-vetch, Gentner's fritillary, Kincaid's lupine, and Cox's mariposa-lily. In addition, the Forest Service has developed mitigation measures/requirements related to their ROW Grant that may also indirectly benefit listed plant species (see chapter 2 of this EIS and appendix F).

Below is a discussion of each federally-listed plant species that could be affected by the Project. The mitigation measures discussed above would apply to all federally-listed plants discussed in this section.

Applegate's Milk-vetch (Federally Endangered Species, State Endangered Species)

FWS listed Applegate's milk-vetch (*Astragalus applegatei*) as endangered on July 28, 1993 (FWS 1993c). This species has a narrow range, known only in the Lower Klamath Basin (the plain containing Lower Klamath Lake), near the city of Klamath Falls in southern Oregon. It was believed to be extinct until its rediscovery in 1983 and at the time of listing was only known from two extant sites. Applegate's milk-vetch grows in flat-lying, seasonally moist, alkaline soils with underlying clay hardpans. The species' habitat was historically characterized by sparse, native bunchgrasses and patches of bare soil, allowing for some seed dispersal by wind. Today, dense coverage of the habitat by introduced grasses and weeds means seed dispersal is highly localized, with most seedling establishment found adjacent to mature plants (FWS 1998b). Continued destruction, modification, and/or curtailment of its habitat or range due to urban and commercial development, and loss of habitat through competition with non-native weeds, are the principal threats to the survival of the species (FWS 2009a).

The Pacific Connector Project is located within known and historic Applegate's milk-vetch range between MPs 191.20 to 214.30. The "Collins Tract site," which is located within and adjacent to the botanical analysis area between approximately MP 195.3 and MP 196.7, contains 19 sub-populations of Applegate's milk-vetch, several of which were discovered by FWS and SBS during surveys conducted for Pacific Connector. This area was revisited in 2018 and no new sites were documented. Pacific Connector has revised its proposed route slightly in this area to avoid direct effects on the plants identified in 2008 within the Collins Tract site. Survey efforts of the pipeline route subsequent to these initial survey efforts in 2007 and 2008 have not identified any additional plants; however, Pacific Connector has not surveyed all potential habitat. Additionally, in 2009, the FWS and The Nature Conservancy documented 1,260 plants within and adjacent to the proposed Klamath Falls Memorial Drive 2 pipe storage yard, in an area that has not been surveyed for the Project (ORBIC 2017a).

The route has been relocated to avoid known populations of Applegate's milk-vetch as well as suitable habitat found during surveys conducted during summer 2008; therefore, no direct effects on known plants in those sites are expected. Additionally, Pacific Connector would resurvey the Klamath Falls Memorial Drive 2 pipe storage yard prior to construction and avoid the use of the proposed yard within 30 meters of known and documented Applegate's milk-vetch plants. Project surveys of all suitable habitat have not been completed for this species; therefore, additional plants could potentially be encountered and affected by the Project. Measures to reduce impacts on unidentified plants are included in the *Applegate's Milk-vetch Mitigation Plan*; however, the FWS has indicated it may require additional mitigation for these potential impacts as part of their BO (including additional survey, seed collection, and salvage requirements). Below is a determination of effects summary for Applegate's milk-vetch and critical habitat. More details will be provided in the pending BA.

The Project **may affect** Applegate's milk-vetch because:

- suitable habitat is available within the botanical analysis area; and
- individual plants have been located within the analysis area during survey efforts.

The Project is **likely to adversely affect** Applegate's milk-vetch because:

- approximately 175.3 acres of potential suitable habitat that has not been surveyed occurs within the botanical analysis area along the pipeline route, which includes 77 acres within the pipeline ROW; therefore, it is possible that unidentified plants occur within the construction ROW and workspace;
- surface disturbance and excavation would occur within potentially suitable habitats and could impact unidentified plants (including in areas where surveys have not been completed); and
- indirect effects, including potential changes in hydrology and soil characteristics, introduction and spread of invasive plants and noxious weeds, alterations to vegetation cover and species composition of associated habitat, and effects from fugitive dust, could impact documented or suspected plants and habitat outside the construction ROW, but within 30 meters of the Project pipeline.

Critical habitat has not been designated for Applegate's milk-vetch.

Gentner's Fritillary (Federally Endangered Species, State Endangered Species)

FWS listed Gentner's fritillary (*Fritillaria gentneri*) as endangered on December 10, 1999 (FWS 1999). Gentner's fritillary is found in small, scattered locations in the Rogue and Klamath River watersheds in Jackson and Josephine Counties in Oregon (FWS 2003c; 2016d). This species is highly localized, with populations occurring within a 30-mile radius of Jacksonville Cemetery in Jacksonville, Oregon (FWS 2003c). Since the 2003 publication of the recovery plan, nine new Gentner's fritillary populations (approximately 131 flowering plants within 1.6 acres) have been detected outside of the four recovery unit boundaries (FWS 2016d). It is difficult to census populations of Gentner's fritillary because this species does not flower every year and individuals can remain dormant for one or more years underground.

Gentner's fritillary is often found on the edge of dry woodland and forests where the overstory can be dominated by Oregon white oak, madrone, Douglas-fir, and ponderosa pine; it also occurs in open chaparral and grassland environments. It occurs at a wide range of elevations, from 1,000 to 5,100 feet, and is usually associated with shrubs that provide protection from the wind and sun (FWS 2003c).

The Pacific Connector Project crosses the plant's range between approximately MP 113 through MP 155. Surveys for Gentner's fritillary have occurred within suitable habitat near the pipeline from 2007 through 2018. Surveys are expected to continue to complete recommended second year survey efforts, where necessary. Additionally, surveys will be initated in other areas that receive survey permission. Since 2007, survey efforts have identified Gentner's fritillary individuals in five locales: (1) approximately 0.38 mile north of MP 128.0 near Indian Creek and 50 feet below a four-wheel drive road; (2) 21 feet from TEWA 128.01-W; (3) 100 feet from proposed access road EAR-128.05; (4) near MP 129.1 approximately 54 feet from TEWA 128.96-N; and (5) within 21 feet of TEWA 142.07-N near MP 142.1. Of these five sites, three are located within the analysis area. Direct impacts on known individuals of Gentner's fritillary would be avoided; however, unidentified *Fritillaria* plants near MP 142.1 that could be Gentner's fritillary occur within the pipeline ROW and would be impacted if a reroute of the pipeline alignment is not implemented (additional details to be provided in our pending BA). Additionally, unidentified *Fritillaria* plants near MP 129 that could be Gentner's fritillary occur within the analysis area and could be indirectly affected.

Additionally, Project surveys of all suitable habitat have not been completed for Gentner's fritillary; therefore, additional plants could potentially be encountered and affected by the Project. The FWS will require two-year protocol surveys in unsurveyed, potentially suitable habitat and in suitable habitat where surveys are older than 10 years. However, indirect impacts on known individuals could be eliminated with minor modifications to the construction ROW. Therefore, **we recommend that:**

- **<u>Prior to end of the draft EIS comment period</u>, Pacific Connector should file with the Secretary revised alignment sheets that eliminate or relocate TEWA 128.01-W, TEWA 128.96-N, TEWA 142.07-N. and EAR-128.05.**

Below is the determination of effects summary for Gentner's fritillary; more details will be provided in our pending BA.

The Project **may affect** Gentner's fritillary because:

- suitable habitat is available within the analysis area; and
- individual plants have been located within the analysis area during survey efforts.

The Project is **likely to adversely affect** Gentner's fritillary because:

- approximately 240.9 acres of potential suitable habitat that has not been surveyed occurs within the botanical analysis area along the pipeline route, which includes 50.4 acres within the pipeline ROW; therefore, it is possible that unidentified plants occur within the construction ROW and workspace;

- *Fritillaria* spp. have been identified within and adjacent to areas that would be affected by the Project;
- Gentner's fritillary can remain dormant underground for one year or longer, does not flower every year, and has been documented to not flower for several years; therefore, it is possible that protocol surveys conducted for the Project did not locate this species; and
- indirect effects, including potential changes in hydrology and soil characteristics, introduction and spread of invasive plants and noxious weeds, alterations to vegetation cover and species composition of associated habitat, and effects from fugitive dust, could impact documented or suspected plants and habitat outside the construction ROW, but within 30 meters of the Project pipeline.

Critical habitat has not been designated for Gentner's fritillary.

Western Lily (Federally Endangered Species, State Endangered Species)

FWS listed the western lily (*Lilium occidentale*) as endangered on August 17, 1994 (FWS 1994b). This lily is currently known from 23 small populations in freshwater marshes and swamps, early successional fens (bogs), coastal scrub and prairie, openings in coastal, Sitka spruce–dominated coniferous forests, as well as other poorly drained soils along the coast of southern Oregon and northern California (FWS 2009b). Western lilies have an extremely restricted distribution, and only occur along the coast within 4 miles of the Pacific Ocean. Occurrences within the Coos Bay area are reported to occur in Blacklock soils; however, it also grows in soils that are well drained that have a substancial layer of organic soil (SHN 2013c).

The closest known western lily occurrence in relation to the Project is approximately 1 mile south of the Myrtlewood Off-site Park & Ride at the Hauser Bog (ORBIC 2017b). However, the Myrtlewood Off-site Park & Ride is located completely in the paved parking lot and does not contain suitable habitat for the western lily. There are no other known occurrences within two miles of the Project (ORBIC 2017b). There are no records of western lily north of Hauser, and the FWS typically considers Hauser the northern extent for the species along the Oregon coast.

Surveys for western lily within potential habitat in the analysis area (i.e., poorly drained bogs with acidic organic soils and within six miles of the coast below 300 feet elevation) were conducted between 2006 and 2017 (SHN 2013c; SBS 2008a, 2012, 2013, 2014, 2017a). Jordan Cove conducted surveys at the LNG terminal site in 2006, 2012, and 2013 and surveys were conducted by SBS for Pacific Connector between 2007 and 2017. No occurrences of western lily were detected during these surveys, and only limited areas of potential suitable habitat were identified. More details will be provided in our pending BA.

Although no plants were identified in the area that would be affected by the Project and potential occurrence of this species in this area is low, surveys of all potential habitat in the area have not been completed for this species; therefore, western lily could potentially be encountered and affected by the Project. Additionally, this species is difficult to detect when not flowering, and surveys may overlook western lily juveniles or vegetative adults, especially non-flowering individuals growing within dense vegetation (FWS 2008b). Below is the determination of effects summary for western lily and critical habitat.

The Project **may affect** the western lily because:

- known populations occur within 1 mile of the botanical analysis area; and
- potential suitable habitat is available within the analysis area.

The Project is **not likely to adversely affect** the western lily because:

- surveys of potential western lily habitat at the Jordan Cove site and associated facilities and along the pipeline route did not document western lily and potential suitable habitat within the botanical analysis area is limited;
- surveys in potentially suitable habitat would occur prior to ground-disturbing activities; if plants are identified, conservation measures developed to avoid or minimize effects on any documented plants would be implemented; and
- consultations with the FWS would be reinitiated if this species is found to be present in the area and effects cannot be avoided.

Critical habitat has not been designated for the western lily.

Large-Flowered Meadowfoam (Federally Endangered Species, State Endangered Species)

The large-flowered meadowfoam (*Limnanthes pumila* ssp. *grandiflora*) was federally listed as endangered on November 7, 2002 (FWS 2002b). It is an endemic species restricted mostly to the Agate Desert area in the Rogue River Valley of southern Oregon. It grows on the wetter, inner edges of vernal pools at elevations between 1,220 and 1,540 feet. The plant is capable of self-fertilization and self-pollination. In the Rogue River Valley, large-flowered meadowfoam is often found in the same vernal pool habitats as Cook's lomatium (*Lomatium cookii*) and the vernal pool fairy shrimp.

In 2010, FWS designated eight CHUs (5,840 acres) for the large-flowered meadowfoam in the Agate Desert complex in Jackson County, Oregon. Two of the units designated are shared by the designated habitat for Cook's lomatium. All designated CHUs are currently occupied (or expected to be occupied; FWS 2010b). Within the vicinity of White City, Oregon, where multiple pipe storage yards would be located, CHUs RV6 (6A through 6H) and RV8 have been designated. Industrial parks surround all units. Unit RV6C is across an existing paved road from the Burrill Lumber pipe storage yard, and Unit RV6D is 590 feet northeast of this pipe storage yard. RV8 is over 1.8 miles west of the proposed Rogue Aggregates and the other three pipe storage yards.

Botanical surveys were conducted within identified suitable habitat for this species where access was permitted, during the flowering season in April 2007. In 2007, survey efforts documented approximately 36 large-flowered woolly meadowfoam plants approximately 850 to 1,165 feet east of the proposed Burrill Lumber pipe storage yard. Additionally, ORBIC (2017a) has reported several other subpopulations of large-flowered woolly meadowfoam (approximately 16,200 plants) near proposed pipe storage yards, including within the Ken Denman State Game Management Preserve across an existing paved road east of the Burrill Lumber pipe storage yard.

No surveys have been permitted within Avenue F & 11th Street and WC Short pipe storage yards; however, off-site observations identified approximately 0.48 acre of highly modified, low-quality vernal pool habitat within 250 feet of the Avenue F & 11th Street and WC Short pipe yards. This area is associated with active industrial sites or previously disturbed industrial areas and is not expected to provide high-quality vernal pool habitat or support individuals of large-flowered woolly meadowfoam. Additionally, no direct or indirect effects on potential vernal pool habitat are expected from use of the Avenue F & 11th Street and WC Short pipe storage yards.

The Project **may affect** large-flowered woolly meadowfoam because:

- the pipeline occurs near occupied, large-flowered woolly meadowfoam habitat.

The Project is **not likely to adversely affect** large-flowered woolly meadowfoam because:

- surveys of potentially suitable habitat at proposed pipe storage yards in Jackson County and along the Project did not document large-flowered woolly meadowfoam plants;
- the 0.48-acre of unsurveyed potential habitat within the Avenue F and 11th and WC Short pipe storage yards consists of low-quality vernal pool habitat within active industrial sites or previously disturbed industrial areas and is unlikely to contain large-flowered woolly meadowfoam;
- Pacific Connector would avoid using portions of the pipe storage yards within 250 feet (indirect effect) of this species or potentially suitable vernal pool habitat;
- effects on suitable habitat are likely to be discountable to the point where no meaningful measurement, detection, or evaluation of effects would be possible (i.e., effects would not reach a level where individual plants would be lost);
- sedimentation barriers would be used, as appropriate, to prevent run-off and changes in hydrology;
- conservation measures have been developed to avoid or minimize effects on any plants identified during surveys prior to construction; and
- construction of the pipeline is not expected to adversely modify hydrology in nearby suitable habitat areas within 250 feet of proposed pipe storage yards.

The Project **may affect** designated critical habitat for large-flowered woolly meadowfoam because:

- the Project occurs adjacent to large-flowered woolly meadowfoam critical habitat.

The Project is **not likely to adversely affect** large-flowered woolly meadowfoam critical habitat because:

- Construction of the pipeline is not expected to adversely modify designated critical habitat areas within 250 feet of pipeline components (i.e., subunit RV6C); existing features (i.e., paved Agate Road) and proposed conservation measures would provide sufficient protection from adjacent development and invasive plant and noxious weed sources; and

- The Burrill Lumber pipe yard is hydrologically disconnected from subunit RV6D due to topography (flow is away from RV6D) and distance (greater than 590 feet) and is hydrologically isolated from subunit RV6C by the raised Agate Road.

Cook's Lomatium (Federally Endangered Species, State Endangered Species)

Cook's lomatium was listed as federally endangered on November 7, 2002 (FWS 2002b). Its range is on seasonally wet soils limited to two areas: (1) along vernal pools in the Agate Desert area of the Rogue River Valley, Jackson County, and (2) in seasonally wet serpentine-derived grassland meadows, sloped mixed-conifer forest openings, and and along roadsides edges in shrub dominated plant communities or adjacent to meadows within the Illinois River Valley area near Cave Junction, Josephine County. The Jackson County populations occur along the margins and bottoms of vernal pool habitats within a 20,510-acre landform known as the Agate Desert. The plant flowers from late March to May and is pollinated entirely by insects. In the Rogue River Valley, Cook's lomatium is often found in the same vernal pool habitats as the large-flowered meadowfoam and the vernal pool fairy shrimp.

In 2010, the FWS designated 16 units (6,289 acres) of critical habitat for the Cook's lomatium, including three CHUs in Jackson County, totaling 2,282 acres. Two of the designated units in Jackson County are shared by the designated habitat for large-flowered woolly meadowfoam. All designated CHUs are currently occupied (FWS 2010b). CHUs RV6 (A, F, G, and H) and RV8 have been designated within the vicinity of White City, Oregon, where multiple pipe storage yards would be located. Industrial parks surround these units. CHUs RV6A and RV6H are located approximately 0.5 mile south and 0.8 mile southeast, respectively, of the Avenue F & 11th Street and WC Short pipe storage yards.

Four pipe storage yards, Burrill Lumber, WC Short, Avenue F & 11th Street, and Rogue Aggregates, occur within the Agate Desert near White City in proximity to known occupied vernal pools. No vernal pool habitat or individuals of Cook's lomatium were observed during surveys of the Burrill Lumber and Rogue Aggregates pipe storage yards, and no potential vernal pools were located within 250 feet of the Burrill Lumber pipe storage yard. Although the layout for the Rogue Aggregates pipe storage yard has been reconfigured since surveys in 2007, unsurveyed portions do not contain suitable soil types for Cook's lomatium. Several patches of Cook's lomatium have been documented in the Denman Wildlife Management Area and Agate Desert Preserve, 0.5 mile south of the Avenue F & 11th Street and WC Short pipe storage yards (Friedman 2006, ORBIC 2017a). Surveys have not been conducted within the Avenue F & 11th Street and WC Short pipe storage yards because access has not been granted; however, based on aerial photography and off-site observation in April 2018, Avenue F and 11th and WC Short pipe storage yards do not appear to contain suitable habitat for Cook's lomatium. A long drainage ditch running along the northern edge of the Avenue F and 11th pipe storage yard, which could provide low-quality habitat for Cook's lomatium, was observed during these off-site surveys.

Below is the determination of effects summary for Cook's lomatium and critical habitat; more details will be provided in our pending BA.

The Project **may affect** Cook's lomatium because:

- suitable, occupied habitat is available within the vicinity of the Project.

The Project is **not likely to adversely affect** Cook's lomatium because:

- surveys of suitable habitat at pipe storage yards in Jackson County and along the pipeline did not document Cook's lomatium;

- Pacific Connector would avoid using portions of pipe storage yards within 250 feet of high-quality vernal pool habitat, as well as areas with potential vernal pool habitat;
- effects on suitable habitat are likely to be discountable to the point where no meaningful measurement, detection, or evaluation of effect would be possible (i.e., effect would not reach a level where individual plants would be affected);
- sedimentation barriers would be used, as appropriate, to prevent run-off and changes in hydrology;
- conservation measures have been developed to avoid or minimize effects on any plants identified during surveys prior to pipeline construction;
- known sites within the vicinity of the Project are farther than 0.5 mile from pipe storage yards; and
- unsurveyed habitat is low-quality vernal pool habitat located over 0.25 mile from known sites with no apparent hydrologic connectivity.

The Project would have **no effect** on designated Cook's lomatium critical habitat because:

- the pipeline is over 0.5 mile from the nearest critical habitat subunit RV6A; and
- the proposed action is not expected to adversely modify habitat areas that provide buffer protection from adjacent development and weed sources, continuous nonfragmented habitat, and intact hydrology (PBFs 1 and 4).

Kincaid's Lupine (Federally Threatened Species, State Threatened Species)

Kincaid's lupine was listed as federally threatened on January 25, 2000 (FWS 2000b). It is a long-lived perennial herb inhabiting native prairies and foothills (FWS 2000b). In Douglas County, Oregon, it occupies sites that are more shaded, occurring in areas with tree (i.e., Douglas-fir, California black oak, Pacific madrone, ponderosa pine, incense cedar, hairy manzanita, and poison oak) and shrub canopy cover of 50 to 80 percent (FWS 2006f). About 600 acres have been designated as critical habitat for this species; however, all of these designated habitats are located outside of areas that would be disturbed by the Project.

The pipeline is located within known or historical Kincaid's lupine range between MPs 46.8 and 99.3. Multiple populations of lupine have been identified in the Project's botanical analysis area within Douglas County, including 11 sites within 2.5 miles of the pipeline (ORBIC 2017a). Surveys in 2007 identified three populations of Kincaid's lupine in the vicinity of the pipeline: 1) within and adjacent to the construction ROW on private land between approximately MPs 57.84 and 57.92; 2) on private land near MP 59.60 (approximately 300 feet north of MP 59.60; 67 and 222 feet to the north and west of TEWA 59.30-N; and approximately 40 and 85 feet to the south and west of EAR 59.62); and 3) and on private land within the construction ROW and along proposed access roads between MPs 96.48 to 96.90.

Pacific Connector has modified the pipeline route to avoid the population located within the construction ROW between MP 57.84 and MP 57.92. No direct impacts are anticipated to the population near MP 59.60, as plants are located at least 67 feet from pipeline facilities. The two sites, near MP 57.84-57.92 and 59.60, were revisited in 2017, and both populations appeared to be stable or slightly increasing (SBS 2017b).

Pacific Connector also modified the construction ROW between MP 96.48 and 96.90 to avoid direct impacts on the Kincaid's lupine individuals identified during surveys in 2007. Additionally, the population between MP 96.48 and 96.90 was burned during the 2015 Stouts Creek fire. This population was revisited in 2016 to determine the affect of the fire, associated fire-suppression activity, and subsequent logging activities. Kincaid's lupine was observed in only 2 of the original 28 subpopulations documented in the area during surveys in 2007, and no viable plants were observed in the pipeline ROW or within proposed access roads (SBS 2016). Although no plants were relocated along the construction ROW between MP 96.48 and 96.90 in 2016, it is possible that construction of the pipeline and use of access roads could affect this population if plants resprout in this area. Pacific Connector would conduct additional surveys within the Stouts Creek fire area (MP 96.48 to 96.9) prior to ground disturbance.

No additional plants have been documented in other areas of the pipeline route, where access was granted, during subsequent surveys. However, not all suitable habitats within the Project area have been surveyed to date, indicating that additional unknown populations may be present within areas that could be affected by the Project. If other Kincaid's lupine populations are identified during additional surveys, Pacific Connector would implement applicable mitigation measures, such as necking down the construction right-of way, excluding a portion of an identified TEWA or pipe storage yard, and erecting a protective fence or barrier, to avoid or minimize impacts on newly observed populations. Persisting subpopulations at MPs 96.48 to 96.9 would be flagged/fenced to minimize potential disturbance.

The Project could affect unknown populations of Kincaid's lupine within and adjacent to the pipeline ROW. The *Federally-listed Plant Conservation Plan* contains a Kincaid's Lupine Mitigation Plan that specifically addresses mitigation that would be implemented for Kincaid's lupine; however, the FWS may require additional mitigation for these potential impacts as part of their BO (including additional survey, seed collection, and salvage requirements). Below is the determination of effects summary for Kincaid's lupine and critical habitat.

The Project **may affect** Kincaid's lupine because:

- suitable habitat is present within the analysis area; and
- individual plants have been located within the analysis area during survey efforts.

The Project is **likely to adversely affect** Kincaid's lupine because:

- approximately 991.6 acres of potential suitable habitat that has not been surveyed occurs within the botanical analysis area along the pipeline route, which includes 448.7 acres within the pipeline ROW; therefore, it is possible that unidentified plants occur within the construction ROW and workspace;
- surface disturbance and excavation would occur within potentially suitable habitats, and could impact unidentified plants (including in areas where surveys have not been completed);
- indirect effects, including potential changes in hydrology and soil characteristics, alterations to vegetation cover and species composition of associated habitat, and effects from fugitive dust, could impact documented or suspected plants and habitat outside of the construction ROW, but within 30 meters of the Project pipeline and along access roads; and

- trenching activities associated with the pipeline could affect below-ground stems, and the expected effect to extant plants is unknown.

The Project would have **no effect** on Kincaid's lupine critical habitat because:

- the pipeline does not occur within designated Kincaid's lupine critical habitat.

Rough Popcornflower (Federally Endangered Species, State Endangered Species)

The rough popcornflower was federally listed as endangered on January 25, 2000 (FWS 2000c). It is found in seasonal wet meadows or wet prairies in poorly drained clay or silty clay loam soils at elevations ranging from 100 to 900 feet. This plant occurs mostly on private lands in the Umpqua River drainage near Sutherlin and Yoncalla in northern Douglas County (FWS 2003d). As of 2010, there were 14 extant populations of rough popcornflower distributed from Yoncalla Creek near Rice Hill, south to Sutherlin Creek near Wilbur, of which five populations have been introduced (FWS 2010c). Six populations are considered protected and have a documented occupancy of at least 5,000 plants (FWS 2010c).

The closest known occurrences of rough popcornflower to the Project include multiple subpopulations approximately 1.7 miles north of the Winchester pipe storage yard and 17.5 miles north of the pipeline ROW at MP 68 (ORBIC 2017a, 2017c). Surveys for rough popcornflower have been conducted in potential habitat between MPs 51.7 and 67.0. To date, no individuals of rough popcornflower have been documented during surveys. However, Pacific Connector has not been granted access to approximately 99.83 acres of potentially suitable rough popcornflower habitat within the analysis area, the majority of which is associated with the Winchester pipe storage yard.

Due to the potential for the plant to occur within areas of potential habitat that have not been surveyed by Pacific Connector and may be disturbed by construction activities, the Project may affect rough popcornflower. Below is the determination of effects summary for rough popcornflower and critical habitat.

The Project **may affect** rough popcornflower because:

- populations occur near a pipe storage yard; and
- potential suitable habitat might be present within the 98-foot (30-meter) botanical analysis area.

The Project is **not likely to adversely affect** rough popcornflower because:

- where access has been granted, surveys for the Project have not documented individuals of rough popcornflower; surveys in potentially suitable habitat identified within the Winchester pipe storage yard would occur prior to ground-disturbing activities; if plants are identified, Pacific Connector would not use either the pipe storage yard or portions of the yard where plants are documented;
- surveys within potential habitat along the pipeline ROW would occur prior to ground disturbing activities; if any plants are identified, conservation measures developed to avoid or minimize effects on documented plants would be implemented; and
- consultation with the FWS would be reinitiated if this species is found to be present in the area and effects cannot be avoided.

Critical habitat has not been designated for rough popcornflower.

4.6.1.7 Conclusions and Recommendations for Threatened and Endangered Species

Based on informal consultations with the FWS and NMFS, 34 federally listed and proposed species were identified as potentially occurring near the Project. The FERC would only authorize the Project to proceed if the FWS' and NMFS' BOs find the Project, as described, would not jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat. Further, to ensure compliance with the ESA, **we recommend that:**

- **Jordan Cove and Pacific Connector <u>should not begin construction until</u>:**
  - **a. the Commission staff completes formal consultations with the NMFS and FWS; and**
  - **b. Jordan Cove and Pacific Connector have received written notification from the Director of OEP that construction and/or implementation of conservation measures may begin.**

4.6.2 State-Listed Threatened or Endangered Species

In addition to species that are federally threatened or endangered, there are 13 species designated as threatened or endangered by the State of Oregon that could potentially occur in the area affected by the Project (table 4.6.2-1).

TABLE 4.6.2-1

State-Listed Species Potentially Occurring in the Area Affected by the Proposed Project

Species	FWS Status	ODFW Status	Portion of the Project Area Where Species Potentially Occur
Mammals			
Kit fox *Vulpes macrotis*	None	Threatened	Pacific Connector Pipeline
Gray Whale *Eschrichtius robustus* (Eastern North Pacific stock)	Delisted	Endangered	LNG carrier transit in the waterway, Navigation Reliability Improvements Dredge Areas
Birds			
California brown pelican *Pelecanus occidentalis*	None	Endangered	Navigation Reliability Improvements Dredge Areas, Jordan Cove terminal
Plants			
Pink sand verbena *Abronia umbellata* ssp. *Breviflora*	Species of Concern	Endangered	Jordan Cove terminal
Point Reyes bird's-beak *Cordylanthus maritimum* ssp. palustre (*C. maritimus* ssp. *palustris*)	Species of Concern	Endangered	Jordan Cove terminal; Pacific Connector pipeline
Wayside aster *Eucephalis vialis* (*Aster vialis*)	Species of Concern	Threatened	Pacific Connector pipeline
Peck's milk-vetch *Astragalus peckii*	None	Threatened	Pacific Connector pipeline
Pumice grape-fern *Botrychium pumicola*	None	Threatened	Pacific Connector pipeline
Cox's mariposa-lily *Calochortus coxii*	Species of Concern	Endangered	Pacific Connector pipeline
Umpqua mariposa-lily *Calochortus umpquaensis*	Species of Concern	Endangered	Pacific Connector pipeline

TABLE 4.6.2-1

State-Listed Species Potentially Occurring in the Area Affected by the Proposed Project

Species	FWS Status	ODFW Status	Portion of the Project Area Where Species Potentially Occur
Dwarf woolly meadowfoam *Limnanthes pumila ssp. pumila*	Species of Concern	Threatened	Pacific Connector pipeline
Silvery phacelia *Phacelia argentea*	Species of Concern	Threatened	Jordan Cove terminal Pacific Connector pipeline
Wolf's evening primrose *Oenothera wolfii*	None	Threatened	Jordan Cove terminal

4.6.2.1 Mammals

Kit Fox (No ESA Status, State Threatened Species)

The kit fox reaches its northern limit in southern Oregon. In Oregon, it is found in arid desert valleys dominated by halophytic plants like greasewood and shadscale, intermingled with sagebrush. Although the Project may affect suitable kit fox habitat, the expected distribution of this species does not include the Project area. Because kit foxes have not been recently observed within the area affected by the Project (ORBIC 2017a), the Project is not expected to affect this species.

Gray Whale (Eastern North Pacific stock; Federal Delisted Species, State Endangered Species)

The gray whale is a large baleen whale that is distributed in the northern Pacific Ocean in western and eastern stocks. The eastern stock, found along the west coast of North America, was federally delisted on June 16, 1994 (59 FR 115), but remains state endangered in Oregon. The eastern Pacific stock feeds in the summer in the Chukchi Sea, the western Beaufort Sea, and the northern Bering Sea. They migrate south from November through early February to lagoons on the Pacific coast of central and southern Baja California. Northward migration occurs after the calving and breeding season, from early February to May. These whales have the longest known migration of any mammal. Gray whales feed on infaunal benthic species that are buried in sediments (Maser et al. 1981). Gray whales are federally protected under the MMPA.

Potential effects on gray whales include injury and/or mortality due to ship strikes, underwater ship noise, construction noise (including pile driving and dredging) and potential adverse effects from a ship fuel spill at sea. Spills could indirectly affect gray whales by impacting forage species. These potential effects would be similar to the effects on federally listed whales that are discussed above, except that gray whales migrate in coastal waters north and south parallel to the Pacific Coast, making them more susceptible to ship strikes in nearshore waters during migration.

According to the Oregon Parks and Recreation Department (OPRD 2007), gray whales are the most predominant whales seen along the Oregon coast. They migrate twice a year, in winter and spring, and about 200 of them feed along the coast during the summer months. Gray whales have on occasion entered Coos Bay beyond the Jordan Cove LNG Project site and have been seen in Coos Bay at about the same frequency as killer whales. Gray whales may be encountered along the LNG carrier transit route during their southern migration from November through early February or from early February to May during the northern migration. Based on data in Pacific waters between 1999 and 2003, gray whales are struck by ships at a rate of 1.2 whales annually (Angliss and Outlaw 2007). The increase in shipping traffic resulting from LNG carriers could cause an increase in the probability of whales being struck by ships, or of being disturbed during migration. Measures that Jordan Cove would implement to avoid or minimize effects on federally listed whales (see section 4.6.1.1) would serve to avoid or minimize effects on the gray whale.

4.6.2.2 Birds

California Brown Pelican (Federal Delisted Species, State Endangered Species)

The brown pelican was listed as a federally endangered species on June 2, 1970, within California, Oregon, Texas, and Washington states, as well as Central and South America (FWS 1970). It was delisted in December 2009 (FWS 2009c); however, Oregon still considers the brown pelican an endangered species under state law (ODFW 2017h).

The California brown pelican is a primarily coastal species, rarely seen inland or far out at sea (FWS 2005b). They feed mostly in shallow estuarine waters, normally staying within 20 miles of shore (FWS 2005b). Pelicans make extensive use of sand spits, offshore sand bars, and islets for nocturnal roosting and daily loafing, especially by non-breeders and during the non-nesting season (FWS 2005b).

Brown pelicans nest in colonies, mostly on small coastal islands in California (FWS 1985, 2007e). Brown pelicans generally breed between February and October and are most abundant in Oregon during post-breeding migration (FWS 2005b). In Oregon, numbers peak in late August through October and gradually decline from October through early November as birds move south (Gilligan et al. 1994). Since brown pelicans have wettable feathers, they return to land daily to roost and dry their feathers (FWS 2005b). Sand islands within three large estuaries in Oregon and Washington serve as primary night roosts (Jaques and O'Casey 2006 as cited in FWS 2007e). The total number of brown pelicans in Oregon in 2001 was estimated to be 6,095 (Marshall et al. 2003).

Brown pelicans are regularly seen in moderate numbers during the summer months in Coos Bay, and they also occur in small numbers in the winter (Contreras 1998). Coos Bay provides excellent habitat for this species. Brown pelicans were recorded foraging near the Project site more than 500 feet from the shore and loafing across the bay in moderate numbers daily during surveys in October 2012 (SHN 2012). The species was also observed during surveys conducted in 2005-2006 until early September (LBJ 2006). The Project site provides no nesting habitat for the brown pelican. Roosting and feeding sites have been documented within the Project area, although the last observation was in 1985. Roosting was reported on the north side of Coos Bay on a sunken jetty close to the Bay mouth and on a sand spit on the North Spit of Coos Bay, as well as on dredge spoil islands around MPs 3R through 4R (ORBIC 2017a).

In the past, California brown pelicans have been affected by human disturbances at nesting colonies and roosting habitats. Existing nesting and roosting habitats within the Coos Bay Estuary and Jordan Cove LNG Project area have not been documented. If they occur within the estuary during construction and operation of the proposed action, pelicans may be associated with on-shore fish-cleaning stations where they possibly feed on offal (Marshall et al. 2003). Existing fish-cleaning stations are present at the Empire Boat Ramp, Oceanside RV Park and Bastendorff Beach County Park, both in Charleston. Fish-cleaning could also occur at the Charleston Marina, California Street Boat Ramp, and BLM Boat Ramp, though they are not designated as such.

Noise and human activities associated with construction and operation of the Project are likely to be the only direct effect to brown pelicans if they occur within one or more of the Project's analysis areas. Jordan Cove is proposing construction of its access channel in Coos Bay during the ODFW recommended in-water work window between October 1 and February 15. This schedule would minimize effects on brown pelicans because there is a gradual decline in populations in Oregon as birds move south from October through early November (Gilligan et al. 1994). However, noise created by pile driving and construction in general is likely to affect brown pelicans if present and could disrupt brown pelican feeding behavior.

Brown pelicans that forage within the vicinity of the Jordan Cove LNG Project (i.e., the estuarine analysis area) could ingest low levels of contaminants through the food web that are re-suspended from dredging activities. However, sediments at the Jordan Cove LNG Project site and pipeline route within Coos Bay are not expected to contain levels of sediment contaminants that could adversely affect brown pelicans. Access channel dredging and maintenance dredging would not occur during the period of peak pelican abundance in the lower bay. Therefore, dredging activities would not substancially disrupt normal behavior patterns for brown pelicans.

Pacific Connector is proposing construction across Coos Bay using HDD construction in two segments (MP 0.12 to MP 1.11 and MP 1.40 to MP 3.09). It is possible that the brown pelican could be present within Coos Bay and its vicinity during the time of construction (see Contreras 1998). Therefore, noise and human activities associated with construction and operation of the pipeline are likely to affect brown pelicans as sources of disturbance and disruption if they are present and could disrupt brown pelican feeding behavior.

There is some evidence in the literature that high intensity continuous anti-collision lights on structures may result in an increased number of bird strikes, especially at night or during fog and overcast conditions. The number of strikes can apparently be reduced by strobe or blinking the anti-collision lights. The LNG storage tanks would not be illuminated with high intensity lighting. The intensity and number of lights would be limited to what is required for security and operations. With the low-intensity lighting to be used, the likelihood of adverse effects on brown pelicans from collisions with the LNG storage tanks is minimal.

Brown pelicans may be encountered during any portion of the LNG carrier transit route in the waterway. There is no evidence that pelicans are struck by current cargo ships using the Port.

During operation of the Pacific Connector pipeline, aerial inspection of the pipeline route would occur within the permanent ROW. Aerial inspections would generally occur during all times of year, although inspections would not affect nesting or breeding brown pelicans since they do not nest or breed within Coos Bay. Additionally, aerial inspection should not disturb migrating, roosting, or foraging brown pelicans since air traffic is a constant disturbance within Coos Bay from the existing North Bend airport.

The proposed action would create auditory and visual disturbances that are likely to cause foraging brown pelicans to temporarily avoid areas of high activity. The proposed action area does not contain existing nesting or roosting habitat and would not affect nesting or roosting individuals. As a result, the proposed action would temporarily affect foraging individuals but is not expected to affect nesting or roosting by brown pelicans

4.6.2.3 Plants

Pink Sand Verbena (Federal Species of Concern, State Endangered Species)

The historical range of pink sand verbena (*Abronia umbellata* ssp. *breviflora*) was from northern California to Vancouver British Columbia, Canada (ODA 2017c). Its present range is along coastal beach and foredune, predominantly from Cape Blanco (Curry County), southern Oregon to Point Reyes National Seashore in Marin County, California and sporadically along Oregon's northern and central coast. Pink sand verbena only inhabits the littoral sandy beach areas and unstabilized sand dunes of the coastal strip and usually occurs on beaches in fine sand between the high-tide line and the driftwood zone, and in areas of active sand movement below the foredune (ORBIC 2010). In the northern portion of its range, most populations of pink sand verbena occur on broad beaches and/or near the mouths of creeks and rivers.

Of the 12 reported occurrences in Oregon, only 2 have more than 50 plants; many of the populations consist of only one plant and will probably not persist. Two populations of pink sand verbena documented near the mouth of Coos Bay, contained approximately 300,000 plants when surveyd in 2012 (ORBIC 2017a). Approximately 15 miles north of the entrance to Coos Bay, 19 plants were documented in 1995 within a protected (public entry prohibited) snowy plover nesting area (ORBIC 2012). There are no known occurrences of pink sand verbena within two miles of the Jordan Cove Project area (ORBIC 2017a). No pink sand verbena plants have been reported within the Pacific Connector pipeline area (ORBIC 2006a) and the pipeline route would not affect coastal sand dune habitat; therefore, Pacific Connector has not conducted botanical surveys for this species and no incidental documentations of this species has occurred.

Jordan Cove identified suitable habitat for the plant along the eastern portion of the LNG terminal in areas of actively moving dunes and European beachgrass. However, surveys conducted at the Jordan Cove Project area in 2006, 2012, and 2013 did not locate any pink sand verbena plants (SHN 2006b, 2013c). As surveys conducted within the Jordan Cove Project area, as well as historic data, indicate that pink sand verbena is not present within the Project area, the Project is not expected to affect this species.

Point Reyes Bird's-beak (Federal Species of Concern, State Endangered Species)

Point Reyes bird's-beak (*Cordylanthus maritimum* ssp. *palustre* [*C. maritimus* ssp. *palustris*]) inhabits salt marshes along the coast, sometimes growing just above tidewater in wet areas. Its habitat requirements are specific: approximately 7.5 to 8.5 feet (2.28 to 2.59 meters) above mean lower low water, soil salinity of 34 to 55 parts per thousand, sandy substrate covered by 1 to 10 cm (0.39 to 3.93 inches) organic silt, and less than 30 percent bare soil in summer. Point Reyes bird's-beak occurs along the Pacific Coast from Tillamook County, Oregon, south to Santa Clara County, California. In Oregon, the species is restricted to Netarts Bay, Yaquina Bay, and Coos Bay, with most known occurrences located in Coos Bay. Within the counties crossed by the Project, Point Reyes bird's-beak is found in Coos County.

Several occurrences of Point Reyes bird's-beak are near both the Jordan Cove LNG Project and the Pacific Connector Pipeline Project. Populations with 1,000 to 10,000 plants are located along the margins of Coos Bay and on sand salt marshes near the edge of high water marks (ORBIC 2017a). Several occurrences of Point Reyes bird's-beak are near the Jordan Cove LNG Project, and this species is known to occur within the intertidal wetland between APCO Sites 1 and 2;

however, there is no suitable habitat on APCO Site 2 as this area is dominated by upland vegetation. This species also occurs outside the LNG terminal area along the west and southeast shoreline of the South Dunes site (ORBIC 2017a) and potential habitat for this species has also been observed along the shoreline south of the South Dunes site. Jordan Cove would conduct an additional survey in this area of potential habitat prior to construction.

The area affected by the Pacific Connector Pipeline Project is within the vicinity of documented populations of Point Reyes bird's-beak and the pipeline route would cross suitable habitat. Populations with 1,000 to 10,000 plants were located in 1982 and 1999 along the margins of Coos Bay approximately 260 feet south of TEWA 0.10 (HDD pull-back) and on sand salt marshes near the edge of high water marks on the west side of Haynes Inlet approximately 815 feet north of the Jordan Cove Meter Station near the proposed HDD across Coos Bay (ORBIC 2017a). These plants are farther than 100 feet from the pipeline route and should not be affected by construction. Surveys conducted for Pacific Connector in 2007 located one population of about 1,000 Point Reye's bird's-beak plants approximately 1.7 miles south of MP 1.7 (FERC 2009). Additional surveys occurred in 2017 along the pipeline route near MPs 0.3, 1.0, and 1.47 near the edge of high water marks where the pipeline HDD exits and enters land. Approximately 30 Point Reyes bird's beak plants were located at the margin of Coos Bay near MP 0.9, approximately 475 feet northwest of the construction right-of way and 700 feet west/northwest of TEWAs 1.09-N and 1.09-W. This portion of the pipeline would be constructed by HDD and should not affect plants observed at this location.

Point Reyes bird's-beak is found within and near the Jordan Cove and Pacific Connector Project areas; however, construction of the Project should not directly affect individual plants. Additionally, Pacific Connector has committed to protecting plants adjacent to the pipeline construction ROW through the appropriate installation of safety and silt fence as determined by Pacific Connector's EIs.

Wayside Aster (Federal Species of Concern, State Threatened Species)

The wayside aster's (*Eucephalis* [*Aster*] *vialis*) range is limited to central, southern, and western Oregon and the northern California state line (ORBIC 2010). About 100 populations are known, totaling fewer than 9,000 individuals. Most populations are centered in the southern Willamette Valley of Lane County or in southern Jackson and Josephine Counties, although a few populations exist in the adjacent counties of California (ORBIC 2010). None of the known populations are protected, and many populations are along roadsides and in areas of residential development. Wayside aster occurs in areas of natural and man-made disturbance, edges and openings in woodlands and forests, in second and old-growth, and in shaded roadsides.

Several populations of wayside aster plants have recently been documented within Douglas and Jackson Counties; however, except for one site discussed below, these records are more than 0.5 mile from the Pacific Connector Project area. Botanical surveys for this species in potential habitat have been conducted by Pacific Connector in Coos Bay, Roseburg, and Medford BLM Districts; Umpqua National Forest; and Jackson County. This species was documented in 2007 adjacent to a previously proposed existing access road that would require improvements; however, this road is no longer proposed for use as an access road. This site was revisited in 2009 and additional surveys were conducted within 0.25 mile of this site; however, no plants were located.

Although the species is documented near the Project, surveys conducted by Pacific Connector for the wayside aster did not detect this plant's presence. Construction of the pipeline, including the use of access roads, is not anticipated to affect this species.

Peck's Milk-vetch (Federal Species of Concern, State Threatened Species)

Peck's milk-vetch (*Astragalus peckii*) occurs east of the Cascades Mountain range. Most populations of Peck's milk-vetch are centered in three separate areas: one in north-central Deschutes County, another in north-central Klamath County, and the third in south-central Klamath County. These populations total about 300,000 individuals. The plant occurs in very dry sites, on loose, sandy soil or pumice, often in or along dry water courses, in sagebrush or rabbitbrush openings in ponderosa pine forests (in the south) or in western Juniper woodlands (in the north), and occasionally on barren flats.

Peck's milk-vetch has not been documented within the vicinity of the Project (ORBIC 2006a). No suitable habitat for Peck's milk-vetch occurs within the areas crossed by the pipeline route; therefore, Pacific Connector did not conduct botanical surveys for this species. As this species is not expected to occur along the pipeline route, it would probably not be affected by construction and operation of the Project.

Pumice Grape-Fern (No ESA Status, State Threatened Species)

This species is one of the rarest grape-ferns, and in Oregon is found only within the Crater Lake area and Paulina Mountains in Deschutes and Klamath Counties. Most known populations are found in fine pumice gravel at elevations above 7,800 feet (2,400 meters). It has also been located within frost pockets in lodgepole pine forests with bitterbrush, in areas with deep, sterile pumice. In Oregon, pumice grape-fern *(Botrychium pumicola*) is typically associated with Brewer's sedge and buckwheat (*Eriogonum* spp.) species (Eastman 1990; ORBIC 2010).

The Project is not located near known sites of this plant, and no suitable habitat for this plant occurs within the areas crossed by the pipeline route; therefore, Pacific Connector did not conduct botanical surveys for this species. As the pumice grape-fern is not expected to occur along the pipeline route, the Project would probably have no effect on this species.

Cox's Mariposa Lily (Federal Species of Concern, State Endangered Species)

The Cox's mariposa lily (*Calochortus coxii*) is endemic to serpentine and ultramafic soils and is limited to a small area (30 square meters) along a 10-mile serpentine ridge system in Douglas County, Oregon. All known populations are on serpentine soils, mostly on shady, north-facing, mesic sites near ridgelines, typically, growing in serpentine grasslands and forest margins. Population monitoring studies on BLM land from 2011 through 2015 demonstrated relatively high interannual variation in population estimates for Cox's mariposa lily. For example, 6,966 plants were observed in 2011, whereas 13,865 individuals were observed in 2012 (Gray and Bahm 2015). Populations are also known to occur on private lands; however, surveys haven't been conducted on private lands since the early 1990s (ORBIC 2017a; Aaron Roe, Botanist Roseburg BLM District, personal communication, February 1, 2019). Threats to this species include fire exclusion, encroachment by conifers, noxious weed invasion, logging, grazing, road construction, and off-highway vehicle recreational use (Gray and Bahm 2015; BLM and FWS 2004).

Based on existing data, the Pacific Connector pipeline route would cross one population between MP 74.1 and 75.0 on lands administered by the BLM Roseburg District (ORBIC 2017a). In 2012, surveys conducted by the BLM documented approximately 1,300 plants within and adjacent (within 100 meters) to the Project, with approximately 300 plants occurring in the construction ROW (BLM 2017c). However, modifications have been made to the pipeline route subsequent to these surveys. In 2018, surveys for Cox's mariposa lily were conducted during the flowering season on approximately 65 acres between MPs 74 and 75 of the revised pipeline route. The 2018 survey data are currently under review by the BLM. Additionally, there are approximately 45.3 acres of potential suitable Cox's mariposa lily habitat on private lands within the pipeline route that have not been surveyed.

Individuals of Cox's mariposa lily occur along the pipeline route; therefore, construction and operation of the Project would directly and indirectly affect this species and this species' habitat. In addition to the direct removal of individuals, construction of the pipeline would fragment approximately 0.9 mile of of suitable Cox's mariposa lily habitat. Potential indirect effects to documented or suspected plants and habitat include potential changes in hydrology and soil characteristics, alterations to vegetation cover and species composition of associated habitat, and effects from fugitive dust.

Pacific Connector has developed a Cox's mariposa lily specific mitigation plan (included as an attachment to the *Federally-Listed Plant Conservation Plan*[141]) to avoid and minimize potential effects on this species. As described in the mitigation plan, Pacific Connector would determine if site-specific neck-downs can be incorporated into the construction ROW to minimize direct effects on the population of Cox's mariposa lily between MPs 74 and 75. The construction ROW in this area utilizes the typical 95-foot width with TEWAs because of the steep and narrow ridgeline alignment; thus, neck-downs would be dependent on site-specific conditions and would be based on species presence and the work area requirements to ensure safe pipeline installation. Appropriate barriers would be installed along areas that contain this species to ensure that the mariposa lily populations in the vicinity are not affected by sediments and debris from the ROW. In locations where individual plants cannot be avoided by construction activities, plants would be salvaged during the late summer or fall after the growing season of the year preceding actual pipeline construction. Additional mitigation techniques that would be employed to protect these populations of Cox's mariposa lily include seed collection and bulb salvage, and site restoration and monitoring. However, there has not been any research on the effectiveness of seed collection and bulb salvage as mitigation techniques for this species. Based on comments provided by the BLM, the BLM may require additional mitigation measures for the Cox's mariposa lily as part of their review of the ROW application.

Umpqua Mariposa Lily (Federal Species of Concern, State Endangered Species)

The Umpqua mariposa lily (*Calochortus umpquaensis*) is known to occur within 17 localities; none of which are protected. This plant grows in both forests and meadows on serpentine soils at elevations below 2,500 feet, but it is the most vigorous in margins between forests and meadows. In southwestern Oregon, it is associated with a diverse array of plants, and it is found in diverse soils, aspects, and slopes.

[141] Appendix J to Pacific Connector's POD filed with the FERC in January 2018.

Several large populations of this plant (5,000 to 60,000-plus) have previously been documented approximately 1.3 and 2.5 miles east of the pipeline alignment near MP 99.55, adjacent to the Green Butte (EAR 102.30) and Callahan Creek (EAR 104.24) access roads. Pacific Connector conducted botanical surveys for this species between 2007 and 2017 in potential habitat within the vicinity[142] of the pipeline in lands administered by the Roseburg BLM District and Umpqua National Forest. In 2016, seven plants were observed adjacent to EAR 102.3 and 25 feet east of the Hatchet Quarry MP 102.3 Rock Source/Disposal Site near a previously (1992) documented population. Additionally, potential suitable habitat would also be crossed by the pipeline near the site where Cox's mariposa-lily was documented (MPs 74.08 to 75.02), although no individuals of Umpqua mariposa lily were observed during surveys conducted for the pipeline in this location.

Although, Umpqua mariposa lily individuals have been documented adjacent to EARs 102.30 and 104.24, no road improvements are necessary. Additionally, plants are separated from the access roads by topography and/or Callahan Creek; therefore, it is not expected that use of the existing access roads would directly or indirectly affect these populations. The population along EAR 102.30 and 25 feet east of the Hatchet Quarry MP 102.3 Rock Source/Disposal Site may be indirectly affected by the Pacific Connector Project; however, construction of the Project should not directly affect individual plants. Additionally, Pacific Connector has committed to protecting plants adjacent to the pipeline construction ROW through the appropriate installation of safety and silt fence as determined by Pacific Connector's EIs.

Dwarf Woolly Meadowfoam (Federal Species of Concern, State Threatened Species)

Dwarf woolly meadowfoam's (*Limnanthes pumila* ssp. *pumila*) range is restricted to two small protected areas, totaling about 2 square miles with at least 10,000 individuals (ORBIC 2010). Dwarf woolly meadowfoam inhabits small depressions in thin clay soil overlying old basalt at the edges of deep vernal pools, which are dry by mid-summer and generally exposed to full sunlight. The only known occurrences are on Table Rock in Jackson County (on Lower and Upper Table Rocks); which is over 12 miles southwest of the Pacific Connector pipeline and 1.4 to 2.4 miles north of four proposed Jackson County pipe storage yards (ORBIC 2006a).

Because the dwarf woolly meadowfoam is endemic to vernal pools at Table Rocks, Pacific Connector did not conduct botanical surveys for this species. Additionally, this species was not documented incidentally during survey efforts for other vernal pool–associated species conducted for the Project. As this species is not expected to occur along the pipeline route, it would probably not be directly affected by construction and operation of the Project.

Silvery Phacelia (Federal Species of Concern, State Threatened Species)

The silvery phacelia (*Phacelia argentea*) is known from 24 occurrences, totaling 15,000 individuals, along the coastline of Coos and Curry Counties and in adjacent northern California, Del Norte County (ORBIC 2010). In March 2015, a petition was submitted to the FWS to list the silvery phacelia as a threatened or endangered species (FWS 2015a); however, the petition was denied in 2015 due to lack of substantial information that this species was a listable entity (FWS 2015b). Silvery phacelia is the only phacelia growing along the coastline in open sand or on dunes

[142] Provided in Pacific Connector's Initial Response to the FERC staff's Environmental Information Request dated January 3, 2018, filed with the FERC on January 23, 2018.

along the south coast of Oregon. It inhabits sandy beach dunes and bluffs near the coast, and some partially-stabilized or unstabilized dunes.

Silvery phacelia has not been documented in the vicinity of the Project and the closest known plants are located more than 10 miles south of the entrance to the Coos Bay Estuary (ORBIC 2017a); however, suitable habitat for this species does exist at the LNG terminal area, in regions of active and semi-active dunes where the European beachgrass and the red fescue-salt rush herbaceous vegetation associations occur (see section 4.4 of this EIS). There is marginal habitat at the APCO Site and the meteorological station, although the European beachgrass in these areas is generally too dense to support this species. Surveys conducted by Jordan Cove have not detected this species (SHN 2006b, 2012) and, due to the lack of suitable habitat, botanical surveys for this species were not conducted along the pipeline route. Based on the lack of occurrences (from both historical data as well as surveys), it is not expected that the Project would affect this species.

Wolf's Evening Primrose (No ESA Status, State Threatened Species)

Wolf's evening primrose (*Oenothera wolfii*) occurs in well-drained sandy soils with adequate moisture in coastal bluff scrub, coastal prairie, roadsides, and coastal dune habitats from Curry County in southern Oregon to the northern California coast (Tibor 2001). This species is associated with a high disturbance regime and several occurrences in California are located along roadsides with sandy soil (CNDDB 2005 as cited in FERC 2015). Wolf's evening primrose is typically associated with low elevation coastal habitats, but there have been reported occurrences in lower montane coniferous forest in California, at elevations greater than 2,500 feet (Tibor 2001).

The closest known occurrence of Wolf's evening primrose to the Project is in Port Orford, Oregon, approximately 60 miles to the south of the Jordan Cove LNG terminal site; however, suitable habitat for this species is present at the LNG terminal site. There is marginal habitat at the APCO Site and the meteorological station, although the European beachgrass in these areas is generally too dense to support this species. Surveys conducted at the LNG terminal site did not detect the Wolf's evening primrose (SHN 2006b, 2012). Considering the lack of occurrences (based on historic and recent survey data), it is not expected that the Project would affect this species.

4.6.3 Other Special Status Species

In addition to the federal and state threatened, endangered, and proposed species described above, there are species that have been given special status designations by federal or state agencies and Indian tribes that could potentially occur in the Project area (see tables I-3, I-4, and I-5 in appendix I). The FWS and NMFS maintain a list of federal species of concern, which are species whose conservation standing is of concern but for which status information is still needed. The ODFW also assigns special status to fish and wildlife species that are not listed. State special status designations include sensitive and sensitive-critical (ORBIC 2016). Sensitive refers to fish and wildlife that are facing one or more threats to their populations and/or habitats. Species or taxa with a sensitive-critical subdesignation are sensitive species of particular conservation concern. Sensitive-critical species have current or legacy threats that are impacting their abundance, distribution, diversity, and/or habitat. They may decline to the point of qualifying for threatened or endangered status if conservation actions are not taken.

In addition to the threatened and endangered plant species described above, ODA designates candidate species for listing. ODA candidate species include any plant species designated for study by the director of ODA whose numbers are believed low or declining, or whose habitat is sufficiently threatened and declining in quantity and quality, so as to potentially qualify for listing as a threatened or endangered species in the foreseeable future (ODA 2017d).

4.6.3.1 U.S. Fish and Wildlife Service and National Marine Fisheries Service

The FWS (2006d, 2006e, 2013h, 2017c) and NMFS (2006) list 69 fish and wildlife species of concern that potentially occur in counties coinciding with the Project. The list of federal species of concern includes 14 mammals, 20 birds, 3 reptiles, 10 amphibians, 10 fish, and 12 invertebrates. These species, and expected habitat for each species, are listed in tables I-3 and I-4 in appendix I of this EIS. The FWS has noted that the Umpqua chub may be present in the Umpqua River, and this species is of concern because it has rapidly decreased in abundance. This species is discussed in detail in the BE (see appendix F.7 of this EIS).

The FWS lists one plant species as a federal candidate for listing, and 52 federal plant species of concern that potentially occur in counties coinciding with the Project. These species are listed in table I-5 in appendix I of this EIS, along with expected habitat for each species.

4.6.3.2 Oregon Department of Fish and Wildlife

The ODFW (2016) identified 71 state sensitive species that potentially occur in counties coinciding with the Project area, some of which (i.e., 37) are also considered federal species of concern. This list includes 15 mammals, 28 birds, 13 fish, 2 reptiles, and 13 amphibians. The ODFW does not assign special status for invertebrates. Tables I-3 and I-4 in appendix I provide the following information for each state special status species: expected habitat and documentation within each county, BLM district, and National Forest crossed by the Pacific Connector pipeline and vicinity.

Although the state sensitive species listed in tables I-3 and I-4 may occur in counties noted by FWS (2006d, 2006e) and ODFW (ORBIC 2006a, 2012), distributions and/or habitat associations of some preclude their potential occurrence in the area that would be affected by the Project.

4.6.3.3 Oregon Department of Agriculture

The ODA identified 41 candidates for listing that potentially occur in counties coinciding with the Project area, 26 of which are also federal species of concern. Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project effects on these special status species as a result of the Project are presented in table I-5 in appendix I.

4.6.3.4 Tribal Species of Concern

The CIT identified the following plant and animal species as species of concern. According to the CIT, this list is not comprehensive, but does represent the most significant and important traditional cultural plant and animal species that are found on the Coquille Forest and other Tribal lands. A more complete list and description of plant usage can be found in "Ethnobotany of the Coquille Indians". Significant and important plants include, but are not limited to:

- Trees (bark and wood): Port Orford cedar, western red cedar, Sitka spruce, big leaf maple, myrtle, red alder, madrone, Pacific yew.

- Shrubs (wood, nuts and berries): elderberry (*Sambucus* spp.), willows, hazel, vine maple, rhododendron, azalea (*Rhododendron* spp.), manzanita, ocean spray, Labrador tea (*Ledum* spp.), huckleberry, salal, thimbleberry, salmonberry, Oregon grape.
- Flowers and vines (roots and fiber): yarrow (*Achillea millefolium*), camas (*Camassia*), tiger lily (*Lilium columbianum*), columbine (*Aquilegia* spp.), various *Lomatium* and *Brodiaeas*, iris (*Iris* spp.), trailing blackberry (*Rubus ursinus*), yerba buena (*Clinopodium douglasii*), beargrass (*Xerophyllum tenax*).
- Wet Meadow/Riparian Plants: cattail, tule (*Schoenoplectus* spp.), various sedges and ferns, skunk cabbage, various mosses.
- Marine/Estuary: eelgrass, giant kelp (*Macrocystis* spp.), bull kelp (*Nereocystis luetkeana*), sea lettuce (*Ulva* spp.), surfgrass (*Phyllospadix* spp.).

Impacts on these species would be similar to the impacts on vegetation described in section 4.4. Project effects on the wetland and estuary species of traditional-cultural importance would be as described for wetlands and waters in section 4.3. Species that are protected by federal and/or state jurisdictions (e.g., various sedges) are also addressed elsewhere in this section and in appendix I.5.

The following list of mammals, bird, and fish is also not comprehensive, but does represent many of the CIT's species of concern:

- Terrestrial: deer, elk, coyote, cougar, bear, bobcat, raccoon, beaver, squirrel.
- Marine/ Estuary: lamprey, salmon (all available species), shellfish, crab, sea mammals, rockfish, lingcod, sculpin, halibut, flounder, perch, herring, greenling, candlefish (i.e., eulachon), snails, mussels, barnacles, chiton, sea urchin, abalone (*Haliotis spp*.), dentalium (*Dentalium spp*.) (other seasonally available estuary species).
- Streams: salmon (all available species), lamprey, sturgeon, trout, mussels.
- Birds: Eagles, hawks, owls, cormorant, kingfisher, herons, osprey, flicker (*Colaptes auratus*), woodpeckers (particularly pileated), grebe, crows and ravens, and colorful neo-tropicals.

Impacts on these species would be similar to the impacts on wildlife and aquatic resources described in section 4.5. Species that are protected by federal and/or state jurisdictions (e.g., owls) are also addressed elsewhere in this section and in appendix I.3.

4.6.3.5 Assessment of Other Special Status Species

Of the other special status species identified above as potentially occuring in counties coinciding with the Project, only a subset have the potential to be affected by the Project. Table 4.6.3.5-1 identifies the number of these other special status mammals, birds, fish, amphibians, reptiles, invertebrates, and vascular plants potentially affected by the Project. For species that are also BLM and Forest Service sensitive species or the Forest Service's Survey and Manage species, occurrence and potential effects on federal lands are also described below in section 4.6.4, Environmental Consequences on Federal Lands.

TABLE 4.6.3.5-1

Numbers of Other Special Status Species Potentially Affected by the Project a/

Taxonomic Group	Federal Status: FWS or NMFS Species of Concern	State Status: ODFW Sensitive or ODA Candidate	Total b/
Mammals	12	12	16
Birds	19	24	31
Non-anadromous Fish	4	4	5
Anadromous Fish	3	5	7
Amphibians and Reptiles	7	9	9
Aquatic Invertebrates	3	N/A	3
Terrestrial Invertebrates	1	N/A	1
Vascular Plants	2	2	2

Sources: FWS (2006d, 2006e, 2017c), NMFS (2006d), ORBIC (2006a, 2006b, 2017a), ODFW 2016b.

a/ Other Special Status Species include FWS and NMFS fish, wildlife, and plant species of concern and candidate species, ODFW Sensitive fish and wildlife species, and ODA candidate species for listing. Forest Service sensitive and Survey and Manage species and BLM sensitive species are only tallied here if they meet this criteria for Other Special Status Species. Species are not tallied here if they are also federal or state listed or proposed.

b/ Rows do not sum because a species is tallied in multiple columns where it is considered special status by multiple agencies.

Descriptions of expected habitat, documented or suspected occurrences, and potential Project effects on these other special status species within the Project area are presented in tables I-3, I-4, and I-5, respectively, in appendix I. Additionally, effects on these species and proposed measures to minimize effects would be similar to the those described for general fish and wildlife in section 4.5 of this EIS.

4.6.4 Environmental Consequences on Federal Lands

The BLM and Forest Service maintain lists of sensitive species to ensure that their actions do not contribute to or cause a trend toward listing under the ESA. Additionally, until 2016, the BLM and Forest Service maintained a list of Survey and Manage species, or species that are rare and uncommon or poorly understood that are closely associated with late successional or old-growth forests within the range of the NSO (Forest Service and BLM 2001a). In August 2016, the BLM issued two RODs for two new RMPs (BLM 2016a and 2016b). These two plans supersede the NWFP on BLM lands, and eliminated requirements to survey and manage for species included on the 2001 ROD Survey and Manage species list on BLM lands. Potential effects on Survey and Manage species on NFS lands are discussed here.

Species that are on both the sensitive list and the Survey and Manage list are discussed on NFS land under section 4.6.4.3, Survey and Manage Species. Additionally, although the Forest Service and BLM include federal and state threatened, endangered, proposed, and candidate species on their species lists, these species are not discussed in this section as they are presented above.

4.6.4.1 Description of BLM and Forest Service Sensitive Species

The BLM maintains a list of Special Status Species (including BLM sensitive species) as required by BLM 6840, Special Status Species Manual, to ensure that BLM actions do not contribute to a loss of viability or cause a trend toward listing under the ESA. Like the BLM, the Forest Service is required by Forest Service Manual (FSM) 2760 to maintain a list of sensitive species for each region, including species listed as federally threatened, endangered, or proposed under the ESA, as well as species that are threatened by human activities. Activities on NFS lands must be managed to ensure that current federally listed species do not become extirpated or that activities do not result in ESA listing for other sensitive species. As required in FSM 2760, the Forest Service is obligated to evaluate Project effects on sensitive species in a BE (see appendix F.7).

The Pacific Northwest Regional Office of the Forest Service and Oregon/Washington State Office of the BLM established an interagency program for the conservation and management of special status species. New criteria for BLM Special Status Species and Forest Service Sensitive Species were jointly approved in 2015 by the Region 6 Regional Forester and BLM Oregon/Washington State Director for determination of species included within the BLM and Forest Service Sensitive Species Program. The new criteria were designed to make the BLM and Forest Service more consistent in their approaches to the development of lists of species with conservation concerns. The BLM (2015) and Forest Service (Forest Service 2015) identify federally listed, federally proposed, and sensitive species required under their respective policies. Additionally, they have identified "strategic species" that are not considered sensitive under those policies. Strategic species include species with information gaps (e.g., distribution, habitat, threats, taxonomy) that are suspected to occur on NFS or BLM lands.

According to Instruction Memorandum No. OR-2015-028, sensitive species are those that are documented or suspected endangered or threatened at the federal or state level, federal de-listed species, are Oregon Heritage List 1 or List 2, and have been documented on at least one Oregon BLM district. These species should be managed to ensure that activities on BLM lands do not contribute to their listing.

Strategic species are not classified as Special Status for management purposes. The only requirement for this group of species is to record sites found during any survey efforts. Therefore, strategic species are not discussed in this section unless observed during surveys.

Table 4.6.4.1-1 lists the BLM and Forest Service sensitive species documented or suspected to occur within the districts and forests crossed by the Pacific Connector pipeline (BLM 2015; Forest Service 2015).

Not all species documented or suspected in BLM districts and national forests crossed by the Project occur within the area affected by the Project. Many were excluded from consideration after review of range and habitat information. Other species were excluded if they were not known to occur in the Project vicinity based on special status species locations within 3 miles of the Project obtained from the BLM Geographic Biotic Observations (GeoBOB) database and Forest Service Natural Resource Information System (NRIS) database (BLM 2006a, 2012, 2017a; Forest Service 2006, 2012, 2017c; NSR 2012), and through ORBIC data requests (ORBIC 2006a, 2012, 2017a).

TABLE 4.6.4.1-1

Numbers of BLM and Forest Service Sensitive Species within the Four BLM Districts and Three National Forests Crossed by the Proposed Pacific Connector Pipeline a/

	Number in BLM Districts				Number in National Forests		
Taxonomic Group	**Coos Bay**	**Roseburg**	**Medford**	**Lakeview**	**Umpqua**	**Rogue River-Siskiyou**	**Fremont-Winema**
Mammals	4	5	4	6	5	6	5
Birds	8	7	9	13	11	9	12
Reptiles	1	1	1	1	1	1	1
Amphibians	1	1	3	2	1	3	2
Non-anadromous Fish	1	1	2	10	2	0	10
Anadromous Fish	5	3	4	0	3	4	0
Invertebrates	14	10	16	7	14	21	21
Fungi	13	12	14	0	11	16	4
Non-vascular Plants	34	17	18	5	26	27	12
Vascular Plants	35	36	91	44	31	99	49

Note: A species is tallied in multiple columns where it occurs and is sensitive on multiple BLM Districts or National Forests.
a/ Source: BLM 2015; Forest Service 2015

Pacific Connector conducted surveys from 2007 through 2018 for special status species, including BLM and Forest Service sensitive species. Special status mollusks, fungi, and vascular and non-vascular plants not detected during these complete, targeted surveys were determined to not be present, and thus not affected by the Project. Forest Service and BLM sensitive species that are documented or suspected to occur on BLM districts and/or national forests crossed by the Project, but were dropped from further consideration due to a lack of habitat or because they were not detected during targeted field surveys are listed in tables I-3, I-4, and I-5 in appendix I. Information provided for each of these species in appendix I includes expected habitat, county, national forest, and BLM district distribution, known occurrences in relation to the Project, and effects determination and rationale for this determination.

BLM and Forest Service sensitive species that may be affected by the Project are listed below in table 4.6.4.1-2, excluding the state and federally listed, proposed, and candidate species discussed above, and the Survey and Manage species on NFS land discussed below. Where suitable habitat was documented for a species, but species-specific surveys were not conducted, presence was assumed, and potential effects on these species are discussed here.

TABLE 4.6.4.1-2

BLM and Forest Service Sensitive Species with the Potential to be Affected by the Project a/

Common Name	Scientific Name	Forest Service Sensitive	BLM Sensitive
Mammals			
Pallid bat	*Antrozous pallidus*	X	X
Townsend's big-eared bat	*Corynorhinus townsendii*	X	X
Fringed myotis	*Myotis thysanodes*	X	X
Pacific marten	*Martes caurina*	X	X
Pacific fisher	*Pekania pennanti*	X	X
Birds			
Grasshopper sparrow	*Ammodramus savannarum*	X	
Red-necked grebe	*Podiceps grisegena*	X	X
Horned grebe	*Podiceps auritus*	X	X
American white pelican	*Pelecanus erythrorhynchos*	X	X
Snowy egret	*Egretta thula*		X
Aleutian Canada goose	*Branta canadadnsis leucopareia*		X
Harlequin duck	*Histrionicus histrionicus*	X	X

TABLE 4.6.4.1-2 (continued)

BLM and Forest Service Sensitive Species with the Potential to be Affected by the Project a/

Common Name	Scientific Name	Forest Service Sensitive	BLM Sensitive
Bufflehead	*Bucephala albeola*	X	
Franklin's gull	*Larus pipixcan*		X
White-tailed kite	*Elanus leucurus*	X	X
Upland sandpiper	*Bartramia longicauda*	X	
Bald eagle	*Haliaeetus leucocephalus*	X	X
American peregrine falcon	*Falco peregrinus anatum*	X	X
Greater sage-grouse	*Centrocercus urophasianus*	X	X
White-headed woodpecker	*Picoides albolarvatus*	X	X
Lewis' woodpecker	*Melanerpes lewis*	X	X
Purple martin	*Progne subis*	X	X
Oregon vesper sparrow	*Pooecetes gramineus affinis*		X
Tricolored blackbird	*Agelaius tricolor*	X	X
Reptiles			
Western pond turtle (formerly Pacific pond turtle)	*Actinemys marmorata*	X	X
Amphibians			
Foothill yellow-legged frog	*Rana boylii*	X	X
Terrestrial Invertebrates			
Oregon shoulderband	*Helminthoglypta hertleini*	X (also Survey and Manage)	X
Traveling sideband	*Monadenia fidelis celeuthia*	X	X
Siskiyou hesperian	*Vespericola sierranas*	X	X
Franklin's bumblebee	*Bombus franklini*	X	X
Western bumblebee	*Bombus occidentalis*	X	X
Siskiyou short-horned grasshopper	*Chloealtis aspasma*	X	X
Gray-blue butterfly	*Plebejus podarce*	X	X
Johnson's hairstreak	*Callophrys johnsoni (Mitoura johnsoni)*	X	X
Insular blue butterfly	*Plebejus saepiolus littoralis*	X	X
Mardon skipper	*Polites mardon*	X	X
Coronis fritillary	*Speyeria coronis coronis*	X	X
Aquatic Invertebrates			
Western ridgemussel	*Gonidea angulata*	X	X
California floater	*Anodonta californiensis*	X	X
A caddisfly (no common name)	*Namamyia plutonis*	X	X
Montane Peaclam	*Pisidium ulttramontanum*	X	X
Pacific walker	*Pomatiopsis californica*	X	X
Archimedes springsnail	*Pyrgulopsis archimedis*	X	
A caddisfly (no common name)	*Rhyacophila chandleri*	X	X
Lined ramshorn	*Vorticifex effusa diagonalis*	X	X
caddisfly (no common name)	*Rhyacophila leechi*		X
Non-anadramous Fish			
Umpqua chub	*Oregonichthys kalawatseti*	X	X
Millicoma dace	*Rhinichthys catarctae* ssp.		X
Anadramous Fish			
Pacific lamprey	*Entosphenus tridentata*	X	X
Chinook Salmon Southern Oregon Coast/California Coast ESU, Fall-run, Spring-run	*Oncorhynchus tshawytscha*	X	X
Steelhead Klamath Mountains Province ESU Summer/winter run	*Oncorynchus mykiss*	X	X
Steelhead Oregon Coast ESU	*Oncorynchus mykiss*	X	X

TABLE 4.6.4.1-2 (continued)

BLM and Forest Service Sensitive Species with the Potential to be Affected by the Project a/

Common Name	Scientific Name	Forest Service Sensitive	BLM Sensitive
Vascular Plants			
Rogue Canyon rockcress	*Arabis modesta*	X	X
Bensonia	*Bensoniella oregana*	X	X
Bristly sedge	*Carex comosa*	X	X
Coastal lip-fern	*Cheilanthes intertexta*	X	X
Pine woods cryptantha	*Cryptantha simulans*	X	
California globe-mallow	*Iliamna latibracteata*	X	X
Bellinger's meadowfoam	*Limnanthes floccosa* ssp. *bellingeriana*	X	X
Lichens			
no common name	*Bryoria subcana*	X	X

a/ Excluding state and federally listed, and select proposed and candidate species and Survey and Manage species, which are discussed in other sections of this EIS.

Excluding federal and state threatened, endangered, and select proposedand candidate species (discussed above), and Survey and Manage species on NFS lands (discussed below), a total of 60 BLM and Forest Service sensitive species have the potential to be affected by the Project: 5 mammal, 19 bird, 1 reptile, 1 amphibians, 20 invertebrate, 6 fish, 7 vascular plant, and 1 lichen species(table 4.6.4.1-2). Tables I-3, I-4, and I-5 in appendix I provide habitat descriptions for these species. Forest Service sensitive species that would potentially be affected by the proposed action are additionally addressed in the BE (appendix F.7), and Survey and Manage species that would potentially be affected by the proposed action on NFS lands are addressed in more detail in the Survey and Manage Report (appendix F.5 of this EIS).

4.6.4.2 Assessment of BLM and Forest Service Sensitive Species

BLM and Forest Service sensitive species that may be present and potentially affected by construction of the pipeline on federal lands are described here. If species were documented during targeted surveys, those locations and potential effects are also described.

Mammals

There are five BLM and Forest Service sensitive mammals that may be present and potentially affected by construction of the pipeline on federal land: the pallid bat (*Antrozous pallidus pacificus*), Townsend's big-eared bat (*Corynorhinus townsendii*), fringed myotis (*Myotis thysanodes*), marten (*Martes caurina*), and fisher (*Pekania pennanti*). Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project effects on these special status species within the Project area are presented in table I-3 in appendix I. As all five of these species are Forest Service sensitive, they are additionally addressed in the BE if effects are anticipated on NFS lands (appendix F.7). Marten and fisher are also discussed above as federal proposed threatened species.

Birds

There are 19 BLM and/or Forest Service sensitive birds that may be present and potentially affected by construction, maintenance, and operation of the pipeline on federal land. Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project effects on these special status species as a result of the Project are presented in table I-3 in appendix

I. Forest Service sensitive birds that would potentially be affected by the proposed action are additionally addressed in the BE (appendix F.7).

Fish

There are six BLM and/or Forest Service sensitive fish species that may be present along the LNG carrier transit route, in the waters of Coos Bay potentially affected by construction of the pipeline, or in waters crossed by the pipeline. Of these species, four are anadromous and two are non-anadromous. Descriptions of life histories, expected habitat, and potential occurrences of these special status fish species within the Project area are presented in table I-4 in appendix I. Forest Service sensitive fish that would potentially be affected by the proposed action are additionally addressed in the BE (appendix F.7).

Amphibians and Reptiles

There are two BLM and Forest Service sensitive amphibians and reptiles that may be present and potentially affected by construction of the pipeline on federal land: western pond turtle (*Actinemys marmorata*) and foothill yellow-legged frog (*Rana boylii*). Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project effects on these special status species within the Project area are presented in table I-3 in appendix I. As both species are Forest Service sensitive, they are additionally addressed in the BE (appendix F.7).

Invertebrates

Aquatic

There are nine BLM and Forest Service sensitive aquatic invertebrates that may be present and potentially affected by construction of the pipeline on federal land. All these species are associated with freshwater environments. Table I-4 in appendix I summarizes the life history, habitat associations, and occurrence of these invertebrates. Eight of these species are Forest Service sensitive aquatic invertebrates, and thus are additionally addressed in the BE if effects are anticipated on NFS lands (appendix F.7).

Terrestrial

There are 11 BLM and Forest Service sensitive terrestrial invertebrates that may be present and potentially affected by the construction of the pipeline on federal land. Descriptions of expected habitat, documented or suspected occurrences, and a description of potential Project effects on these special status species within the Project area are presented in table I-3 in appendix I. As all 11 species are Forest Service sensitive terrestrial invertebrates they are additionally addressed in the BE (appendix F.7).

Approximately 20 acres of the ROW near known populations of two Forest Service sensitive terrestrial invertebrates (Mardon skipper and short-horned grasshopper) on the Dead Indian Plateau would be restored with grasses (including *Festuca* sp.) preferred by these species in addition to the rehabilitation required under BMP guidelines. This mitigation on the Rogue River National Forest has the potential to increase the habitat and local range for these two species.

Three BLM and Forest Service sensitive mollusk species were located during surveys for the Project: Siskiyou hesperian, traveling sideband, and Oregon shoulderband. These three species are discussed in the following paragraphs; Siskiyou hesperian and traveling sideband are additionally addressed in the BE as they were observed on NFS lands during surveys (appendix F.7).

Field Survey Locations and Potential Effects

Traveling sideband is a BLM and Forest Service sensitive species (BLM 2015; Forest Service 2015) and an Oregon endemic terrestrial snail. During surveys in 2007 and 2010, this species was observed at nine locations on the Rogue River and Winema National Forests (between MP 154.9 and 175.4), and at six locations on BLM land in the Lakeview and Medford BLM Districts (MPs 116.3 to 176.9). Shells and live individuals were located within and outside the ROW, as well as within proposed TEWAs and UCSAs (SBS 2008a, 2011b). During surveys in 2012 and 2015, this species was observed at five locations on the Rogue River and Umpqua National Forests (between MP 104.9 and 162.5) and four locations on BLM land in the Roseburg and Medford BLM Districts (MPs 91.7 to 116.9), adjacent to the ROW and TEWAs.[143]. Direct mortality could occur to this species if they are within the ROW during Project clearing or construction due to their low mobility. Clearing of the ROW could affect habitat by removing forest overstory, potentially making the area unsuitable for this species. Indirect effects could result from the alteration of composition and structure of vegetation resulting in changes in microclimate. Realignments following the 2007 and 2010 surveys resulted in avoidance of some but not all the sites observed during Project surveys. As currently proposed, Pacific Connector would directly affect 5 of the 14 sites observed during Project surveys on NFS lands, and 4 of the 10 sites observed during Project surveys on BLM-managed lands. Indirect effects are expected to the traveling sideband sites observed even if direct effects on these sites are avoided because 5 and 4 of the sites are within approximately 100 feet of Project disturbance on NFS lands and BLM-managed lands, respectively, and thus would be affected by changes in microclimate conditions.

Siskiyou hesperian is a BLM and Forest Service Sensitive species (BLM 2015; Forest Service 2015) and a riparian associated terrestrial snail. During Project surveys in 2007, 2008, and 2010, this species was observed at 14 locations on the Rogue River and Umpqua National Forests (between MPs 110.2 and 164.7), and 10 locations in the Medford and Roseburg BLM Districts (MPs 79.8 to 151.5). In 2011, 2012, and 2014, this species was observed at nine locations within the Rogue River and Winema National Forests (between MPs 154.5 and 168.9), and two locations in the Medford BLM District (MP 148.7 and 153.5). Shells and live individuals were observed within and outside the ROW, as well as proposed TEWAs and UCSAs (SBS 2008, 2011b; April 27, 2015 response to FERC data request). During surveys in 2015, this species was observed at eight locations on the Rogue River National Forest (between MP 155.7 and 160.6) and one location on BLM land in the Medford BLM District (MP 128.8), within and adjacent to the ROW and TEWAs.[144] During surveys in 2017, active individuals were observed at one location on the Rogue River National Forest (MP 154.6; Tona 2018). Direct mortality to individuals could occur if they are located within the ROW during Project clearing or construction. Another potential direct effect is destruction or alteration of hydrology of riparian, wetland, or aquatic habitats used by this species. Indirect effects could result from the alteration of composition and structure of vegetation resulting in changes in microclimate. The increase in sun exposure could reduce moisture levels

[143] See Table D.3-10 in Pacific Connector's Resource Report 3, included as part of their September 2017 filing with the FERC.
[144] See Table D.3-10 in Pacific Connector's Resource Report 3, included as part of their September 2017 filing with the FERC.

and potential decrease dispersal between populations or suitable habitat. As currently proposed, Pacific Connector would directly affect 11 of the 31 sites observed during Project surveys on NFS lands, and 6 of the 13 sites observed during Project surveys on BLM-managed lands. Indirect effects are expected to the Siskiyou hesperian sites observed even if direct effects on these sites are avoided as 16 and 5 of the sites on NFS lands and BLM-managed lands, respectively, are within approximately 100 feet of Project disturbance, and thus would be affected by changes in microclimate conditions.

Oregon shoulderband is a BLM and Forest Service sensitive species (BLM 2015; Forest Service 2015) and a terrestrial snail endemic to northern California and southwest Oregon. This species is also managed as a Survey and Manage species on NFS lands; however, it was not observed on NFS lands during surveys for the Project. During Project surveys in 2007, this species was observed at five locations in the Roseburg BLM District (MPs 64.6 to 76.0). Shells and live individuals were observed within and outside the ROW (SBS 2008a). Direct mortality to individuals could occur if they are located within the ROW during Project clearing or construction. Clearing of the ROW could affect habitat by removing forest overstory, potentially making the area unsuitable for this species. Indirect effects could result from the alteration of composition and structure of vegetation resulting in changes in microclimate. The increase in sun exposure could reduce moisture levels and potential decrease dispersal between populations or suitable habitat. As currently proposed, Pacific Connector would directly affect two of the five sites observed during Project surveys on BLM-managed lands. Indirect effects are expected to the Oregon shoulderband sites observed even if direct effects on these sites are avoided as two of the sites on BLM-managed lands are within approximately 100 feet of Project disturbance, and thus would be affected by changes in microclimate conditions.

Plants and Fungi

A total of 270 BLM and/or Forest Service sensitive bryophyte, lichen, fungus, and vascular plant species were identified as potentially occurring within the Project area (see table I-5 in appendix I). Between 2007 and 2018, SBS surveyed for special status fungi and vascular and non-vascular plant species in suitable habitat, where access was granted, within 50 feet (non-federal lands) or 100 feet (federal lands) of the ROW, TEWAs, UCSAs, and access roads (note that surveys continued through 2018). Plant and fungus species documented on federal lands during surveys are described below. Descriptions of expected habitat, documented or suspected occurrences, and potential Project effects on all species within the area affected by the Project are presented in table I-5 in appendix I. Forest Service sensitive plants and fungi that would potentially be affected by the proposed action are additionally addressed in the BE (appendix F.7).

Of the 41 BLM and/or Forest Service sensitive bryophytes identified as potentially occurring within the area affected by the Project, none were documented during surveys of the currently proposed route. Two strategic bryophyte species (*Andreaea nivalis* and *Orthotrichum euryphyllum*) were documented during surveys. See table I-5 in appendix I for a list of sensitive and strategic bryophyte species identified as potentially occurring within the area affected by the Project, descriptions of their expected habitat, and documented or suspected occurrences, including documented occurrences of the two strategic species observed during Project surveys.

Lichens

There are 16 BLM and/or Forest Service sensitive lichens identified as potentially occurring within the area affected by the Project. Potential Project effects on lichens include trampling or killing of individual plants. One BLM and Forest Service sensitive species, *Bryoria subcana*, was documented during surveys of the currently proposed route. This species is also an Survey and Manage species under the 2001 ROD list (Forest Service and BLM 2001a).

Bryoria subcana is a BLM and Forest Service Sensitive coastal lichen species and was observed during Project surveys in the BLM Coos Bay District, approximately 100 feet of the ROW near MP 21.88BR. The species was observed just east of the area affected by the Project and may be avoided by activities within the corridor; however, construction would disturb vegetation and soils within 200 feet of the site and could modify microclimate conditions around the observation. The removal of trees and woody debris could negatively affect *Bryoria subcana* in adjacent areas by removing its habitat and affecting its association with the trees, affecting site persistence even if the entire site is not disturbed. In addition, modification of shading, moisture, and habitat conditions within 200 feet of the observation as a result of the Project construction and operation would likely make habitat within the site no longer suitable for the species. Restored portions of the corridor and TEWAs would be dominated by early seral vegetation for approximately 30 years, which would result in long-term changes to habitat conditions. A portion of the corridor would be maintained in low-growing vegetation for pipeline maintenance and would not provide habitat for the species during the life of the Project. *Bryoria subcana* is not likely to persist at the site following Project implementation; however, remaining sites of this species would continue to provide a reasonable assurance of species persistence.

Five BLM and/or Forest Service strategic lichen species (*Collema curtisporum*, *Collema quadrifidum*, *Leptogium platynum*, *Peltula euploca*, and *Sclerophora amabilis*) were also observed during Project surveys. See table I-5 in appendix I for a list of sensitive and strategic lichen species identified as potentially occurring within the Project area, descriptions of their expected habitat, and documented or suspected occurrences, including documented occurrences of the one sensitive and five strategic lichen species observed during Project surveys.

Fungi

Of the 25 BLM and/or Forest Service sensitive fungi identified as potentially occurring within the Project area, none were documented during surveys. Thirteen Forest Service and BLM strategic fungi were observed during surveys. See table I-5 in appendix I for the locations of these observations in relation to the Project.

Vascular Plants

There are 188 BLM and/or Forest Service sensitive vascular plants identified as potentially occurring within the Project area, 10 of which were documented during Project surveys: Rogue Canyon rockcress (*Arabis modesta*), Bensonia (*Bensoniella oregana*), Cox's mariposa lily, Umpqua mariposa lily, bristly sedge (*Carex comosa*), coastal lip fern (*Cheilanthes intertexta*), pine woods cryptantha (*Cryptantha simulans*), clustered lady's slipper (*Cypripedium fasciculatum*), California globe-mallow (*Iliamna latibracteata*), and Bellinger's meadowfoam. Two of these species—Cox's mariposa lily and Umpqua mariposa lily—are also state-listed species and are discussed above in section 4.6.2.3. One of these species, clustered lady's slipper, is a Forest Service Survey and Manage species and is discussed below under section 4.6.4.3. Potential effects on Umpqua mariposa lily, pine woods cryptantha, California globe-mallow, and Bellinger's meadowfoam on NFS lands are additionally discussed in the BE (appendix F.7 of this EIS).

Field Survey Locations and Potential Effects

Rogue Canyon rockcress is a regional endemic found within chaparral and lower montane coniferous forests in northern California and southern Oregon (CNPS 2018). In Oregon, it is only known from Jackson and Josephine Counties (NRCS 2018). This species has been found on dry, serpentine soils on exposed slopes and rocky cliffs in the Rogue River canyon at elevations between 490 and 1,480 feet (NatureServe 2018). Two sites of Rogue Canyon rockcress were observed during Project surveys in 2017 on state forest lands 24 feet and 90 feet north/northwest of TEWA 124.30-N. This species was not observed on BLM or Forest Service land during Project surveys.

Bensonia is found mainly within the Siskiyou Mountains of southwestern Oregon in Curry and Josephine Counties, with a few small disjunct populations in adjacent Humboldt County, California (NatureServe 2018). The rhizomatous species grows in wet meadows and edges near bogs and springs. Populations seem to be associated with cloud or fog banks that blanket the mountain tops at certain times of year. Most plants are in meadows on gentle slopes, and they thrive on partial shade. The species has been found at elevations between 2,000 to 4,750 feet (Hoover and Holmes 1998). One bensonia site was noted near the Project in 2011 in the Roseburg BLM District, approximately 100 feet east of the existing Signal Tree Road Quarry at MP 47. Pacific Connector surveyed this area in 2013 and no special status species were observed, including bensonia. Due to the distance between this site and the Project, no effects are anticipated.

Bristly sedge is found from Quebec to Minnesota and south, as well as in the Pacific Northwest and Montana (NatureServe 2018). This species habitat includes marshes, lakeshores, and wet meadows. In Oregon, this species is known from Columbia, Klamath, and Multnomah Counties; although it is believed to be extirpated or possibly extirpated in Columbia and Multnomah Counties (NatureServe 2018). One population of bristly sedge was documented in 2012 on private land 66 feet south of TEWA 184.30. This species was not observed on BLM or Forest Service land during Project surveys.

Coastal lip fern grows in crevices and bases of rocks and is found mainly in California, although it also occurs in Oregon and Nevada (The Jepson Herbarium 2018). In Oregon, this species is known from Douglas and Jackson counties (NRCS 2018). Two observations of coastal lip fern site were noted near the Project in the Medford BLM District. One observation is located approximately 65 feet west of the pipeline ROW near MP 148.9 and the other observation is greater than 100 feet from the pipeline ROW near MP 149.9. Due to the distance between these sites and the Project, direct effects are not anticipated; however, the Project could potentially indirectly affect individuals and/or habitat of this species.

Pine woods cryptantha is found in dry gravelly sites, disturbed areas, and open conifer forests from elevations between 820 and 8,530 feet (The Jepson Herbarium 2018). This species' range includes California north to Washington and east to Idaho (NRCS 2018). Five observations of pine woods cryptantha were documented during Project surveys in 2017. One site was located in the Rogue River-Siskiyou National Forest approximately 96 feet northwest of MP 155.8. One site was located on the Fremont-Winema National Forest pm the edge of Clover Creek Road and 10 feet from the pipeline ROW near MP 175.3, and two sites were located in the Lakeview BLM District:

1) within the ROW near MP 176.96 and 2) on the edge of Clover Creek Road near MP 176.98. Because this species was observed within the pipeline ROW, the Project may directly and indirectly affect individuals and habitat of this species.

California globe mallow is found in southwestern Oregon, extending into Humboldt County in northern California (Malaby 2005). This species inhabits moist forests, streamsides, lower montane coniferous forests, and montane chaparral; often in recently burned areas (Malaby 2005; CNPS 2018). In Oregon, California globe mallow is found in coastal ranges in Coos and Douglas counties and is also known from Curry, Jackson, Josephine, and Linn Counties. Three observations of California globe mallow were observed during Project surveys in 2017: one in the Roseburg BLM District and two in the Umpqua National Forest. The observation in the Roseburg BLM District was located within the pipeline ROW near MP 99.9, within the are burned during the Stouts Creek fire in 2015. The sites in the Umpqua National Forest are in the pipeline ROW near MP 106.2 and MP 106.7; both sites were in recently burned areas. Because this species was observed within the pipeline ROW, the Project may directly and indirectly affect individuals and habitat of this species.

Bellinger's meadowfoam (*Limnanthes floccosa* ssp. *bellingeriana*) is associated with vernally wet meadows or vernal pools and is generally found on basalt scablands at elevations between 1,000 and 4,000 feet in Jackson and Klamath Counties, Oregon, and Shasta County, California. Six Bellinger's meadowfoam populations were located in the Project area. Two populations were in the Rogue River-Siskiyou National Forest: within the pipeline ROW near MP 154.1 and within the pipeline ROW between MP 154.71 to 154.82. The other four populations were in the Medford BLM District: near MPs 120.3, MP 128.8, and MP 129.0, and TEWA 128.79-N. All these observations are located greater than 100 feet from the pipeline route, except for the observation in TEWA 128-79. Six hundred plants were observed in and near TEWA 128.79-N during Project surveys in 2017.

In 2010, 30,000 plants within less than one acre were documented between MPs 154.8 and 154.7, near Heppsie Mountain (SBS 2011a), also within the Rogue River National Forest. Potential effects on this site include removal of individuals, temporary disturbance, and permanent loss or alteration of habitat including changes in hydrology. The site is in a vernally moist scabland meadow within the ROW and a TEWA and therefore would be disturbed by the Project (SBS 2011a; Rolle 2014). Measures to avoid this site considered but excluded to avoid a rare fungus, *Gymnomyces abietis*, which was also found at the same location on the north end of the meadow at MP 154.8. *Gymnomyces abietis* is a Forest Service Survey and Manage species, discussed below in section 4.6.4.3. Although Project activities would affect the local population at MP 154.7, the species would not likely be eliminated from the site as it is able to grow on disturbed soil (Rolle 2014). Conservation measures at this site include recontouring, reseeding, and controlling for noxious weeds. Additionally, although the site that would be affected is one of only a few Bellinger's meadowfoam sites on NFS land, a large number of sites are known from BLM and private land in eastern Jackson County. More undocumented sites are likely to occur on unsurveyed private lands (Rolle 2014). Consequently, the expected loss of individuals and habitat at this site is not expected to affect the viability of Bellinger's meadowfoam over the broader geographic area of the low mountains and foothills of eastern Jackson County (Rolle 2014).

4.6.4.3 Survey and Manage Species

The BLM and Forest Service first identified Survey and Manage species in 1994 as rare amphibians, mammals, bryophytes, mollusks, vascular plants, fungi, lichens, and arthropods that occupy LSOG forests in the range of the NSO (see Forest Service and BLM 1994a, the NWFP ROD). The agencies established standards and guidelines for management of these rare species in the *Standards and Guidelines for Management for Late-Successional and Old-Growth Related Species in the Range of the Northern Spotted Owl* (Forest Service and BLM 1994b). The NWFP ROD established overall objectives for managing Survey and Manage species populations that were referred to as "persistence objectives." These objectives were based on the Forest Service viability provision in the 1982 National Forest System Land and Resource Management Planning Regulation for the National Forest Management Act of 1976.

In 2001, the Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines (2001 ROD; Forest Service and BLM 2001a) modified the management direction provided in the NWFP ROD for Survey and Manage species and amended BLM and Forest Service land management plans in the range of the NSO accordingly. The management direction for Survey and Manage species varies based on its assigned category, which establishes varying levels of surveys and management of known sites (refer to the 2001 ROD and appendix F.5 to this EIS for additional details on the categories). For the Survey and Manage Standards and Guidelines, the major elements were retained with some restructuring for clarity, and the 1994 list of Survey and Manage species was modified to remove 72 species in all or part of their range because new information indicated they were secure or otherwise did not meet the basic criteria for Survey and Manage. Based on the history of the Survey and Manage rule, it should be noted that by definition, there is a general concern for persistence for any of the species listed in the 2001 ROD. That concern is the basic reason species are listed in the Survey and Manage Standards and Guidelines.

In 2004 and again in 2007, the BLM and Forest Service issued a ROD to eliminate the Survey and Manage requirements of the 2001 ROD and to provide protection for species on the Survey and Manage lists by managing them under the agencies' special-status species programs. In 2014, the Court issued a remedy order in the case of *Conservation Northwest et al. v. Bonnie et al.*, No 08-1067-JCC (W.D. Wash.)/No. 11-35729 (9th Circ.). As the latest step in the ongoing litigation challenging the 2007 ROD, this remedy order vacated the 2007 ROD to remove or modify the Survey and Manage mitigation measure standards and guidelines, which returned the agencies to the status quo in existence prior to the 2007 ROD. Thus, the 2001 ROD was reinstated, including any amendments or modifications to the 2001 ROD that were in effect as of March 21, 2004, returning the species to the category assigned in the 2001 ROD.

In accordance with the 2014 Court decision, this assessment was completed using the 2001 ROD Survey and Manage Standards and Guidelines, with the 2003 Annual Species Review (ASR) modifications for the species list and category assignments (excepting the 2003 ASR red tree vole removal).

In 2016, the BLM approved two new RMPs, including the Northwestern and Coastal Oregon RMP and the Southwestern Oregon RMP (BLM 2016a, 2016b). All lands managed by the BLM that occur in the Pacific Connector Project are within the revised RMPs' management areas. The past RMPs were developed consistent with the 1994 NWFP and thereby included Survey and Manage species measures. The 2016 RMPs revises the past RMPs in their entirety and removes all measures for Survey and Manage species, although Forest Service Survey and Manage species identified as BLM sensitive species would continue to receive protections consistent with BLM's sensitive species management program.

Although some species covered by the Survey and Manage Standards and Guidelines also occur on private land, land managed by the BLM, and areas outside the NSO range, the requirements of the 1994 NWFP and 2001 ROD apply only to lands managed by the Forest Service within the range of the NSO.

The NWFP ROD and the 2001 ROD do not prescribe a well-defined process for evaluating effects on species persistence or viability from a proposed activity. The 2001 ROD states "instead, common sense and agency expertise must be used in making determinations of compliance with the viability provision" (Standards and Guidelines). The Forest Service has embraced this approach for evaluating effects of the Project on the persistence of affected Survey and Manage species in the NSO range. The Standards and Guidelines and 2001 ROD are intended to "provide a reasonable assurance of species persistence" for all the Survey and Manage species. If the Project is constructed, it would affect numerous known sites of Survey and Manage species. This assessment seeks to determine, should the Project be constructed, whether there would be a reasonable assurance of species persistence for those Survey and Manage species affected by the Project in the NSO range. The evaluation of species persistence is presented in appendix F.5 to this EIS, and this section summarizes the results of the evaluation. Attachment A to appendix F.5 lists the Survey and Manage species considered in the persistence evaluation.

This section is organized by taxonomic group and includes a brief overview of the species considered in the persistence evaluation; a summary of the distribution of sites of the species in the NSO range; an analysis of the effects of the Project on the sites; and breakdowns of the number of sites of each species in the NSO range, the number of affected sites of each species across the analysis area, and the number of affected sites on the Umpqua, Rogue River-Siskiyou, and Fremont-Winema National Forests. Details on the methodology used for the persistence evaluation (e.g., establishment of sites for each species, mapping of general habitat and site distribution, analysis of effects on sites) and a glossary of key terms used in the evaluation available in appendix F.5. The factors used to evaluate the Project effects are outlined in appendix F.5 and were derived from the 2001 ROD criteria for species persistence and relative rarity. This persistence evaluation is not intended to serve as an annual species review or an evaluation of the relative rarity of the species. This analysis is focused only on the effects on the species that could result from implementation of the Project and is intended to provide sufficient information to support subsequent findings by the Forest Service.

This assessment provides a conservative site-specific analysis of effects on sites, which consist of the recorded observations of Survey and Manage species from agency geodatabases and a surrounding protection buffer, and generally assumes that site persistence would not be maintained following Project implementation if a site falls within the analysis area. This conservative approach was considered sufficient if Project-related effects on the sites would not substantially alter the distribution of the species across the NSO range (e.g., the species would still be well distributed or locally abundant near the Project area). However, if the initial analysis revealed that remaining sites (i.e., those not affected by the Project) may not provide a reasonable assurance of species persistence, a closer evaluation of the effects on each site was conducted to further assess effects of the Project and determine if site persistence would be maintained at any of the sites following Project implementation, or if measures would be needed to protect or avoid the site(s). Additional details on the methodology used to evaluate effects are presented in appendix F.5.

Incomplete or Unavailable Information

CEQ regulations 40 CFR 1502.22 require a discussion of incomplete or unavailable information. Information is incomplete or unavailable for:

- **Total populations of Survey and Manage species beyond those represented in the geodatabases of the agencies used in this report.** Although a statistically reliable region-wide survey has been completed for most of the Survey and Manage species (Forest Service and BLM 2007: 142), the results of those surveys have not been biologically interpreted, and the final results have not yet been published. In absence of a published interpretation of the results of those regional surveys, this assessment relies on the known sites of affected species that have been inventoried and recorded in the known site geodatabases of the BLM and Forest Service. These data constitute "best available information" for populations of Survey and Manage species and provide sufficient information to make a reasoned choice between the alternatives and to make an informed decision related to the persistence standards of the 2001 Survey and Manage ROD. A total population estimate is not necessary to make a reasoned choice between the alternatives.
- **Total acres of the specialized microsites and habitats used by certain Survey and Manage species.** This analysis was completed using geodatabase records of observations (i.e., "known sites"), regionally available vegetation inventory data, and evaluation criteria developed from the 2001 ROD. In many cases, Survey and Manage species rely on specialized habitats that may not be catalogued in agency geodatabase records or vegetation inventories. This is one of the reasons why pre-Project surveys are required for Survey and Manage species. Habitat requirements for each of the species considered are discussed in detail in appendix F.5. In this assessment, estimates are provided of the general areas where specialized habitats may be found, but these should not be interpreted as the actual acres of available specialized habitats; the actual acres of available specialized habitats are typically a fraction of the general habitat description. For example, some mollusks rely on moist microsites found in late-successional coniferous forests. A regional inventory of late-successional coniferous forests is available, but a regional inventory of moist microsites is not; there are many, many more acres of late-successional forests than there are acres of moist microsites within those forests. This assessment identifies known sites and broad habitat classifications such as "late-successional coniferous forests below 6,000 feet" where specialized habitats and the species in question may be found, but makes no estimates of, nor does the analysis rely on, estimates of specialized habitats that may exist within those broad vegetation categories. The cost of acquiring such an inventory of microsite environments over the entire area of the NWFP would be exorbitant and is not essential to making a reasoned choice between the alternatives. As noted in the Final Supplemental EIS for Survey and Manage Species, "the likelihood that an activity modifying late-successional forest will occur within the range of a truly rare or localized species population must be viewed in light of the relatively conservative degree of modification of late-successional forest projected to occur within the NWFP area. For example, management activities (timber harvest and prescribed fire) are projected to

modify approximately 3 percent of the late-successional forest within the area over the next decade" (Forest Service and BLM 2000: 180). Pre-Project survey data and existing known sites of Survey and Manage species within the area of the NWFP provide sufficient information to determine whether there is a "reasonable assurance of species persistence," which is the standard of the 2001 Survey and Manage ROD.

- **Recovery of occupied sites after disturbance.** Survey and Manage species are associated with LSOG forests on NFS lands. The construction corridor and TEWAs will be reforested and replanted with native vegetation similar to what occupied the Project area prior to disturbance. It will be at least 80 years before those areas provide late-successional habitat. A 30-foot-wide maintenance corridor centered along the pipeline route would be maintained in low growing brush and grass vegetation (no trees) for the life of the Project. When the Project is decommissioned, it would be at least an additional 80 years before this strip provides late-successional stand characteristics. Information is not generally available as to how effectively the affected Survey and Manage species will reoccupy these areas. This analysis presumes that if the "site" is within the construction clearing or TEWAs, the Project would result in a long-term loss of that site. This analysis does not speculate on when or if the affected species may reoccupy the site. Since sites are presumed lost if affected, and that provides the basis for the assessment, data related to recovery or reoccupation of sites are not essential to the decision to be made or the choice between alternatives.

Survey and Manage Species Surveys and Evaluations

Surveys conducted for the Project in and near the Project area through 2016 resulted in numerous observations of Survey and Manage species. These survey results in combination with results from prior surveys conducted near the Project area were used to identify the Survey and Manage species that could be affected by the Project. Observation data stored in agency geodatabases were converted to "sites" or "known sites" using a standardized mapping protocol based on buffer distances described in the 2001 ROD. Species evaluated include those that have sites on NFS lands in or near the Project area. The species considered include 31 fungi, 2 lichens, 1 vascular plant, 2 mollusks, 1 mammal, and 1 bird.

Fungi

The diverse fungi of the Pacific Northwest include several hundred saprobic (decomposers), parasitic, and symbiotic (mutualistic) macro- and micro-fungi species. The 2003 list includes 194 species of fungi under the Survey and Manage Standards and Guidelines. Of these species, 31 are considered in this evaluation of the Project because they have been documented on NFS lands in or near the Project area. Appendix F.5 of this EIS presents additional details on each species, while the key information used to evaluate Project-related effects is summarized in this section.

The fungi considered in this analysis consist primarily of mycorrhizal or symbiotic species, which include truffles, false truffles, chanterelles, boletes, coral fungi, and gilled mushrooms. Some of the species are saprobic gilled mushrooms or parasitic fungi. The mycorrhizal fungi form symbiotic relationships with vascular plants to exchange nutrients and water for photosynthate. The saprobic species are found on dead or decaying wood, including snags. The fungi fruit at different times of year, and many do not fruit annually, although they may still be present in the soil. Although surveys have been conducted across the Project area and in other parts of the NSO range, the difficulty in detecting fungi when fruiting bodies are not present has limited the ability to fully describe the range and distribution of many species within the NSO range. The fungi species considered in this analysis are listed in table 4.6.4.3-1 with the currently known number of sites in the NSO range. Many of these species are likely more abundant than currently documented, and more survey effort would be expected to locate additional sites of the species.

TABLE 4.6.4.3-1

Regional Site Count of Fungi Species Potentially Affected by the Project

Species	Total Sites in NSO Range a/	Sites on NFS Lands in NSO Range b/	Sites in NFS Reserves in NSO Range c/
Albatrellus ellisii	112	72	33 (46%)
Arcangeliella crassa	26	21	2 (10%)
Boletus pulcherrimus	60	34	21 (62%)
Choiromyces alveolatus	21	17	11 (65%)
Clavariadelphus occidentalis	177	63	21 (33%)
Clavariadelphus sachalinensis	273	35	20 (57%)
Clavariadelphus truncatus	332	127	56 (44%)
Collybia bakerensis	149	145	64 (44%)
Collybia racemosa	71	24	13 (54%)
Cortinarius magnivelatus	47	28	8 (29%)
Cortinarius olympianus	73	44	27 (61%)
Cortinarius verrucisporus	52	32	5 (16%)
CCudonia monticola	82	35	9 (26%)
Galerina atkinsoniana	96	68	55 (81%)
Gastroboletus subalpinus	91	81	36 (44%)
Gomphus clavatus	189	102	53 (52%)
Gomphus kauffmanii	159	99	53 (54%)
Gymnomyces abietis	21	18	10 (55%)
Hygrophorus caeruleus	56	47	14 (30%)
Mycena overholtsii	205	201	94 (47%)
Polyozellus multiplex	87	83	40 (38%)
Ramaria araiospora	152	69	26 (38%)
Ramaria coulterae	67	19	26 (32%)
Ramaria rubrievanescens	143	105	53 (50%)
Ramaria rubripermanens	231	103	35 (34%)
Rhizopogon truncatus	210	70	26 (34%)
Sarcodon fuscoindicus	74	38	18 (46%)
Sedecula pulvinata	3	3	2 (67%)
Sparassis crispa	106	51	9 (18%)
Spathularia flavida	194	81	52 (64%)
Tremiscus helvelloides	318	62	34 (55%)

a/ Total site count reflects the number of sites generated by the 8/2/17 FME extract.
b/ Site count reflects only those sites on NFS lands using land ownership data for the NSO range (dated October 2011).
c/ Site count reflects only those sites on NFS lands and in reserve land allocations based on 1994 ROD reserve land allocations for the NSO range (data dated December 2002 and September 2009) and National Hydrography Dataset, v. 2.1.0 to represent "Riparian Reserves" across the NSO range. These counts underestimate the number of sites in reserves, but regionally mapped reserve data are not available. The percentage represents the estimated proportion of sites in NFS reserves to total sites on NFS lands.

Habitat for these species varies and has generally been classified as coniferous, mixed hardwood-coniferous, and/or hardwood forests, including the LSOG component of these forests. Forests that may provide suitable habitat have been mapped using available data for the NSO range that were also used for the NWFP Effectiveness Monitoring 15-year report to map LSOG forests (Moeur et al. 2011). The data are the best available data on forest types across the NSO range but likely overestimate the amount of potential habitat available in the region for many of the species considered in this analysis, particularly those with microsite conditions that have not been mapped at a regional scale. The extent of potential habitat for each species varies based on its distribution across the NSO range and its habitat preferences, and additional details on habitat are presented in appendix F.5.

The Project could affect site persistence of 31 Survey and Manage fungi at one or more sites in or near the Project area. Vegetation removal and grading activities in the construction corridor and in TEWAs would disturb vegetation and soil within sites and could result in the removal of populations or individuals of fungi. Construction of the Project would create an open corridor, which would be dominated by early seral vegetation for approximately 30 years. This is a long-term effect that could modify microclimate conditions around populations or individuals adjacent to the corridor during the early seral vegetation phase, although not all species are affected by open corridors or change in forest age (e.g., *P. fallax*, *P. piceae*, *P. sipei*, and *P. spadicea*). The removal of coniferous, mixed hardwood-coniferous, and hardwood forests, including the LSOG component of these forests, and disturbance to soil, understory substrate (e.g., rocks, downed logs), and roots of trees could negatively affect the fungi in adjacent areas by removing their habitat, disturbing soil or duff around trees or roots of trees, and affecting mycorrhizal associations with the trees or other relationships between the fungi and their hosts, potentially affecting site persistence even if the entire site is not disturbed. For some species that are found in more open habitats (e.g., *C. olympianus*, *H. caeruleus*, *S. flavida*), these microclimate changes may not affect site persistence. In addition, modification of shading, moisture, and habitat conditions as a result of the corridor and TEWAs could make habitat within the sites no longer suitable for the species. Material storage within UCSAs would disturb understory habitat in some sites, which could also modify microhabitats near extant populations or individuals, potentially making the habitat no longer suitable for the species. Road improvements and establishment could remove habitat and extant populations or individuals of the fungi. The specific effects on sites in and near the Project area vary by species and depend on where the sites are in proximity to the corridor and other activities. Table 4.6.4.3-2 presents a summary of the number of sites of each species that would be affected by the Project; additional details for each species are included in appendix F.5.

TABLE 4.6.4.3-2

Fungi Sites Potentially Affected by the Project

Species	**Total Affected NFS Sites a/**	**Affected Sites in NFS Reserves**	**Remaining Sites on NFS Lands in NSO Range**	**Remaining Sites on all Lands in NSO Range**
Albatrellus ellisii	10	3	62	102
Arcangeliella crassa	1	—	21 b/	26 b/
Boletus pulcherrimus	7	—4	31 b/	57 b/
Choiromyces alveolatus	1	—	17 b/	21 b/
Clavariadelphus occidentalis	1	—	62	171
Clavariadelphus sachalinensis	7	2	28	258
Clavariadelphus truncatus	10	4	117	311
Collybia bakerensis	2	—	143	147
Collybia racemosa	1	—	23	70
Cortinarius magnivelatus	5	—	24 b/	43 b/
Cortinarius olympianus	5	4	40 b/	69 b/
Cortinarius verrucisporus	5	—	29 b/	49 b/
Cudonia monticola	1	—	34	81
Galerina atkinsoniana	1	—	67	95
Gastroboletus subalpinus	2	—	79	89
Gomphus clavatus	3	1	99	186
Gomphus kauffmanii	7	6	91	152
Gymnomyces abietis	1	1	18 b/	21 b/

TABLE 4.6.4.3-2 (continued)

Fungi Sites Potentially Affected by the Project

Species	Total Affected NFS Sites a/	Affected Sites in NFS Reserves	Remaining Sites on NFS Lands in NSO Range	Remaining Sites on all Lands in NSO Range
Hygrophorus caeruleus	6	—1	846 b/	55 b/
Mycena overholtsii	2	1	199	203
Polyozellus multiplex	1	1	82	86
Ramaria araiospora	3	—	67	149
Ramaria coulterae	3	1	17	65
Ramaria rubrievanescens	2	—	103	141
Ramaria rubripermanens	7	—	96	223
Rhizopogon truncatus	6	1	64	203
Sarcodon fuscoindicus	1	—	37	72
Sedecula pulvinata	1	1	3 b/	3 b/
Sparassis crispa	1	—	50	104
Spathularia flavida	5	4	76	189
Tremiscus helvelloides	1	1	61	310

a/ Affected sites are those on NFS land that would be directly or indirectly affected by Project activities based on the analyses presented in appendix F.5.
b/ Although one or more sites would be affected by the Project, individuals within some of the sites would not be affected, and site persistence would be maintained for those sites following project implementation. The remaining site count includes sites that may be affected, but for which site persistence is expected to be maintained. Only sites for which site persistence would be affected were removed from the remaining site count.

The species listed below appear to be more common than previously documented or are relatively common across the NSO range based on new information available from surveys for the Project and/or other sources since these species were listed in the 2001 ROD. For these species, the Project would affect individuals or habitat at one or more sites and could affect site persistence, but the remaining sites in the NSO range would continue to provide a reasonable assurance of species persistence:

Clavariadelphus occidentalis
Clavariadelphus sachalinensis
Clavariadelphus truncatus
Collybia bakerensis
Cortinarius olympianus
Cudonia monticola
Galerina atkinsoniana
Gastroboletus subalpinus
Gomphus clavatus
Gomphus kauffmanii
lbatrellus ellisii
Mycena overholtsii
Polyozellus multiplex
Ramaria araiospora
Ramaria coulterae
Ramaria coulterae
Ramaria rubrievanescens
Ramaria rubripermanens
Ramaria rubripermanens
Ramaria stuntzii
Rhizopogon truncatus
Rhizopogon truncatus
Sparassis crispa
Spathularia flavida
Tremiscus helvelloides

The species listed below are not necessarily more common than previously documented despite new information available from pre-disturbance surveys for the Project and/or other sources since these species were listed in the 2001 ROD. For these species, the Project would affect individuals or habitat at one or more sites and could affect site persistence, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence:

Arcangeliella crassa
Boletus pulcherrimus

Choiromyces alveolatus
Collybia racemose
Cortinarius magnivelatus
Cortinarius verrucisporus
Gymnomyces abietis
Hygrophorus caeruleus
Sedecula pulvinata

The species listed below is not necessarily more common than previously documented despite new information available from pre-disturbance surveys for the Project and/or other sources since these species were listed in the 2001 ROD. For this species, the Project would affect site persistence at one or more sites, and the remaining sites in the NSO range may not provide a reasonable assurance of species persistence. These species are known from a low number of sites within a part of the NSO range, has limited habitat requirements, and has a distribution pattern in which every site may be important for dispersal opportunities to ensure the persistence of the species in the NSO range:

Sarcodon fuscoindicus

The Project would affect a portion of one site where two observations of this species have been documented on NFS lands. This site is located in the Trail Creek watershed on the ridge just east of the South Fork Cow Creek watershed between MPs 111.5 and 111.6. Approximately 1.2 acres (30 percent of the site) is associated with the construction corridor (0.8 acres) and associated UCSA (0.4 acres). The location of this site is illustrated in appendix F-5 (Section 2.27, Figure SAFU-5).

The Project would result in ground disturbance and vegetation removal in the eastern half of the site near MP 111.5. The two recorded observations within the site may be avoided by construction activities within the corridor, but fruiting bodies, if present, could be disturbed in one of the observations during material storage within a UCSA (see Figure SAFU-5). The species would also be subject to indirect effects associated with the Project based on the proximity of project activities to the observations.

Establishment of the 95-foot wide construction corridor would disturb vegetation and soils within the site. The area within the site is mostly forested, and the establishment of the corridor could modify microclimate conditions around the recorded observations. The removal of forests and host trees and disturbance to soil could negatively affect *S. fuscoindicus* in adjacent areas by removing its habitat, disturbing soil or duff around trees or roots of trees, and affecting its mycorrhizal association with the trees, potentially affecting site persistence even if the entire site is not disturbed. In addition, modification of shading, moisture, and habitat conditions within 100 feet of an observation as a result of the corridor could make habitat within the site no longer suitable for the species. Restored portions of the corridor would be dominated by early seral vegetation for approximately 30 years, which would result in long-term changes to habitat conditions. A 30-foot wide portion of the corridor would be maintained in low-growing vegetation for pipeline maintenance and would not provide habitat for the species during the life of the Project. Material storage within UCSAs could damage individuals and would disturb understory habitat within the site, which could modify microhabitats near individuals that are not removed or damaged, potential making the habitat no longer suitable for the species.

Based on this analysis of the site on NFS lands, *S. fuscoindicus* is not likely to persist following Project implementation. The site is the only site on NFS lands in the local area and the nearest sites on NFS lands are approximately 45 miles to the northeast and 75 miles to the southwest.

Lichens

Lichens are distinct symbiotic organisms that consist of a fungus and an algae or cyanobacterium, which make them members of two or three biological kingdoms. They play a major ecological role, particularly in old-growth forests, by cycling nutrients and producing biomass. Lichens tend to be dispersal limited and grow slower than vascular plants. The 2001 Survey and Manage ROD including the 2003 ASR modifications to the species list includes 45 lichen species. Of these, two are considered in this evaluation because they have been documented on NFS lands in or near the Project area. Appendix F.5 presents additional details on each species, while the key information used to evaluate Project-related effects is summarized in this section.

Both lichens considered in this analysis are epiphytic lichens, which grow directly on trees or shrubs. *Chaenotheca subroscida* commonly occurs on pine trees in upland habitats and *Leptogium teretiusculum* tends to be associated with riparian habitat.

Although surveys have been conducted across the Project area and in other parts of the NSO range, the difficulty in detecting some lichens because of their size has limited the ability to fully describe the range and distribution of some species within the NSO range. The lichen species considered in this analysis are listed in table 4.6.4.3-3 with the currently known number of sites in the NSO range, and the distributions of the species are briefly discussed after the table.

TABLE 4.6.4.3-3

Regional Site Count of Lichen Species Potentially Affected by the Project

Species	Total Sites in NSO Range a/	Sites on NFS Lands in NSO Range b/	Sites in NFS Reserves in NSO Range c/
Chaenotheca subroscida	396	110	73 (66%)
Leptogium teretiusculum	267	16	9 (56%)

a/ Total site count reflects the number of sites generated by the 8/2/17 FME extract.
b/ Site count reflects only those sites on NFS lands using land ownership data for the NSO range (dated October 2011).
c/ Site count reflects only those sites on NFS lands and in reserve land allocations based on 1994 ROD reserve land allocations for the NSO range (data dated December 2002 and September 2009) and National Hydrography Dataset, v. 2.1.0 to represent "Riparian Reserves" across the NSO range. These counts underestimate the number of sites in reserves, but regionally mapped reserve data are not available. The percentage represents the estimated proportion of sites in reserves to total sites on NFS lands.

Habitat for these species has been classified as coniferous, mixed hardwood-coniferous, and/or hardwood forests, including the LSOG component of these forests. Forests that may provide suitable habitat have been mapped using available data for the NSO range that were also used for the NWFP Effectiveness Monitoring 15-year report to map LSOG forests (Moeur et al. 2011). The extent of potential habitat for each species varies based on its distribution across the NSO range and habitat preferences. Additional details on habitat for these species are presented in appendix F.5.

The Project could affect site persistence of two Survey and Manage lichens at one or more sites on NFS lands in or near the Project area. Vegetation removal and grading activities in the construction corridor and in TEWAs would disturb vegetation and soil within sites and could result in the removal of populations or individuals of lichens. Construction of the Project would create an open corridor, which would be dominated by early seral vegetation for approximately 30 years. This is a long-term effect that could modify microclimate conditions around populations or individuals adjacent to the corridor during the early seral vegetation phase. The removal of coniferous, mixed hardwood-coniferous, and hardwood forests, including the LSOG component of these forests, and disturbance to soil, understory substrate (e.g., rocks, downed logs), and roots of trees could negatively affect the lichens in adjacent areas by removing their habitat, disturbing soil or substrate around trees or roots of trees, and affecting associations with the trees or other substrate, potentially affecting site persistence even if the entire site is not disturbed. In addition, modification of shading, moisture, and habitat conditions as a result of the corridor and TEWAs could make habitat within the sites no longer suitable for the species. Material storage within UCSAs would disturb understory habitat in some sites, which could also modify microhabitats near extant populations or individuals, potentially making the habitat no longer suitable for some of the species. Road improvements and establishment could remove habitat and extant populations or individuals of the lichens. The specific effects on sites in and near the Project area vary by species and depend on where the sites are in proximity to the corridor and other activities. Table 4.6.4.3-4 presents a summary of the number of sites of each species that would be affected by the Project; additional details for each species are included in appendix F.5.

TABLE 4.6.4.3-4

Lichen Sites Potentially Affected by the Project

Species	Total Affected NFS Sites a/	Affected Sites in NFS Reserves	Remaining Sites on NFS Lands in NSO Range	Remaining Sites on all Lands in NSO Range
Chaenotheca subroscida	6	4	104	382
Leptogium teretiusculum	1	1	15	261

a/ Affected sites are those that would be directly or indirectly affected by Project activities based on the analyses presented in appendix F.5. Using the spatial analysis process described in appendix F.5, these sites may be clipped by the Project area or fall outside the Project area, but within the analysis area.

The two lichen species analyzed appear to be more common than previously documented or are relatively common across the NSO range based on new information available from surveys for the Project and/or other sources since these species were listed in the 2001 ROD. The Project would affect site persistence at one or more sites, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence.

Measures incorporated into the Project as design features would be implemented to minimize soil and vegetation disturbance in the Project area and restore areas following construction, which could minimize adverse effects on all Survey and Manage lichens in and near the Project area. The Forest Service will prepare and implement a monitoring plan that describes specific protocols to monitor affected sites and habitat adjacent to the sites over the long term.

For lands directly affected by the Project, the Forest Service would waive implementation of Management Recommendations for Survey and Manage species through amendment of the land management plans for the National Forests that encompass the Project area. Table 4.6.4.3-5 lists the lichen species and the number of affected sites on each National Forest.

TABLE 4.6.4.3-5

Affected Lichen Sites by National Forest

	Number of Sites Affected a/		
Species	Umpqua	Rogue River-Siskiyou	Fremont-Winema
Chaenotheca subroscida	—	5	1
Leptogium teretiusculum	—	1	—

a/ All sites are directly affected (i.e., are located in the Project area).

Vascular Plants

Vascular plants are the most dominant organism in LSOG forests and serve an essential role by providing a food source and cover or shelter for animals and influencing microclimate conditions for other species, such as fungi and lichens. Vascular plants include seed-bearing plants, such as flowering plants and conifer trees, and spore-bearing forms, such as ferns, horsetails, and clubmosses. The Survey and Manage 2001 ROD including 2003 ASR modifications includes 12 plant species. Of the 12 species, clustered lady's slipper (*Cyripedium fasciculatum*) is evaluated for this Project because it has been documented on NFS lands in or near the Project area. Appendix F.5 presents additional details on the species, while the key information used to evaluate Project-related effects is summarized in this section.

Surveys for vascular plants have been conducted in much of the NSO range, and the results of these surveys have contributed information to characterize the known extent of the plants in the NSO range. Additional surveys for Survey and Manage species were conducted for the Project as recently as the fall of 2018.[144] Table 4.6.4.3-6 includes the currently known number of *C. fasciculatum* sites in the NSO range. The range of *C. fasciculatum* in the NSO range is relatively well known, and more survey effort would be expected to locate additional sites of the species within its currently known range.

TABLE 4.6.4.3-6

Regional Site Count of Plant Species Potentially Affected by the Project

Species	Total Sites in NSO Range a/	Sites on NFS Lands in NSO Range b/	Sites in NFS Reserves in NSO Range c/
Cypripedium fasciculatum	1,392	1540	198 (37%)

a/ Total site count reflects the number of sites generated by the 8/2/17 FME extract.
b/ Site count reflects only those sites on NFS lands using land ownership data for the NSO range (dated October 2011).
c/ Site count reflects only those sites on NFS lands and in reserve land allocations based on 1994 ROD reserve land allocations for the NSO range (data dated December 2002 and September 2009) and National Hydrography Dataset, v. 2.1.0 to represent "Riparian Reserves" across the NSO range. These counts underestimate the number of sites in reserves, but regionally mapped reserve data are not available. The percentage represents the estimated proportion of sites in reserves to total sites on NFS lands.

C. fasciculatum is well distributed across most of its known range in the NSO range. Sites are distributed in two general groups in the Klamath Mountains and Cascade Range in Oregon and California and the eastern Cascade Range in Washington. The species appears to be well distributed in the Klamath Mountains in California and Oregon.

General habitat for this species consists of coniferous and mixed hardwood-coniferous forests, including the LSOG component of these forests, across each species' currently known range. Forests that may provide suitable habitat have been mapped using available data for the NSO range that were also used for the NWFP Effectiveness Monitoring 15-year report to map LSOG forests (Moeur et al. 2011). The extent of potential habitat for each species varies based on its distribution across the NSO range and habitat preferences, and additional details on habitat are presented in appendix F.5.

The Project could affect site persistence of *C. fasciculatum* at one site on NFS land in the Project area. The site occurs on the Umpqua National Forest. Vegetation removal and grading activities in the construction corridor and in TEWAs would disturb vegetation and soil within sites and could

[144] Results from these will be incorporated into the final EIS.

result in the removal of populations or individuals of plants. Construction of the Project would create an open corridor, which would be dominated by early seral vegetation for approximately 30 years. This is a long-term effect that could modify microclimate conditions around populations or individuals adjacent to the corridor during the early seral vegetation phase. The removal of coniferous and mixed hardwood-coniferous forests, including the LSOG component of these forests, and disturbance to soil could negatively affect the plants in adjacent areas by removing their habitat, potentially affecting site persistence even if the entire site is not disturbed. In addition, modification of shading, moisture, and habitat conditions as a result of the corridor and TEWAs could make habitat within the sites no longer suitable for the species. Material storage within UCSAs would disturb understory habitat in some sites, which could also modify microhabitats near extant populations or individuals, potentially making the habitat no longer suitable for some of the species. Road improvements and establishment could remove habitat and extant populations or individuals of the plants. The specific effects on sites in and near the Project area vary by species and depend on where the sites are in proximity to the corridor and other activities. Table 4.6.4.3-7 presents a summary of the sties that would remain after the single site is affected by Project activities; additional details for each species are included in appendix F.5.

TABLE 4.6.4.3-7

Vascular Plant Sites Potentially Affected by Project

Species	Total Affected NFS Sites a/	Affected Sites in Reserves	Remaining Sites on NFS Lands in NSO Range	Remaining Sites on all Lands in NSO Range
Cypripedium fasciculatum	1	1	1,539	1,390

a/ Affected sites are those that would be directly or indirectly affected by Project activities based on the analyses presented in appendix F.5. Using the spatial analysis process described in appendix F.5, these sites may be clipped by the Project area or fall outside the Project area, but within the analysis area.

Cypripedium fasciculatum appears to be more common than previously documented based on new information available from surveys for the Project and/or other sources since these species were listed in the 2001 ROD. Many sites have been documented in southwest Oregon since the 2001 ROD was published. Should the Project be constructed, it is unlikely that the loss of one site from Project effects would affect the status of *C. fasciculatum* in the NSO range. The Project would affect site persistence at one site on NFS lands, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence.

Measures incorporated into the Project as design features would be implemented to minimize soil and vegetation disturbance in the Project area and restore areas following construction, which could minimize adverse effects on Survey and Manage plants in and near the Project area. The Forest Service will prepare and implement a monitoring plan that describes specific protocols to monitor affected sites and habitat adjacent to the sites over the long term.

For lands directly affected by the Project, the Forest Service would waive implementation of Management Recommendations for Survey and Manage species through amendments to the land management plans for National Forests that encompass the Project area.

Mollusks

Approximately 350 species of mollusks, including land snails, aquatic snails, slugs, and clams, are found in the Pacific Northwest (Forest Service and BLM 2000). Slugs and snails are found in colonies, which may consist of hundreds to many thousands of individuals. Most mollusks are found in moist forests and riparian areas near streams, springs, and seeps. The 2001 ROD including 2003 ASR modifications includes 38 species of mollusks. Of these species, two are considered in this evaluation of the Project because they have been documented on NFS lands in or near the Project area. Appendix F.5 presents additional details on each species, while the key information used to evaluate Project-related effects is summarized in this section.

The mollusk species considered in this analysis include evening fieldslug (*Deroceras hesperium*) and Chace sideband (*Monadenia chaceana*). *Deroceras hesperium* is a land slug that requires high moisture environments and is found along the forest floor. A recent study on the molecular characteristics of *D. hesperium* revealed that the mollusk is likely a variant of the more common *D. laeve* (Roth et al. 2013), and *D. hesperium* may no longer belong on the Survey and Manage list, pending an annual species review. Since the species is on the 2003 list, it is evaluated like other Survey and Manage species on the list in this assessment. *Monadenia chaceana* is a land snail that is found in talus or under rocks in moist forests. Both mollusks may be associated with Riparian Reserves.

Surveys for mollusks have been conducted in parts of the NSO range, and the results of these surveys have contributed information to characterize the known extent of the mollusks in the NSO range. Surveys for the Project resulted in several observations of both species. The mollusk species considered in this analysis are listed in table 4.6.4.3-8 with the currently known number of sites in the NSO range. The ranges of these species in the NSO range are relatively well known, and more survey effort would be expected to locate additional sites of the species within their currently known ranges.

The distribution of the species and their ranges within the NSO range vary. *Deroceras hesperium* has a distribution pattern with limited potential for connectivity between isolated sites or site clusters. Sites are found in four general areas in Oregon, including a relatively large cluster of sites located in the southern Cascade Range, and other clustered sites located in the northern Cascade Range and southern Coast Range. Scattered sites are in the northern Cascade Range, and several isolated sites are in other areas. *Monadenia chaceana* has multiple sites or clusters of sites that are nested within a web of potential interconnections. Sites are primarily found in a large group of several clusters in the eastern Klamath Mountains and southern Cascade Range in Oregon and extreme northern California.

TABLE 4.6.4.3-8

Regional Site Count of Mollusk Species Potentially Affected by the Project

Species	Total Sites in NSO Range a/	Sites on NFS Lands in NSO Range b/	Sites in NFS Reserves in NSO Range c/
Deroceras hesperium	54	27	13 (48%)
Monadenia chaceana	258	246	34 (14%)

a/ Total site count reflects the number of sites generated by the 8/2/17 FME extract.
b/ Site count reflects only those sites on NFS lands using land ownership data for the NSO range (dated October 2011).
c/ Site count reflects only those sites on NFS lands and in reserve land allocations based on 1994 ROD reserve land allocations for the NSO range (data dated December 2002 and September 2009) and National Hydrography Dataset, v. 2.1.0 to represent "Riparian Reserves" across the NSO range. These counts underestimate the number of sites in reserves, but regionally mapped reserve data are not available. The percentage represents the estimated proportion of sites in reserves to total sites on NFS lands.

General habitat for these species consists of a subcomponent (e.g., moist riparian areas, shaded rocky areas) of coniferous, mixed hardwood-coniferous, and hardwood forests, including the LSOG component of these forests, across each species' currently known range. Forests that may provide suitable habitat have been mapped using available data for the NSO range that were also used for the NWFP Effectiveness Monitoring 15-year report to map LSOG forests (Moeur et al. 2011). The extent of potential habitat for the species varies based on its distribution across the NSO range and habitat preferences, and additional details on habitat are presented in appendix F.5.

The Project could affect site persistence of two Survey and Manage mollusk species at one or more sites in or near the Project area. Vegetation removal and grading activities in the construction corridor and in TEWAs would disturb vegetation and soils within sites and could result in injury or mortality to individuals of mollusks. Construction of the Project would create an open corridor, which would be dominated by early seral vegetation for approximately 30 years. This is a long-term effect that could modify microclimate conditions around populations or individuals adjacent to the corridor during the early seral vegetation phase. The removal of forests and understory components could negatively affect the mollusks in adjacent areas by removing their habitat, potentially affecting site persistence even if the entire site is not disturbed. In addition, modification of shading, moisture, and habitat conditions as a result of the corridor could make habitat within sites no longer suitable for the species. Material storage within UCSAs could disturb understory habitat in sites, which could remove rocks, logs, or woody debris, potentially making the habitat unsuitable for the species or injuring individuals.

The specific effects on sites in and near the Project area vary by species and depend on where the sites are in proximity to the corridor and other activities. Table 4.6.4.3-9 presents a summary of the number of sites of each species that would be affected by the Project; additional details for each species are included in appendix F.5.

TABLE 4.6.4.3-9

Mollusk Sites Potentially Affected by the Project

Species	Total Affected NFS Sites a/	Affected Sites in NFS Reserves	Remaining Sites on NFS Lands in NSO Range	Remaining Sites on all Lands in NSO Range
Deroceras hesperium	1	1	26	53
Monadenia chaceana	9	9	249	396

a/ Affected sites are those that would be directly or indirectly affected by Project activities based on the analyses presented in appendix F.5. Direct effects are those that would take place within the Project area, such as from ground disturbance, vegetation removal, or removal of individuals. Indirect effects are those that would take place outside of the Project area, such as from edge effects or increased open canopy. Using the spatial analysis process described in appendix F.5, these sites may be clipped by or fall outside the Project area, but within the analysis area.

Deroceras hesperium is not necessarily more common than previously documented despite new information available from pre-disturbance surveys for the Project and/or other sources since this species was listed in the 2001 ROD. The Project would affect site persistence at one site, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence. Although this species has a somewhat limited distribution in the NSO range, the affected site is part of a large cluster of sites in the southern Cascade Range in Oregon. The distribution and connectivity of the species would likely remain the same despite the loss of one site.

Monadenia chaceana appears to be more common than previously documented based on new information available from surveys for the Project and/or other sources since this species was listed in the 2001 ROD. The Project would affect site persistence at nine sites, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence.

Measures incorporated into the Project as design features would be implemented to minimize soil and vegetation disturbance in the Project area and restore areas following construction, which could minimize adverse effects on Survey and Manage mollusks in and near the Project area. The Forest Service will prepare and implement a monitoring plan that describes specific protocols to monitor affected sites and habitat adjacent to the sites over the long term.

For lands directly affected by the Project, the Forest Service would waive implementation of Management Recommendations for Survey and Manage species through amendments to the land management plans for the National Forests that encompass the Project area. Table 4.6.4.3-10 lists the mollusk species and the number of affected sites in each National Forest.

TABLE 4.6.4.3-10

Affected Mollusk Sites by National Forest

	Number of Sites Affected a/		
Species	**Umpqua**	**Rogue River=Siskiyou**	**Fremont-Winema**
Deroceras hesperium	—	—	1
Monadenia chaceana	—	3 (5)	1

a/ First number presents sites directly affected (i.e., in Project area), number in parentheses presents sites indirectly affected (i.e., sites wholly in analysis area). a

Vertebrates

A diverse array of vertebrate species, including mammals, birds, amphibians, and reptiles, inhabit the forests of the Pacific Northwest and provide essential functions in the ecosystem, such as dispersing fungal spores and lichens and serving as a food source for predators. The 2001 ROD including the 2003 ASR modifications to the species list includes seven vertebrate species. Two vertebrate species are considered in this evaluation of the Project because they have been documented on NFS lands in or near the Project area. Appendix F.5 presents additional details on each species, and the key information used to evaluate Project-related effects is summarized in this section.

The vertebrate species considered in this analysis include red tree vole (*Arborimus longicaudus*) and great gray owl (*Strix nebulosa*). *Arborimus longicaudus* is a small arboreal rodent that lives in tree canopies of coniferous and mixed hardwood-coniferous forests and seldom goes to the forest floor (Forest Service and BLM 2001b). It is a primary prey item of the northern spotted owl, as well as other predators found in coniferous forests. *Strix nebulosa* is a forest owl that uses existing stick nests constructed by other raptors and large corvids, and nests between March 1 and July 31 (Williams 2012). It forages in natural forest openings, typically larger than 10 acres, and nests in coniferous and mixed hardwood-coniferous forests.

Surveys for the vole and owl have been conducted across much of the NSO range, and the results of these surveys have contributed information to characterize the known extent of the species in the NSO range. Surveys for the Project resulted in multiple observations of both species in the surveyed areas. The vertebrate species considered in this analysis are listed in table 4.6.4.3-11 with the currently known number of sites in the NSO range, and the distributions of the species are briefly discussed after the table. The ranges of these species in the NSO range are relatively well known, and more survey effort would be expected to locate additional sites of the species within their currently known ranges.

TABLE 4.6.4.3-11

Regional Site Count of Vertebrate Species Potentially Affected by the Project

Species	**Total Sites in NSO Range a/**	**Sites on NFS Lands in NSO Range b/**	**Sites in NFS Reserves in NSO Range c/**
Arborimus longicaudus	34,946	1,524	624 (34%)
Strix nebulosa	177	55	16 (12%)

a/ Total site count reflects the number of sites generated by the 8/2/17 FME extract.
b/ Site count reflects only those sites on NFS lands using land ownership data for the NSO range (dated October 2011).
c/ Site count reflects only those sites on NFS lands and in reserve land allocations based on 1994 ROD reserve land allocations for the NSO range (data dated December 2002 and September 2009) and National Hydrography Dataset, v. 2.1.0 to represent "Riparian Reserves" across the NSO range. These counts underestimate the number of sites in reserves, but regionally mapped reserve data are not available. The percentage represents the estimated proportion of sites in reserves to total sites on NFS lands

The distribution of the species and their ranges within the NSO range vary. Both species have multiple sites or clusters of sites that are nested within a web of potential interconnections. Most *A. longicaudus* sites are found in the Klamath Mountains in Oregon, where sites are abundant and close together in large clusters or groups. Sites are more scattered in the western Cascade Range in Oregon, although they are still relatively abundant. *Arborimus longicaudus* appears to be well distributed within its range in Oregon. Most *S. nebulosa* sites are found in a large group in the southern Cascade Range and eastern Klamath Mountains, where the species appears to be well distributed.

General habitat for *A. longicaudus* consists of LSOG coniferous and mixed hardwood-coniferous forests across the species' currently known range in Oregon. General habitat for *S. nebulosa* consists of coniferous and mixed hardwood-coniferous forests, including the LSOG component of these forests, with a subcomponent of natural forest openings (e.g., meadows) that are used for foraging. Forests that may provide suitable habitat have been mapped using available data for the NSO range that were also used for the NWFP Effectiveness Monitoring 15-year report to map LSOG forests (Moeur et al. 2011). The extent of potential habitat for the species varies based on its distribution across the NSO range and habitat preferences, and additional details on habitat are presented in appendix F.5.

The Project could affect site persistence of two Survey and Manage vertebrates at more than one site or habitat area in or near the Project area. Vegetation removal in the construction corridor and TEWAs and along roads could result in the removal of trees that support *A. longicaudus* nests or cause injury or mortality to individuals. Construction of the Project would create an open corridor, which would be dominated by early seral vegetation for approximately 30 years. This is a long-term effect that could modify microclimate conditions around populations or individuals adjacent to the corridor during the early seral vegetation phase. The removal of forests and potential nest trees could negatively affect *A. longicaudus* in adjacent areas by removing its habitat and opening the tree canopy, potentially affecting site persistence at the habitat areas even if the entire habitat area is not disturbed. In particular, modification of shading and habitat conditions as a result of the corridor, TEWAs, and roads could make entire habitat areas no longer suitable for the species because of the preference for closed canopy habitats. Activities within the corridor and TEWAs would result in extensive noise disturbance during vegetation clearing, grading, and pipeline installation and could result in *S. nebulosa* nest abandonment and loss of young during the nesting season. No active *S. nebulosa* nest sites were documented in the Project area; therefore, direct effects on the owl (e.g., removal of active nests, injury to owls) are not anticipated. Vegetation removal across the Project area would also result in a long-term loss of habitat that may be suitable for the species. Conversely, if constructed, the construction corridor would also create an early seral plant community suitable for foraging by great grey owls.

The specific effects on sites in and near the Project area vary by species and depend on where the sites are in proximity to the corridor and other activities. Table 4.6.4.3-12 presents a summary of the number of sites (habitat areas for *A. longicaudus*) of each species that would be affected by the Project; additional details for each species are included in appendix F.5.

Both species appear to be more common than previously documented based on new information available from surveys for the Project and/or other sources since these species were listed in the 2001 ROD. The Project would affect site persistence at multiple sites or habitat areas of each species, but the remaining sites in the NSO range would provide a reasonable assurance of species persistence.

TABLE 4.6.4.3-12

Vertebrate Sites Potentially Affected by the Project

Species	Total Affected NFS Sites a/	Affected Sites in NFS Reserves	Remaining Sites on NFS Lands in NSO Range	Remaining Sites on All Lands in NSO Range
Arborimus longicaudus	525 (55) b/	10 (24)	1,469 c/	4,843
Strix nebulosa	1	1	54	171

a/ Affected sites are those that would be directly or indirectly affected by Project activities based on the analyses presented in appendix F.5. Direct effects are those that would take place within the Project area, such as from ground disturbance, vegetation removal, or removal of individuals. Indirect effects are those that would take place outside of the Project area, such as from edge effects or increased open canopy. Using the spatial analysis process described in appendix F.5, these sites may be clipped by or fall outside the Project area, but within the analysis area.
b/ *A. longicaudus* sites are habitat areas (55 sites were converted to 25 habitat areas in the analysis area), as mapped in accordance with the management recommendations for the species (Forest Service and BLM 2001b).
c/ The total of remaining sites is based on site data, not habitat areas. Habitat areas were not produced for the entire regional area, just the analysis area.

Measures incorporated into the Project as design features would be implemented to minimize vegetation disturbance in the Project area and restore areas following construction, which could minimize adverse effects on Survey and Manage vertebrates in and near the Project area. The Forest Service will prepare and implement a monitoring plan that describes specific protocols to monitor affected sites and habitat adjacent to the sites over the long term.

For lands directly affected by the Project, the Forest Service would waive implementation of Management Recommendations for Survey and Manage species through amendments to the land management plans for the National Forests that encompass the Project area. Table 4.6.4.3-13 lists the vertebrate species and the number of affected sites or habitat areas in each National Forest.

TABLE 4.6.4.3-13

Affected Vertebrate Sites by National Forest

	Number of Sites Affected a/		
Species	Umpqua	Rogue River-Siskiyou	Fremont-Winema
Arborimus longicaudus b/	125	—	—
Strix nebulosa	—	0 (1)	—

a/ First number presents sites directly affected (i.e., in Project area), number in parentheses presents sites indirectly affected (i.e., sites wholly in analysis area).
b/ *A. longicaudus* sites are habitat areas, as mapped in accordance with the management recommendations for the species (Forest Service and BLM 2001b).

In conclusion, the Project could affect site persistence of 38 Survey and Manage species at one or more sites or habitat areas in or near the Project area. The remaining sites of 37 of these 38 species, however, would provide a reasonable assurance of these species persistence. The Project as proposed would affect site persistence of the fungi *Sarcodon fuscoindicus* at one or more sites, and the remaining sites may not provide a reasonable assurance of this species persistence. However, above we have recommended that Pacific Connector avoid affecting the *Sarcodon fuscoindicus* site by incorporating a pipeline route variation that avoids this site into the proposed action (see chapter 3). Therefore, the analysis summarized in this section, supported by the information presented in appendix F.5, indicate that construction and operation of the Project would provide a reasonable assurance of persistence of Forest Service Survey and Manage species that would be affected.

4.7 LAND USE

4.7.1 Jordan Cove LNG Terminal

4.7.1.1 Land Ownership and Existing Land Use

Land Ownership

The 197-acre LNG terminal site (figure 4.7-1a) is owned by Fort Chicago Holdings II US LLC (Fort Chicago Holdings), an affiliate of Jordan Cove. As depicted in figure 4.7-1a, the terminal site consists of two parcels that are connected by an access corridor. The two parcels are commonly referred to as the Ingram Yard and South Dunes properties. The associated terminal sites depicted in figures 4.7-1b and 4.7-1c are privately owned lands that Jordan Cove has secured or would secure agreements to use. Ownership of lands required for the Project is summarized in table 4.7.1.1-1. With the exception of BLM land crossed by the industrial wastewater pipeline (within an existing utility corridor), no federal lands would be used for the Jordan Cove Project.

In addition, the COE possesses a 40-acre perpetual easement that coincides with the boundaries of the Ingram Yard loading terminal site. Located between Roseburg Forest Products and Jordan Cove lands, this easement reserves: "*[t]he perpetual right, power, privilege and easement in, upon, over, and across the lands described herein for sand stabilization*." As part of the COE Section 408 process, the COE would need to issue a "consent to easement structures," which would address the COE's rights and how Jordan Cove would provide alternatives should the rights need to be exercised.

TABLE 4.7.1.1-1

Land Ownership of the Jordan Cove Project Area Facilities

Project Facility/Activity	Ownership
Construction and Operation	
LNG Terminal	Fort Chicago Holdings II US LLC
Ingram Yard	
South Dunes Site (including Workforce Housing Facility)	
Access and Utility Corridor	
Slip	
Access Channel	State of Oregon (easement)
Material Offloading Facility (MOF)	State of Oregon (easement)
Industrial Wastewater Pipeline	Designated Trans-Pacific Parkway roadway, railway, & utility corridor (permission from Coos County and an easement from BLM)
Meteorological Station Site	Oregon International Port of Coos Bay
Temporary Construction	
LNG Terminal	Fort Chicago Holdings II US LLC
Ingram Yard Laydown Area	
South Dunes Laydown, Housing, and Parking Area	
Hydraulic Dredge Pipeline	
Trans-Pacific Parkway/U.S. 101 Widening	ODOT and Coos County Rights-of-Way
Roseburg Laydown Site	Roseburg Forest Products Company
Port Laydown Site	Oregon International Port of Coos Bay
APCO Laydown Site	APCO Coos Properties, LLC
Boxcar Hill Staging Area	Oregon Dunes Sand Park, LLC
Myrtlewood Offsite Park & Ride	Private
Temporary Dredge Lines	State of Oregon (easement)
Kentuck Line	State of Oregon (easement)
Environmental Mitigation Areas	
Kentuck Project Site	Fort Chicago Holdings II US LLC and private
Eelgrass Mitigation Site	State of Oregon
Lagoon Site	Oregon International Port of Coos Bay
North Bank Site	Fort Chicago Holdings II US LLC
Panhandle Site	Oregon International Port of Coos Bay

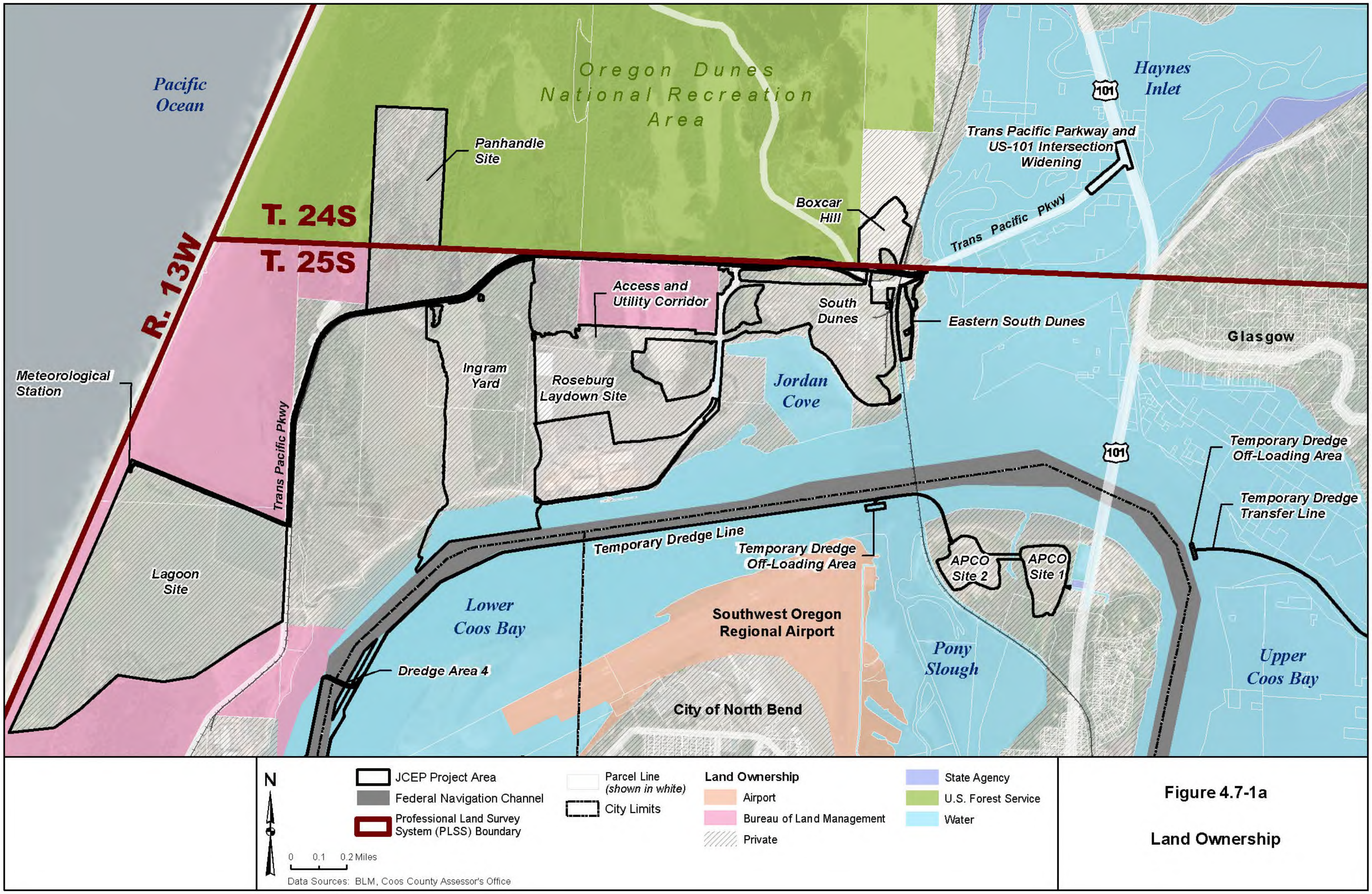


Figure 4.7-1a

Land Ownership

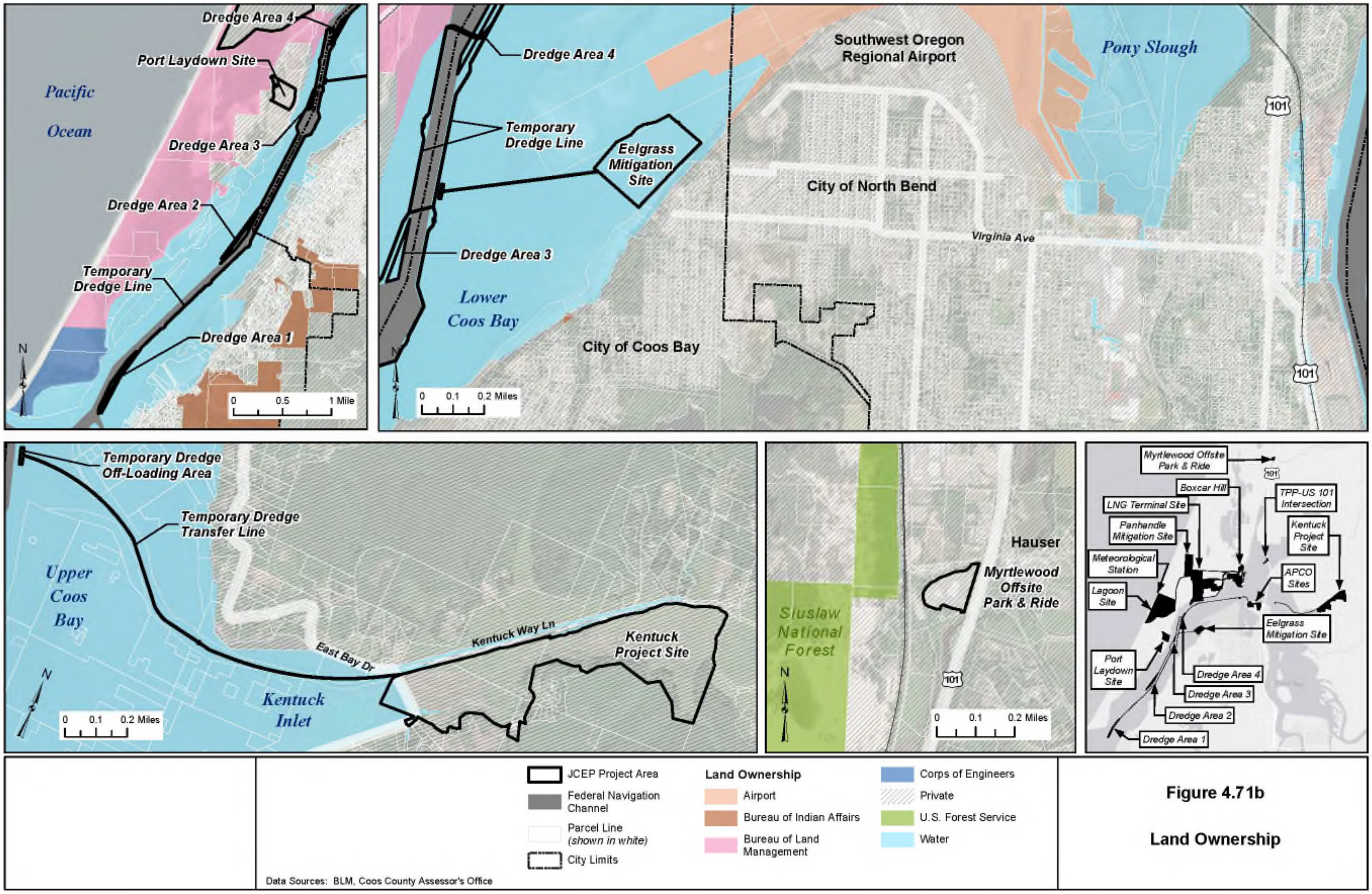
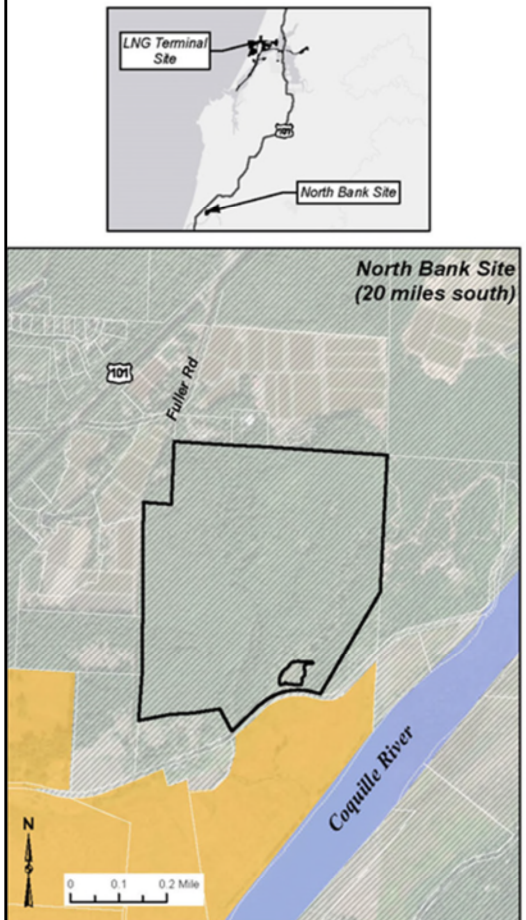


Figure 4.71b

Land Ownership



JCEP Project Area
Parcel Line (shown in white)
Land Ownership
Private
State Agency
U.S. Fish and Wildlife Service

Data Sources: BLM, Coos County Assessor's Office

Figure 4.7-1c

Land Ownership

Existing Land Use

The LNG terminal site consists of a combination of brownfield decommissioned industrial facilities, an existing landfill requiring closure, and open land covered by grasslands, sand, and shrubs, as well as an area of forested dunes (see figures 4.7-2a, 4.7-2b, and 4.7-2c). Portions of the proposed site and the Port Laydown site were previously used for disposal of dredged material.

Land uses affected by construction and operation of the LNG terminal and associated facilities are identified in table 4.7.1.1-2. Lands affected during construction include areas that would be permanently and temporarily altered. Operation-related estimates include only those lands that would be permanently affected. Lands affected by operation would be permanently converted from their former uses to the project facilities identified in table 4.7.1.1-2.

Forest/Woodland

A total of 122 acres of forest/woodland would be affected during construction, with 71 acres permanently affected (table 4.7.1.1-2). More than three-quarters of the forest/woodland affected during construction is located on the terminal site, with an additional 12 percent on the adjacent Roseburg laydown site. Almost all of the permanently affected forest/woodland is located on the terminal site. Permanently affected areas would remain cleared of vegetation for the life of the Project. Areas temporarily disturbed during construction would be restored and, to the extent possible, native plant species would be used for stabilization and to prevent erosion of the disturbed areas. Impacts on vegetation are discussed in more detail in section 4.4.

Industrial/Commercial

Industrial/commercial lands that would be used during construction include parts of the terminal site and also the Roseburg Laydown Site, Port Laydown Site, and off-site park and ride sites. With the exception of the industrial/commercial lands that would become part of the terminal site, almost all impacts on existing industrial/commercial lands would be temporary.

Open Land

Open land disturbed during construction would primarily be located on the terminal site (68 percent) and the APCO Sites 1 and 2 (14 percent) (table 4.7.1.1-2). Open land on the terminal site includes land covered by grasslands, sand, and shrubs. Approximately 73 of the 129 acres of open land that would be disturbed on the terminal site during construction would be permanently affected and converted to site uses. The remaining acres would be restored following construction. Although no permanent facilities are proposed for the APCO Sites 1 and 2, the sites would be used for dredge disposal, with disposal expected to raise site elevations above existing grade by between 37 and 49 feet over a 30 year planning horizon.

In addition to the acres of open land identified in table 4.7.1.1-2, approximately 104 acres of the Kentuck project site would be converted to a wide-ranging habitat of mudflats, salt marsh, willowed scrub/shrubs, and fish structures to provide mitigation for both the Jordan Cove and Pacific Connector projects. Formerly a golf course, the Kentuck project site is currently used for pasture.

Open Water

An estimated 77 acres of open water would be affected during construction, with 28 acres permanently affected (table 4.7.1.1-2). Open water would primarily be disturbed during construction as part of activities related to the access channel (40 percent) and the four dredge areas (40 percent). Impacts related to construction of the access channel that would connect the terminal to the Federal Navigation Channel would be permanent.

Other

The industrial wastewater pipeline would be located entirely within an existing roadway, railway, and utility corridor. Installation would disturb approximately 0.2 acre of the existing corridor, with no permanent effects anticipated.

Residential

No residential lands would be affected by construction and operation of the Project (table 4.7.1.1-2). However, mitigation activities associated with the Kentuck Project site would affect an estimated 7.4 acres currently designated for residential use. Impacts on existing residences are discussed in section 4.7.1.3.

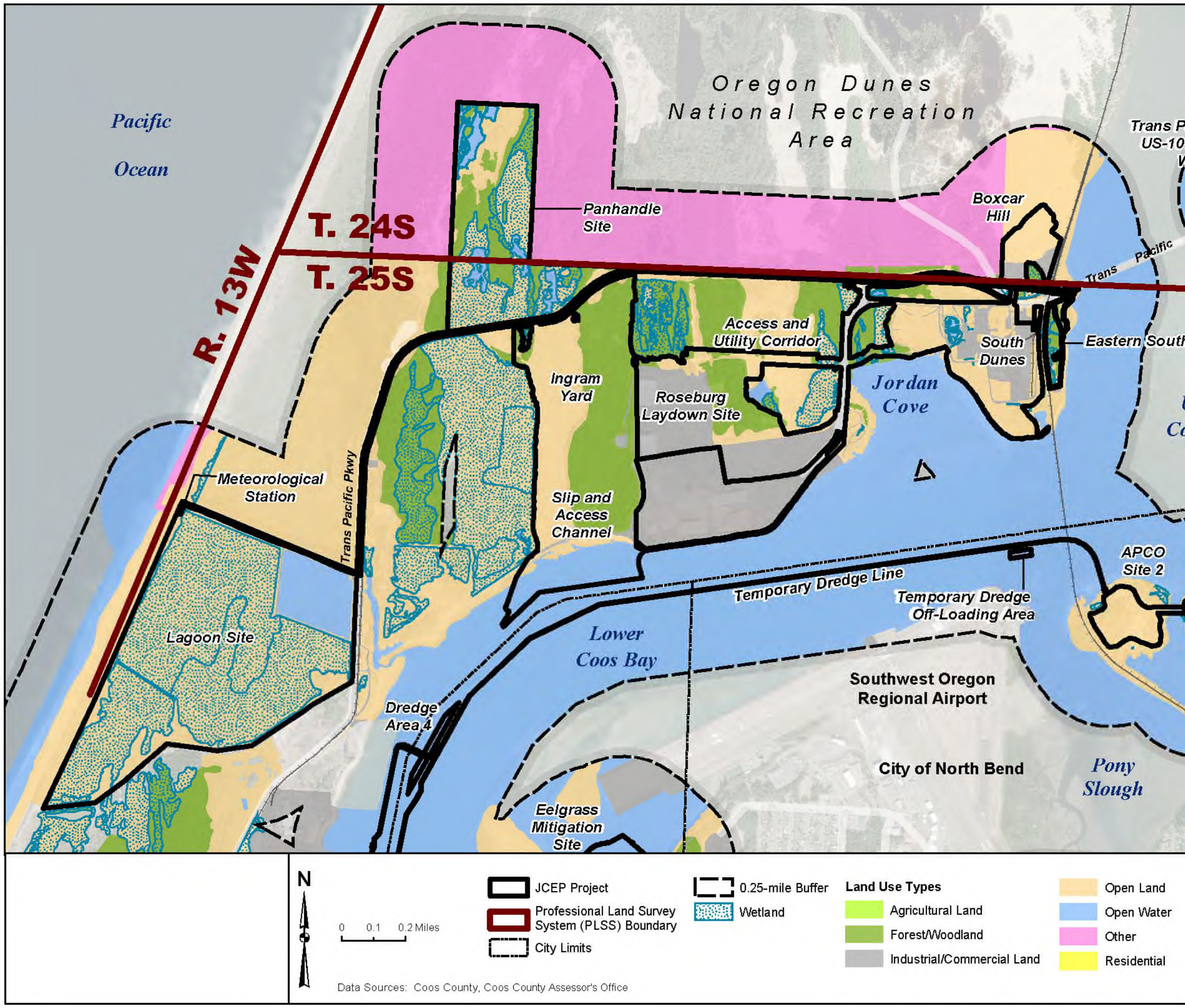


Figure 4.7-2a

Land Use Types within 0.25 Mile

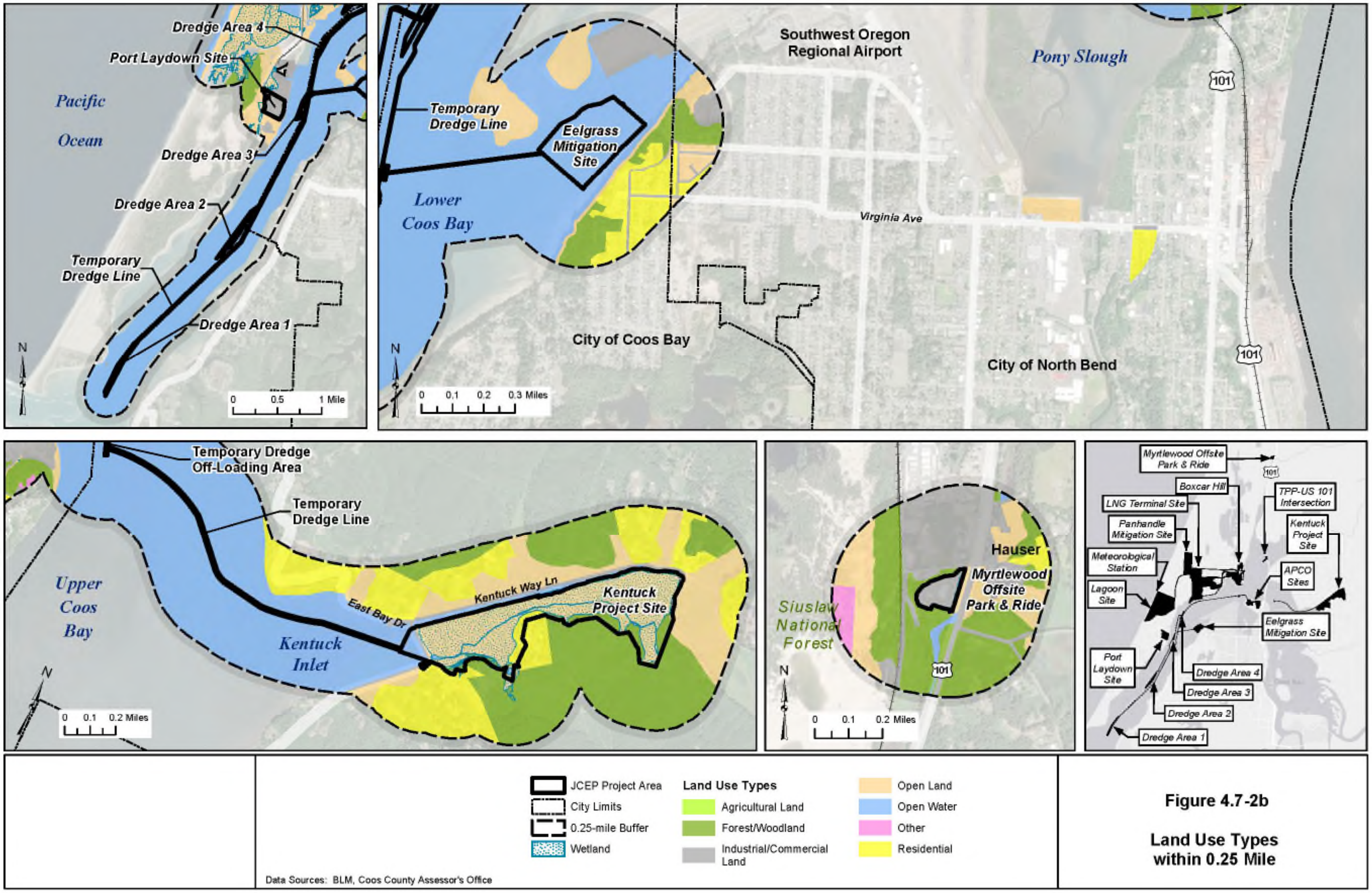


Figure 4.7-2b

Land Use Types within 0.25 Mile

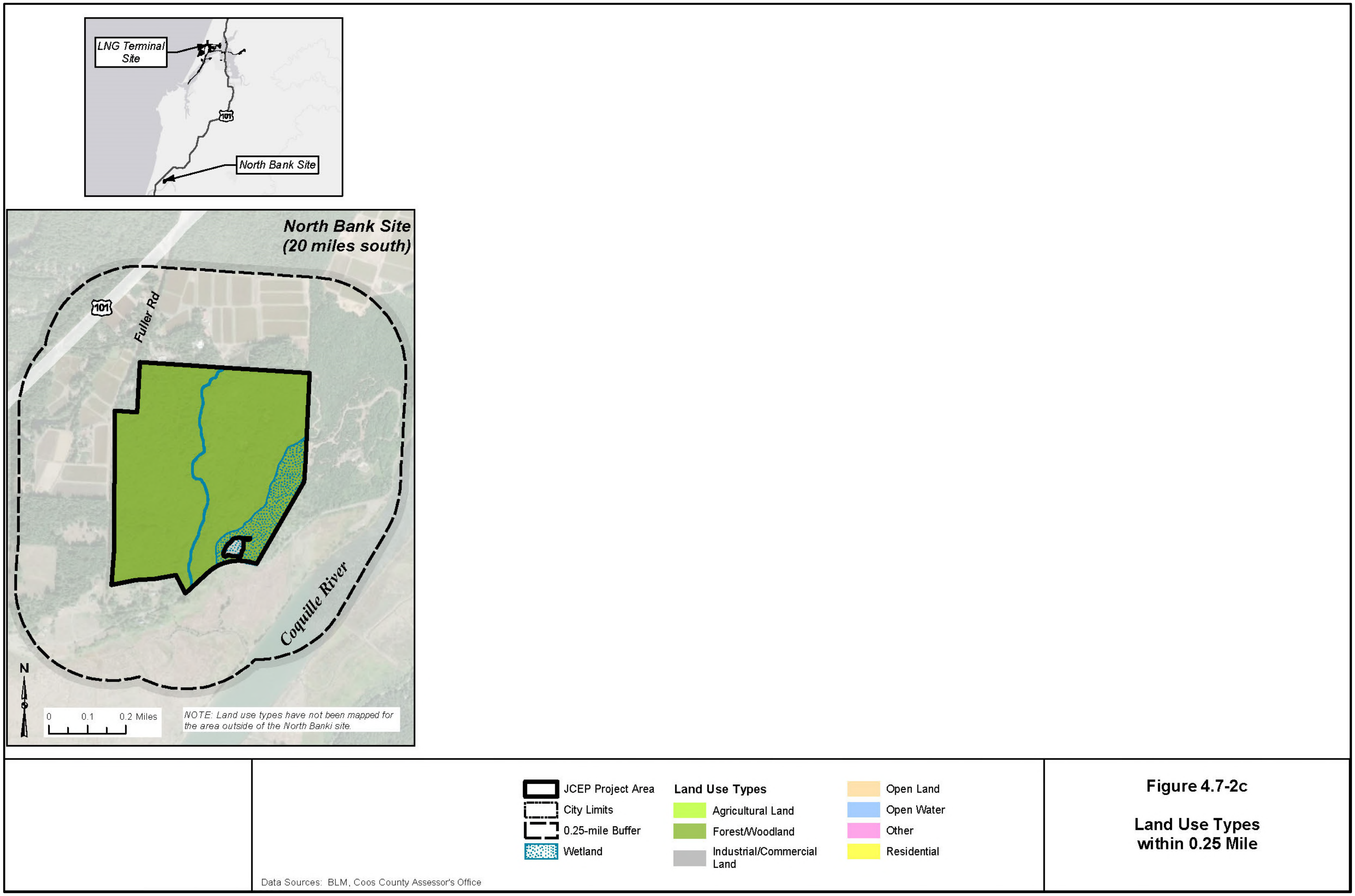


Figure 4.7-2c

Land Use Types within 0.25 Mile

TABLE 4.7.1.1-2

Land Uses Affected by Construction and Operation of Aboveground Jordan Cove Project Area Facilities (in acres)[a/]

Project Facility/Activity	Forest/Woodland		Industrial/Commercial		Open Land		Open Water		Other		Residential	
	Const	Oper	Const	Oper	Const	Oper	Const	Oper	Const	Oper	Const	Oper
LNG Terminal Site												
Ingram Yard	72.9	45.9	4.3	2.8	40.8	34.0	0.0	0.0	0.0	0.0	0.0	0.0
South Dunes	5.7	2.5	35.0	13.8	52.2	8.7	0.8	5.7	0.0	0.0	0.0	0.0
Access and Utility Corridor, Fire Department	9.7	7.0	4.1	4.0	12.8	9.9	0.0	0.0	0.0	0.0	0.0	0.0
Hydraulic Dredge Pipeline	0.1	0.0	6.2	0.0	0.7	0.0	1.0	0.0	0.0	0.0	0.0	0.0
Slip	16.4	16.4	1.1	1.1	22.7	20.4	0.0	0.0	0.0	0.0	0.0	0.0
Industrial Wastewater Pipeline	0.3	0.0	6.7	0.0	8.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Access Channel	0.0	0.0	0.3	0.2	4.1	4.1	29.1	27.0	0.0	0.0	0.0	0.0
Material Offloading Facility (MOF)	0.4	0.4	1.0	0.9	1.2	1.2	0.6	0.5	0.0	0.0	0.0	0.0
Trans Pacific Parkway/US-101 Widening	0.0	0.0	3.7	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0
Meteorological Station and Access Road	0.0	0.0	0.6	<0.1	0.9	<0.1	0.0	0.0	0.0	0.0	0.0	0.0
Roseburg Laydown Site	16.2	0.0	60.6	0.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Port Laydown Site	0.0	0.0	33.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
APCO Sites 1 and 2	0.0	0.0	12.2	0.0	27.2	0.4	0.3	0.0	0.0	0.0	0.0	0.0
Off-Loading Area and Temporary Dredge Transfer Line for APCO Site 2	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0
Boxcar Hill Site	0.3	0.0	5.9	0.0	13.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Myrtlewood Offsite Park & Ride	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Off-Loading Area and Temporary Dredge Transfer Line for Kentuck Project Site	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0
Off-Loading Area and Temporary Dredge Line for Eelgrass Mitigation Site	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0
Dredge Areas	0.0	0.0	0.0	0.0	0.0	0.0	26.5	0.0	0.0	0.0	0.0	0.0
Temporary Dredge Line	0.0	0.0	0.0	0.0	<0.1	0.0	13.1	0.0	0.0	0.0	0.0	0.0
Total	**122.0**	**72.2**	**181.3**	**22.8**	**190.2**	**78.7**	**76.5**	**27.7**	**0.2**	**0.0**	**0.0**	**0.0**

a/ Note that columns may not sum correctly due to rounding.
b/ Const = construction
c/ Oper = operation

4.7.1.2 Coastal Zone Management

The Jordan Cove LNG terminal would be located within the Oregon coastal zone. The coastal zone is formally defined as extending from the Washington border on the north to the California border on the south; seaward to the extent of state jurisdiction as recognized by federal law (i.e., the territorial sea, extending 3 nautical miles offshore); and inland to the crest of the Oregon Coast Range. The Oregon Coastal Management Program of the ODLCD coordinates management of the State's coastal zone and reviews project-specific compliance and consistency with the CZMA. Procedures for ODLCD coastal zone reviews are specified in federal (15 CFR 930) and state regulations (OAR 660-035). Jordan Cove and Pacific Connector are currently in the process of filing their Coastal Zone Management Act (CZMA) application with the State. The Commission cannot authorize the start of construction until a consistency determination has been provided by the Oregon Coastal Management Program. Therefore, **we recommend that**:

- **Jordan Cove and Pacific Connector <u>should not begin construction</u> of the Project <u>until</u> they file with the Secretary a copy of the determination of consistency with the Coastal Zone Management Plan issued by the State of Oregon.**

4.7.1.3 Existing Residences, Commercial Buildings, and Planned Developments

The nearest residential structure to the LNG terminal site is about 1.1 miles to the southeast. There are no residences within 50 feet of any of the Jordan Cove LNG Project area facilities or the navigation route, with the exception of one residence located approximately 20 feet from the Kentuck project site and another located approximately 30 feet from the North Bank site. Neither of these residences are expected to be affected by Project-related construction or operations. All structures within 0.25 mile of the Project facilities are shown in figure 4.7-3a, figure 4.7-3b, and figure 4.7-3c. The following structures are located within 50 feet of the Jordan Cove facilities:

- one Coos Bay-North Bend Water Board (CBNBWB) facility approximately 50 feet from the Trans-Pacific Parkway work area;
- two structures within the construction work area for the Roseburg Laydown site;
- three structures within the construction work area for the Boxcar Hill site: one business and one shed that would not be affected, and one shed that would be removed; and
- one structure, the Myrtlewood Factory and Gift Shop, within the parking area that would be used as the Myrtlewood Off-site Park & Ride.

With the exception of the shed that would be removed from the construction work area for the Boxcar Hill site, none of these structures would be affected and no mitigation is proposed.

There are currently no planned residential or commercial developments identified within 0.25 mile of the Jordan Cove Project site. However, the Coos County Airport District is planning to extend one of the runways at the Southwest Oregon Regional Airport, which is approximately 0.55 mile south of the LNG terminal site. According to the October 2013 Southwest Oregon Regional Airport Master Plan Update (Coos County Airport District 2013), the Airport Layout Plan and the implementation plan included a proposed 400-foot-long extension of Runway 4-22; however, current plans do not identify this large of an extension. Current proposals are limited to cordoning off the northeast corner of the existing runway to gain land acreage for safety purposes to meet FAA regulations (Krug 2018).

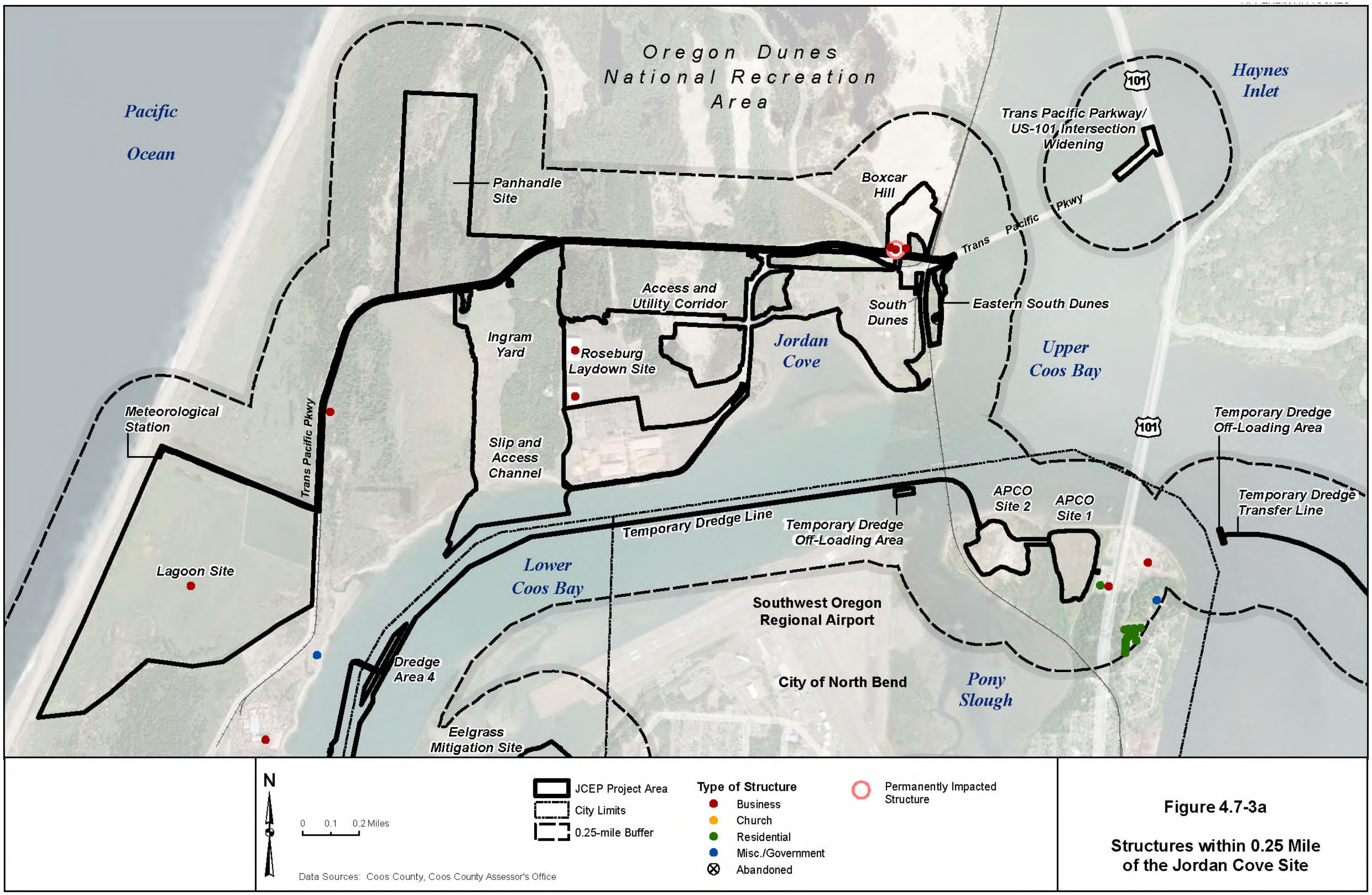


Figure 4.7-3a

Structures within 0.25 Mile of the Jordan Cove Site

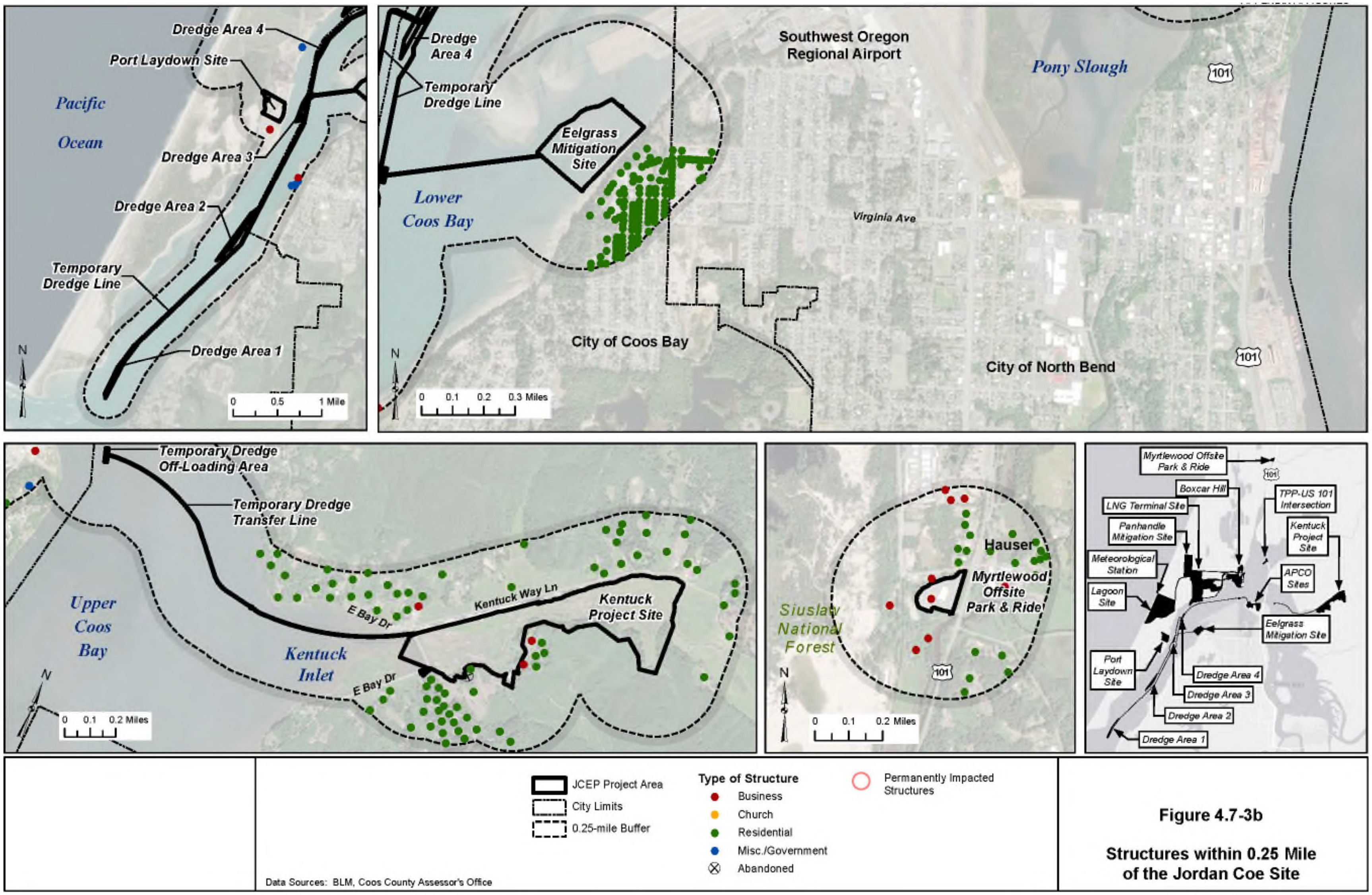
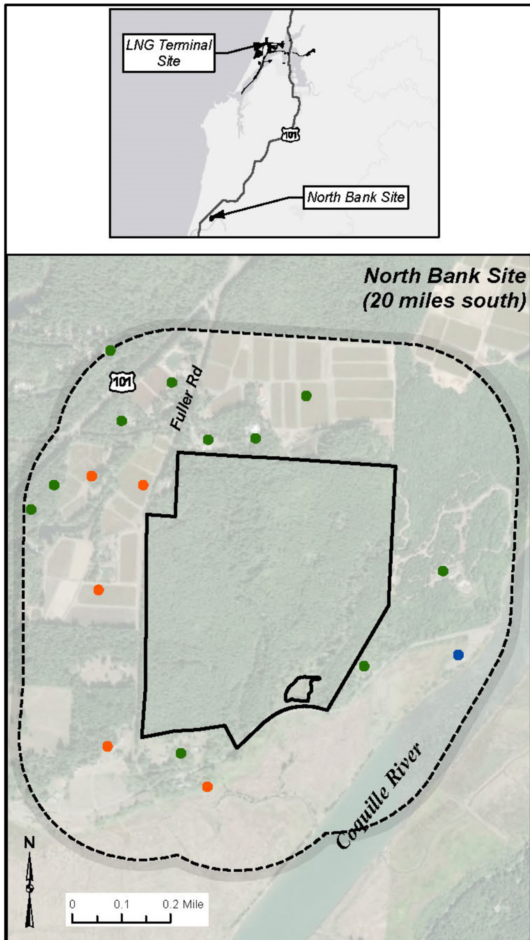


Figure 4.7-3b

Structures within 0.25 Mile of the Jordan Coe Site



JCEP Project Area

Type of Structure

- Farm Building
- Residential
- Misc./Government

Data Sources: BLM, Coos County Assessor's Office

Figure 4.7-3c

Structures within 0.25 Mile of the Jordan Cove Site

The City of North Bend has indicated that it expects to consider adoption of a proposed North Point Area Master Plan for the North Point District in the near future. The North Point District consists of approximately 80 acres made up of the northernmost parcels of North Point. The District is located southeast across Coos Bay from the LNG terminal site, and east across Pont Slough from the airport. The City of North Bend is also proposing to redevelop Simpson Park along Highway 101 to include a new Visitor Information Center and Parks Department facilities. The closest Project components to these areas would be the APCO sites. Advanced Health has demolished the McAuley Hospital in downtown Coos Bay, approximately 3 miles south of the proposed LNG terminal site, and is redeveloping the site to provide housing for Oregon Health and Science University medical students (Johnson 2018). Construction and operation of the LNG terminal is not expected to affect these plans or future uses.

4.7.1.4 Timber

The dune areas at the LNG terminal site currently contain non-merchantable timber. Before mobilizing earth-moving equipment, the trees would be felled and selectively processed for commercial timber. Scrub and stumps from across the site would be processed into mulch for use during construction operations.

4.7.2 Pacific Connector Pipeline and Associated Facilities

4.7.2.1 Land Ownership

The pipeline would cross public and private lands. Approximately 64 percent of the land crossed is privately owned, 34 percent is federal land and 2 percent is state lands (table 4.7.2.1-1). No tribal-owned lands or county lands would be crossed. Federally managed lands are discussed below.

TABLE 4.7.2.1-1

Land Crossed by the Pacific Connector Pipeline by Ownership

	Federal Land		State Land		Private Land		
County	**Miles**	**Percent of Overall Total**	**Miles**	**Percent of Overall Total**	**Miles**	**Percent of Overall Total**	**Total**
Coos	17.1	7.5	3.4	1.5	26.3	11.5	**46.8**
Douglas	21.3	9.3	0.0	0.0	43.6	19.0	**64.9**
Jackson	30.1	13.2	0.2	0.1	25.6	11.2	**56.0**
Klamath	9.2	4.0	0.2	0.1	51.9	22.7	**61.4**
Total	**77.7**	**33.9**	**3.9**	**1.7**	**147.5**	**64.4**	**229.1**

4.7.2.2 Existing Land Use

Land Use

Pipeline

The pipeline would cross a variety of land uses including forest land (62 percent), rangeland (14 percent), agricultural lands (14 percent), and developed land (8 percent) (table 4.7.2.2-1).

TABLE 4.7.2.2-1

Land Uses Crossed by the Pacific Connector Pipeline ROW

U.S. Geological Survey Land Use Classification			Project Total (miles)	Percent of Total
Developed Land	Residential		0.3	0.1
	Industrial		0.8	0.3
	Transportation/Communication		16.3	7.1
	Other Developed Land		1.1	0.5
		Subtotal	***18.5***	***8.1***
Agricultural Land	Cropland and Pasture		31.2	13.6
	Orchards, Groves, Vineyards, Nurseries		0.1	0.0
		Subtotal	***31.3***	***13.7***
Rangeland	Herbaceous Rangeland		8.9	3.9
	Shrub and Brush Rangeland		17.3	7.5
	Mixed Rangeland		8.0	3.5
		Subtotal	***34.2***	***14.9***
Forest Land	Deciduous Forest Land		4.4	1.9
	Evergreen Forest Land		46.2	20.2
	Clearcut Forest Land		9.6	4.2
	Regenerating Forest Land		49.2	21.5
	Mixed Forest Land		32.3	14.2
		Subtotal	***141.8***	***62.0***
Water	Streams		0.7	0.3
	Ditches and Canals		0.2	0.1
	Bays and Estuaries		2.4	1.0
		Subtotal	***3.3***	***1.4***
Other	Beaches		<0.1	<0.01
	Mines, Quarries, Gravel Pits		<0.1	0.01
		Subtotal	***<0.1***	***0.01***
		Project Total	**229.1**	**100**

Note: Rows and columns may not sum correctly due to rounding. Miles are rounded to the nearest tenth of a mile (values below 0.1 are shown as "<0.1").

A summary of acres affected by the construction and operation of the Pacific Connector pipeline is presented in table 4.7.2.2-2.

Developed Land

Pipeline construction would affect an estimated 721 acres of developed lands, mainly consisting of existing industrial land (49 percent; 350 acres) and transportation/communication corridors (44 percent; 316 acres) (table 4.7.2.2-2). The majority of the construction-related disturbance on existing industrial land (331 acres) would be related to temporary pipe storage. An estimated 111 developed acres would be permanently disturbed, with more than 91 percent of this disturbance related to the permanent ROW. The majority (86 percent) of the ROW disturbance would be located in existing transportation/communication corridors. Other developed areas disturbed during construction would be allowed to return to their existing uses.

TABLE 4.7.2.2-2

Acres of Land Affected by Construction and Operation of the Pacific Connector Pipeline Project

Project Feature	Residential	Commercial	Industrial	Transportation/ Communication	Other Developed Land	Cropland/Pastureland	Orchards, Groves, Vineyards, Nurseries	Herbaceous Rangeland	Shrub/Brush Rangeland	Mixed Rangeland	Deciduous Forest Land	Evergreen Forest Land	Mixed Forest Land	Clearcut Forest Land	Regenerating Forest	Streams	Ditches/Canals	Bays and Estuaries	Beaches	Mines, Quarries, Gravel Pits	Total
Construction Disturbance a/																					
Construction ROW	3.7	0.4	6.0	158.9	12.0	358.9	1.4	101.2	194.7	88.1	52.0	538.1	378.8	113.8	564.3	5.3	3.0	0.0	1.2	0.2	2,582.0
Klamath CS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.1
Temporary Extra Work Areas	3.1	0.1	12.8	66.2	16.2	173.8	0.6	39.8	73.2	59.0	16.3	103.8	101.5	29.9	192.8	3.8	1.1	0.1	6.5	22.2	922.6
Uncleared Storage Areas	0.1	0.0	0.0	19.2	0.0	0.3	0.0	3.1	10.7	2.9	5.8	159.5	215.9	66.7	191.9	0.6	0.0	0.0	0.0	0.0	676.4
Rock Source/Disposal	0.0	0.0	0.0	2.2	0.0	2.8	0.0	1.7	0.0	0.0	0.0	2.6	0.0	0.0	5.9	0.0	0.0	0.0	0.0	26.1	41.2
Contractor and Pipe Storage Yards	4.1	0.8	331.3	47.1	14.3	14.4	0.0	130.2	0.0	127.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	4.6	0.0	0.0	674.2
Access Roads (TARs/PARs) b/	0.1	0.0	0.0	22.5	0.0	2.4	0.0	0.9	0.4	1.0	0.1	0.4	0.1	0.3	0.2	0.0	0.0	0.0	0.0	0.0	28.5
Total	**11.1**	**1.4**	**350.1**	**316.0**	**42.5**	**552.4**	**2.0**	**276.9**	**296.2**	**278.2**	**74.3**	**804.4**	**696.4**	**210.8**	**955.2**	**9.7**	**4.1**	**4.6**	**7.6**	**48.5**	**4,942.1**
Operation Disturbance																					
Permanent Easement c/	2.0	0.2	4.7	94.7	6.3	188.5	0.7	53.7	104.5	47.8	26.8	279.4	197.6	60.0	299.1	3.1	1.4	2.9	0.1	0.1	1,373.7
Aboveground Facilities d/	0.0	0.0	1.7	1.7	0.0	0.4	0.0	0.5	17.4	0.4	0.0	0.0	0.2	0.1	0.3	0.0	0.0	0.0	0.0	0.0	22.8
Permanent Access Roads	0.0	0.0	0.0	0.1	0.0	0.3	0.0	0.9	0.2	0.5	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2
Total	**2.0**	**0.2**	**6.4**	**96.5**	**6.3**	**189.3**	**0.7**	**55.0**	**122.2**	**48.8**	**26.8**	**279.5**	**197.9**	**60.1**	**299.5**	**3.1**	**1.4**	**2.9**	**0.1**	**0.1**	**1,398.6**
30-Foot Maintenance Corridor	1.1	0.1	2.8	57.9	3.8	113.3	0.4	32.2	62.8	28.4	16.0	167.8	117.6	35.5	178.4	1.7	0.8	0.0	0.1	0.1	820.6

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown a "<1").
a/ Construction disturbance associated with the aboveground facilities is included in the pipeline construction ROW effects.
b/ Portions of some of the PARs are located within the construction ROW and, therefore, there is some duplication in the acreage calculations.
c/ The permanent easement is located within the disturbed acreage of the construction ROW. It is not an addition to the construction effects.
d/ Operation-related disturbance from aboveground facilities is summarized by facility in table 4.7.2.2-3.

CS = communication station; PAR = permanent access road; TAR = temporary access road

Agricultural Land

About 552 acres of cropland and pastureland would be temporarily affected by pipeline construction, with approximately 2 acres of orchards, groves, vineyards, and nurseries also expected to be affected (table 4.7.2.2-2). The majority of this disturbance would be associated with the construction ROW (65 percent) and TEWAs (31 percent). Grazing and other agricultural uses would not be allowed in the affected areas during construction. With the exception of the permanent ROW in orchards, agricultural lands disturbed during construction would be restored and returned to their original condition. Shallow-rooted crops and pasture grasses may be grown across the entire 50-foot-wide permanent easement. The planting of deep-rooted crops, such as orchards and vineyards, would not be permitted directly over the pipeline. Pacific Connector would negotiate with landowners and provide compensation for crop losses or orchards taken out of use as a result of pipeline construction. Landowners could select seed mixes or crops to be planted over the ROW in agricultural crop land or pastures.

To lessen effects on agricultural lands, Pacific Connector would segregate topsoil and repair any damaged irrigation systems or drain tiles. The segregation of topsoil is discussed in section 4.2. In addition, in agricultural areas the pipeline would have a minimum depth cover of 5 feet over the top of the pipe, where possible, to avoid operational effects. The largest proportion of agricultural lands that would be crossed by the pipeline are irrigated cropland in Klamath County.

Rangeland

Pipeline construction would affect an estimated 851 acres of rangeland (table 4.7.2.2-2). Temporary disturbance would result from the construction ROW (45 percent), TEWAs (20 percent), and pipe yards (31 percent). During construction, fences would be temporarily removed and affected lands would be unavailable for grazing. To reduce effects on rangelands (and pasture), Pacific Connector would erect temporary fences and gates to landowner specifications. Fences that are cut during construction would be braced and secured to prevent slack wires. If construction activities break or destroy a natural barrier used for livestock control, gaps would be temporarily fenced to prevent passage of livestock. After construction, fences, gates, and cattle guards (including any natural barriers broken) would be restored to their original state as soon as practical. Pacific Connector would contact the owners of fences prior to disturbing them and provide landowners with an opportunity to remove livestock from the construction ROW. Hayfields and pastures would not be cleared except in areas directly over the trench or where grading would be required to create a level working surface. Potential effects on grazing allotments on federal lands are discussed below in section 4.7.3.

Forest Land

Excluding areas along the pipeline route that have been clear cut recently and storage areas where trees would not be cleared, about 1,957 acres of upland forest would need to be cleared during pipeline construction activities. Less than one acre of forest would be permanently removed for access roads. During operation of the pipeline, a 30-foot-wide corridor centered on the pipeline would be kept in an herbaceous state, resulting in a permanent loss of about 804 acres of forest land. Outside of that 30-foot-wide corridor, forest would be restored within the remainder of the construction ROW. Pacific Connector would also follow the procedures for cutting forest along all lands crossed by its pipeline as outlined in the *Right-of-Way Clearing Plan for Federal Lands*[145] (note that although the title of the plan specifies "federal lands," the plan contains measures that would be applied on all lands). However, even with restoration, this would be a long-term to permanent effect, as it takes many years for trees to mature.

Approximately 65 miles of commercial private forestlands would be affected by the pipeline. Forest operations are not expected to be significantly altered, nor would the costs of forestry operations be expected to increase due to the presence of the pipeline; however, the Coquille Tribe raised concerned regarding the ability of operators to cross the pipeline. Surrounding forestry operators would be able to cross the pipeline ROW with heavy hauling and logging equipment, provided they coordinate those crossings with Pacific Connector and safety precautions are implemented to protect the integrity of the pipeline. While the requirement to coordinate with the pipeline operator would be an inconvenience for some forest operators, it does not constitute a significant change in forestry operations because the operator would be able to continue to cross the pipeline area in order to access or haul timber. Additionally, timber operators generally develop and carefully consider future harvesting and access plans. The need to consult with the pipeline operator if those plans include future crossings of the pipeline ROW would not represent a significant imposition or significant change in normal planning activities. The coordination requirement would also not significantly increase the cost of conducting forestry operations. In some situations, however, the presence of a pipeline along a ridge would require a change in log landing locations, which would affect timber operations. See additional discussion of potential effect on timber operations, including impacts on State Forest lands, in section 4.7.2.4.

Other

Other land uses that would be affected during construction include an estimated 8 acres of beaches and 49 acres of strip mines, quarries, and gravel pits (table 4.7.2.2-2). The affected beaches would primarily be used for TEWAs. The affected strip mines, quarries, and gravel pits would be used for TEWAs (46 percent) and rock source/disposal (54 percent). Approximately 0.1 acre of beach and 0.1 acre of strip mines, quarries, and gravel pits would be permanently affected.

<u>Aboveground Facilities</u>

Table 4.7.2.2-3 identifies the land uses that would be permanently affected by operation of the aboveground facilities.

TABLE 4.7.2.2-3

Acres Affected by Operation of Pacific Connector Proposed Aboveground Facilities

Facility a/	MP	Acres Disturbed During Construction b/	Land Use	Jurisdiction
Jordan Cove Meter Station, MLV #1, and Receiver c/, d/, e/	0.00	1.7	Industrial	Private
MLV #2 (Boone Creek Road)	15.1	0.1	Mixed Forest Land, Transportation	Private
MLV #3 (Myrtle Point Sitkum Road)	29.5	0.1	Cropland Pasture	Private
MLV #4 (Deep Creek Spur) e/	48.6	0.1	Mixed Forest Land	BLM
MLV #5 (South of Olalla Creek)	59.6	0.1	Cropland Pasture	Private
MLV #6, Launcher/Receiver e/	71.5	0.5	Herbaceous Rangeland	Private

[145] Included as Appendix U of Pacific Connector's POD filed on January 23, 2018.

TABLE 4.7.2.2-3 (continued)

Acres Affected by Operation of Pacific Connector Proposed Aboveground Facilities

Facility a/	MP	Acres Disturbed During Construction b/	Land Use	Jurisdiction
MLV #7 (Pack Saddle Road)	80.0	0.1	Mixed Forest Land	BLM
MLV #8 (Hwy 227)	94.7	0.1	Mixed Rangeland	Private
MLV #9 (BLM Road 33-2-12/Dead Horse Creek)	113.7	0.1	Evergreen Forest Land, Clearcut Forest Land	Private
AMLV #10 (Shady Cove) e/	122.2	0.1	Mixed Rangeland	Private
AMLV #11, Launcher/Receiver (Butte Falls) 5	132.5	0.3	Mixed Rangeland	Private
MLV #12 (Heppsie Mtn Quarry Spur)	150.7	0.1	Shrub and Brush Rangeland	BLM
MLV #13 (Clover Creek Road)	169.5	0.1	Regenerating Evergreen Forest	Private
MLV #14 and Launcher/Receiver Site	187.4	0.4	Regenerating Evergreen Forest Land, Shrub and Brush Rangeland	Private
AMLV #15 (Klamath River) e/	196.5	0.1	Cropland Pasture	Private
AMLV #16 (Hill Road) e/	211.6	0.1	Cropland Pasture	Private
Klamath Compressor Station, Klamath-Beaver and Klamath-Eagle Meter Stations, MLV #17, Launcher & Communications Tower e/	228.8	17.1	Shrub and Brush Rangeland	Private
Total		**21.1**		
Communication Sites				
Blue Ridge Communication Site – Coos County f/	~ 20	0.2	Transportation, Communications, and Utilities/Commercial	BLM
Signal Tree Communication Site – Coos County f/	~45	0.2		BLM
Sheep Hill Communication Site – Douglas County f/	~70	0.2		Private
Harness Mountain Communication Site – Douglas County g/	~75	0.0		Private
Starvout Communication Site – Jackson County f/	~115	0.2		Private
Flounce Rock Communication Site – Jackson County f/	~123	0.2		BLM
Robinson Butte Communication Site – Jackson County f/	~159	0.2		Forest Service
Stukel Mountain Communication Site – Klamath County f/	~209	0.2		BLM
	Total	**1.6**		
	Grand Total	**22.8**		

Note: Rows and columns may not sum correctly due to rounding. Miles are rounded to the nearest tenth of a mile.
a/ MLVs denoted as AMLV are automated valves and would include a 40-foot-tall communication tower.
b/ Temporary construction disturbance associated with the aboveground facilities is included within the Pipeline construction ROW, and is not double counted in total Pipeline disturbance estimates.
c/ The 17 mainline block valves (MLVs) would be located within areas disturbed by the construction right-of way or within associated aboveground facility footprints (*i.e.*, meter stations and the compressor station); however, the permanent operation acres provided would remain as permanent disturbance associated with these graded, graveled and fenced facilities.
d/ The Jordan Cove meter station would be located entirely within the proposed LNG terminal.
e/ Communication facilities are included in the disturbed areas associated with the meter station, block valves and compressor station.
f/ Communication facilities would utilize existing towers and equipment buildings, where space is available for lease, with no associated disturbance. If construction of new facilities is required, Pacific Connector would obtain an approximate 100 x 100 foot (0.23 acre) area in the immediate area of the existing communication tower facilities.
g/ The Harness Mountain Communication Tower is an existing communication facility, with no new disturbance is required.

4.7.2.3 Coastal Zone Management

Coos County and a portion of Douglas County, up to the crest of the Coastal Range, are within Oregon's coastal zone. Therefore, Pacific Connector would need to obtain a finding from the ODLCD that the portion of its pipeline within the coastal zone (MPs 1.5 R to 53) is consistent with the CZMA. This consistency determination would be made for both the pipeline portion as well as the LNG portion of the Project. Coastal zone management is discussed further in section 4.7.1.2.

4.7.2.4 Existing Residences, Commercial Buildings, and Planned Developments

Existing Residences

No commercial buildings or residences are located within 50 feet of the proposed pipeline or aboveground facility workspaces. The edge of the construction work area for the pipeline would be located within 50 feet of seven residences (see table 4.7.2.4-1). Two of these residences are abandoned and would be removed as part of the Project. For the residences within 50 feet of construction work areas, Pacific Connector developed site-specific drawings depicting the temporary and permanent ROWs and has noted special construction techniques and mitigation measures (see appendix J). We are seeking any additional comments from the affected landowners on these site-specific drawings.

TABLE 4.7.2.4-1

Residences within 50 Feet of the Construction ROW or Temporary Extra Work Areas

MP	Distance from Pipeline (feet)	Distance from Edge of Construction Work Area (feet)	Number of Residences
49.7	106	41	1
56.9 a/	0	0	1
57.5	57	17	1
65.6	112	47	1
65.9	92	15	1
199.7	161	33	1
228.8 a/	1,680	0	1

a/ Abandoned residences at MP 56.9 and 228.8 would be removed prior to construction.

Within 50 feet of residences, the edge of the construction work area would be fenced for a distance of 100 feet on either side to ensure that construction equipment and materials, including the spoil pile, remain within the construction work area. Fencing would be maintained, at a minimum, throughout the open trench phases of pipeline installation. Where possible, the width of the construction ROW would be reduced near residences, and TEWAs would be located as far away from residences as practical. Pacific Connector would also limit the period of time the trench remains open prior to backfilling in residential areas.

Pacific Connector would implement numerous measures to reduce effects on residential properties including:

- Landowners would be notified at least 45 days prior to construction, and Pacific Connector would implement a Landowner Complaint Resolution Procedure. If a landowner is not satisfied with Pacific Connector's response to a complaint, they would be directed to call or email FERC's Dispute Resolution Division for further assistance.
- Pacific Connector would install orange safety fence between the construction ROW and the residence.
- Pacific Connector would attempt to schedule activities during normal working hours. Pacific Connector does not currently plan to work on Sundays; however, certain activities, such as waterbody crossing construction and hydrotesting, may require a 24-hour work schedule.
- Pacific Connector would comply with all local noise ordinances.

- Access and traffic flows would be maintained during construction activities through residential areas, particularly for emergency vehicles. Access to residences would be maintained at all times.
- Dust minimization techniques such as watering would be used on-site and all litter and debris would be removed daily from the construction site.
- Mature trees, vegetation screens, and landscaping would be preserved to the extent possible. Landowners would be compensated for the removal of any trees.
- Immediately after backfilling the trench, all lawn areas and landscaping within the construction work area would be restored.
- Pacific Connector would provide alternative sewer facilities if septic system is disturbed during construction. Pacific Connector would repair and restore septic systems affected by construction.
- Pacific Connector would compensate landowners for damage to homes should the home be damaged by pipeline construction.

During the scoping process, many landowners expressed concern about the pipeline and requested that the pipeline be moved off their property. Section 3.4 evaluates route alternatives to lessen effects on specific tracts where landowners raised routing concerns. Other comments expressed concern about effects on water wells, utility lines, septic systems, slope erosion, farming operations, loss of future development opportunities, and effects on environmental resources. As appropriate, these comments have been addressed throughout this analysis.

Concerns were raised about the location of the pipeline relative to the Woods Valley Airport, a licensed airport located near Trail, Oregon. As currently proposed, the pipeline would cross the runway. Pacific Connector outlined the measures that it proposes to implement to reduce impacts on the airport in a filing with FERC dated January 3, 2018. These measures include crossing the grassed airstrip as a tie-in crossing, scheduling construction at a time negotiated with the landowner, and either salvaging and replacing the existing sod or installing new sod following construction. In a letter to the FERC dated August 17, 2018, legal counsel for the property owner indicated that they believed Pacific Connector's January 3, 2018 response to be inadequate and requested that FERC require Pacific Connector to relocate the pipeline to avoid crossing the airstrip. Concerns expressed in the letter include safety concerns related to burying a natural gas pipeline several feet below a runway that is the location of aircraft take-offs and landings.

Planned Developments

Pacific Connector's communications with Coos County, the City of North Bend, Douglas County, Jackson County, and Klamath County did not identify any large-scale residential, commercial, or business projects/planned developments within 0.25 mile of the pipeline.

Comments received from affected landowners and other interested parties during scoping expressed concern that the pipeline would affect the ability of landowners to undertake small-scale developments, such as adding a home site, barn, or other structure, or subdividing a lot into two parcels for development. In some cases, Pacific Connector modified the route of the pipeline to avoid improvements on private parcels, as discussed in section 3.4 (Pipeline Route Alternatives) of this EIS.

4.7.2.5 Timber

Pipeline construction would require clearing all forested vegetation and timber from a 95-foot-wide temporary ROW and associated TEWAs. Timber removal and construction activities would take place over two years. While Pacific Connector anticipates that timber clearing would typically be done from May through November (the usual dry period in Oregon), timing restrictions would be imposed within habitat for federally listed NSO and MAMU (see section 4.6). Timber clearing within MAMU stands or within 300 feet of MAMU stands would not occur during the MAMU breeding season, which occurs between April 1 to September 15, in order to prevent impacts on nesting MAMU. Habitat removal within 0.25 mile of an NSO activity center would occur outside of the NSO's breeding season (see section 4.6).

Impacts on forest and timber resources would depend on the clearing (logging) methods used, quantity of lumber removed, and the age of affected stands. The Pacific Connector pipeline would cross approximately 39.3 miles of LSOG forests, 43.7 miles of mid-seral forests, and 59.5 miles of recently harvested forested lands. Table 4.7.2.5-1 lists the log types that occur along the pipeline's route.

TABLE 4.7.2.5-1

Merchantable Timber to be Cleared for the Proposed Pacific Connector Pipeline, by Class and Age

Type of Timber	Diameter to Breast Height (inches dbh)	Inside Top Bark Height Diameter (inches)	Age
Small conifer sawlog	10-20	6-10	26–60 years
Medium conifer sawlog	20-30	8-12	61–100-125 years
Large conifer sawlog	30 and larger	8-16	125–250 years; with an unquantified population of ancient relic trees 300 to 500 years

While timber cruises have not yet been conducted, information available indicates that approximately 1,573 acres of large mature trees over 40 years in age and approximately 1,177 acres of small to medium trees under 40 years in age would be harvested to construct the pipeline. A portion of these 1,177 acres of small to medium trees would not be merchantable (e.g., those less than 25 years in age). Future timber production would be lost on these younger (small and medium) stands. The exact number and board feet of these non-merchantable trees would be determined during timber cruises. Operating the pipeline would permanently affect approximately 514 acres of forest, which would be removed from the future timber base.

Timber cruises would be conducted prior to vegetation clearing to determine timber volumes, values, and species composition within forested lands. These timber cruises would be completed on private lands in compliance with professional forestry standards and on federal lands to required federal agency standard. Information gathered from timber cruises would be used to determine damage payments during easement acquisition. Pacific Connector would be required to retain qualified foresters and logging engineers to develop site-specific logging plans for each area to be logged. These plans would identify the size, height, volume, and value of trees in each portion of the construction ROW, how the timber would be felled and yarded, where landings and log decks would be placed, the haul routes that would be used to remove the logs, and how logging debris would be disposed of. Logging methods would vary by location, and would not be known until timber contractors evaluate site-specific conditions. The exact timber harvest and decking requirement locations would be determined by the contractor within the access roads and staging areas already approved for the pipeline.

Merchantable timber would be cut and removed from the construction ROW and TEWAs. In limited areas, TEWAs have been identified for log storage and decking. Clearing of forest is a two-step process: tree felling followed by yarding. Pacific Connector's ***Right-of-Way**ROW Clearing Plan for Federal Lands* outlines different scenarios that may be used to cut and remove timber from the ROW along the pipeline route, based on slope, stand density, and tree types. Ground-based skidding and cable (where feasible) logging methods would likely be the standard method.

In some isolated rugged topographic areas with poor access, helicopter logging may be used. Cable and helicopter logging methods would minimize the potential for soil compaction. Any timber cleared from the ROW that would be used for instream or upland wildlife habitat diversity structures would be stored on the edge of the ROW or in TEWAs for later use during restoration efforts. Prior to clearing operations, the EI or Pacific Connector's authorized representative would flag existing snags on the edges of the construction ROW or TEWAs where feasible to save from clearing. These snags would be saved as and used in placement projects to benefit primary and secondary cavity nesting birds, mammals, reptiles, and amphibians. During this process, other large diameter trees on the edges of the construction ROW and TEWAs would also be flagged to save/protect as green recruitment or habitat/shade trees, where feasible. Some of these trees would be girdled to create snags to augment the number of snags along the ROW to benefit cavity nesting birds, mammals, reptiles, and amphibians; however, snags that are determined to be a threat to worker safety would be removed.

Danger trees are those trees at risk of falling on workers or vehicles and thus would need to be removed for safety reasons. A tree may be at risk of falling for a number of reasons including the tree's location and the presence of defects, insects, disease, work activities, and weather conditions. Such trees would be felled in advance of logging, pipeline construction, road construction/reconstruction, and road maintenance. Additionally, danger trees could be created from trees felled for the pipeline. This would occur if trees outside of approved construction areas are damaged during felling of harvested timber. While this could result in growth loss, for which Pacific Connector would compensate the land-management agency (or landowner on private lands) for any trees removed and any loss in timber productivity, the FERC requires that all operations be contained within the certificated work areas. Danger trees would be designated by qualified Pacific Connector representatives, in accordance with OSHA standards and the Forest Service/BLM–published *Field Guide for Danger Tree Identification and Response* (Forest Service and BLM 2008). Danger trees exterior to the ROW would be directionally felled, when consistent with OSHA guidelines, away from the construction ROW if trees are to be left, and towards the construction ROW if trees are to be removed. To ensure safety during construction, Pacific Connector has requested a variance to Section IV.A.1 of the FERC's *Plan* for removing danger trees outside the approved construction limits. Pacific Connector would compensate the respective land manager/owner for any merchantable danger trees that are felled.

Logs would not be stored next to conifer trees bordering the sides of the ROW to avoid damage to live trees. Logs planned for removal from the site would be hauled off the site as soon as practical following yarding in order to prevent disease problems, as well as potential theft problems. Slash pieces larger than 8 inches in diameter may be decked for short periods in agency or landowner designated and approved storage areas or in places where roads cross the ROW and made available to the public. However, Pacific Connector has stated that they may place LWD in UCSAs adjacent to standing conifers.

Where feasible, logs yarded out of wetlands or riparian zones would be skidded with at least one end suspended from the ground so as to minimize soil disturbance. Pacific Connector proposes that any debris entering a waterbody as a result of felling and yarding of timber would be removed as soon as practical after entry into the waterbody and shall be placed outside the 100-year floodplain where practical, unless specified otherwise by the applicable landowner or land-managing agency. Logs and slash would not be yarded across perennial streams unless fully suspended. During logging/clearing operations, the direction of log or slash movement would be conducted to minimize sediment delivery to waterbodies, including intermittent streams. Logs firmly embedded in the bed or bank of waterbodies that are in place prior to felling and yarding of timber would not be disturbed, unless they prevent trenching and fluming operations. Any existing logs that are removed from waterbodies to construct the pipeline crossing would be returned to the waterbody after the pipeline has been installed, backfilling is complete, and during the time the streambanks are being restored.

In addition to the above mentioned impact minimization measures, Pacific Connector would implement the following measures to further reduce impacts on timber:

- All tree felling and vegetation clearing would occur within the certificated construction work areas, except for danger trees adjacent to the ROW, additional work areas, and travel corridors. Trees within the certificated construction work areas would be directionally sheared or felled so as to prevent damage to adjacent trees, facilities, or structures.
- Where ground skidding is used, the following measures would be employed to minimize significant detrimental soil disturbance (compaction and displacement):
  - low ground weight (pressure) vehicles would be used;
  - logging machinery would be restricted to the 30-foot permanent ROW wherever possible to prevent soil compaction;
  - the removal of soil duff layers would be avoided in order to maintain a cushion between the soil and the logs and the logging equipment;
  - designed skid trails would be used to restrict detrimental soil disturbance (compaction and displacement) to a smaller area of the ROW over the pipeline trenching area; and
  - landings, yarding, and load-out areas used for timber harvesting would be scarified or after use and prior to the rainy season where the potential for sediment delivery to waterbodies is possible.
- Material designated to remain on site to meet resource concerns would be placed in designated UCSAs along the edge of the ROW and then scattered/redistributed across the ROW during final cleanup and reclamation (following seeding). In upland areas, stump removal would be limited to the trenchline and areas where grading is necessary to construct a safe, level working plane.
- Off-site slash disposal and/or burning may occur in areas where slash is concentrated, such as landings. Slash would be machine or hand piled with the outer edge of piles no closer than 20 feet from the outer drip line of live trees, and burned according to state burning

requirements and landowner, BLM, and Forest Service stipulations. Burns would occur during the wet season.

- Outside of the 30-foot-wide permanent pipeline easement, which would be kept clear of trees with roots that could compromise the integrity of the pipeline coating, the temporary construction area would be restored and revegetated using native seeds, to the extent possible, and saplings according to the ECRP.

State Lands

The proposed route would cross the Southwest Oregon and the Eastern Oregon Forest Practices Regions, which contain mature forest. Trees within this portion of the ROW would be cut and merchantable trees would be sold as directed by Oregon Department of Forestry (ODF). As stipulated within ORS 527.670(3), a written plan must be submitted to the ODF State Forester before extracting timber within:

- 100 feet of a stream classified as Type F (stream with fish or fish and domestic water use) or Type D (stream with domestic water use but no fish use);
- 300 feet of a specific site involving threatened or endangered wildlife species, or sensitive nesting, roosting, or water sites;
- 300 feet of any resource site identified in OAR 629-665-0100 (Sensitive Bird Nesting, Roosting, and Watering Resource Sites on Forestlands), OAR 629-665-0200 (threatened and endangered species that use Resource Sites on Forestlands), or OAR 629-645-0000 (Significant Wetlands); and
- 300 feet of any nesting or roosting site, or critical habitat of threatened or endangered species listed by the FWS or by the ODFW Commission.

If necessary, Pacific Connector would prepare and submit to the ODF State Forester for approval a written plan describing how the pipeline would be in compliance with the Forest Practices Act (OAR 629-605-0170), prior to harvesting activities. In addition to the written plan, Pacific Connector would be required to submit a Notification to the ODF. The Notification serves three purposes: notification of a forest operation (ORS 527.670), a request for a Permit to Use Fire or Power Driven Machinery (PDM, ORS Chapter 477), and notice to the Department of Revenue of timber harvest (ORS 321.550).

4.7.3 Environmental Consequences on Federal Lands

4.7.3.1 Land Requirements on Federal Lands

The Pacific Connector pipeline would cross approximately 31 miles of NFS lands and 47 miles of BLM lands (table 4.7.3.1-1). Between MPs 200.5 and 227.2, the pipeline would cross 31 irrigation facilities that fall under the jurisdiction of Reclamation.

Temporary impacts of the pipeline on federal lands would include timber and brush clearing, grading, trenching, impacts to visual quality at some locations, and soil compaction as a result of equipment driving and storage of logs, slash, pipe lengths, and other supplies. Long-term impacts include the time it would take trees to grow back within the temporary construction ROW. Permanent impacts would include the conversion of forest to herbaceous vegetation within a 30-foot-wide corridor kept clear of trees, and prohibitions of use of the operating pipeline easement. The pipeline and associated facilities would not cross, and therefore no acreage would be removed from, any federally designated wilderness, wildlife refuge areas, or inventoried roadless areas.

TABLE 4.7.3.1-1

Federal Lands Affected by the Pacific Connector Pipeline Project

Pipeline Facility/Component	Jurisdiction BLM	Forest Service	Reclamation
Miles Crossed by Pipeline	46.8	30.6	0.3
Temporary Construction Acreage Requirements (acres)			
Construction ROW	535	350	4
Temporary Extra Work Areas	166	103	<1
Uncleared Storage Areas	184	124	0
Off-site Source/Disposal	7	9	0
Existing Roads Needing Improvements in Limited Locations	2	1	0
Temporary Access Roads (TAR)	<1	0	0
Hydrostatic Discharge Locations Outside the ROW	<1	0	0
Total Temporary Impacts (acres)	**894**	**587**	**4**
Permanent Construction Acreage Requirements (acres)			
Permanent Easement	245	185	2
Permanent Access Roads (PAR)	<1	0	0
Existing Roads Needing Improvements in Limited Locations a/	2	1	0
Aboveground Facilities	<1	0	0
Total Permanent Impacts (acres)	**248**	**186**	**2**
ROW (acres)			
30-Foot Maintained ROW (acres)	147	111	1

Note: Columns may not sum correctly due to rounding. Miles rounded to the nearest tenth of a mile (values below 0.1 are shown as "<0.1"). Acres rounded to the nearest whole acre (values less than 1 shown as "<1").

a/ Road improvements necessary for construction would not be restored; however, no additional maintenance would occur on access roads improved for construction of the Project. Acres are not included in the Permanent Construction acres total.

Pacific Connector would protect its pipeline from corrosion over time through a CP system. The CP system would consist of a number of sites where below ground rectifier/anode beds would be installed that input a low voltage electrical charge into the pipeline. These rectifier/anode beds would typically be spaced about 15 to 20 miles apart, usually installed within the previously disturbed pipeline construction ROW. The CP system would be installed about one year after the pipeline would be constructed, to allow the trench to stabilize and for collection of post-construction data on electro-conductivity soil potentials, which is required before the system can be designed and installed. Pacific Connector would consult with appropriate federal, state, and local regulatory agencies after pipeline construction to acquire the permits necessary for the CP system. A *Corrosion Control Plan* was included as Appendix F to Pacific Connector's POD. Based on a preliminary analysis of CP sites that could create a potential for new electrical service, there is no need for new electrical service on federal lands.

Table 4.7.3.1-2 provides acres affected by the pipeline broken out by land use type and ownership for each federal jurisdiction.

TABLE 4.7.3.1-2

Federal Lands Required for Construction and Operation of the Pacific Connector Pipeline by Land Use Type (acres)

Jurisdiction/ Project Element	Residential	Industrial	Transportation/ Communication	Cropland/Pastureland	Orchards, Groves, Vineyards, Nurseries	Herbaceous Rangeland	Shrub/Brush Rangeland	Mixed Rangeland	Deciduous Forest Land	Evergreen Forest Land	Mixed Forest Land	Clearcut Forest Land	Regenerating Forest Land	Streams	Ditches	Forested Wetlands	Nonforested Wetlands	Strip Mines, Quarries, Gravel Pits	Total
Coos Bay BLM																			
Construction a/	0	0.1	30.05	1.09	0.01	0	0	0	0	99.51	71.09	5.00	76.83	0.22	0	0.38	.07	0.39	**284.64**
Aboveground Facilities Outside the ROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Operational Easement b/	0	0	14.24	0.19	0.01	0	0	0	0	39.19	24.58	1.49	23.45	0.12	0	0.20	0.03	0	**103.48**
Permanent Access Roads c/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
30-Foot Maintenance Corridor	0	0	6	<1	0	0	0	0	0	24	1	1	8	<1	0	<1	0	0	**39**
Roseburg BLM																			
Construction a/	0	0	22.71	0	0	0.36	4.87	0	0	74.29	144.75	4.90	64.38	0.04	0	0	0.01	0	**316.32**
Aboveground Facilities Outside the ROW	0	0	0	0	0	0	0	0	0	0	0.18	0	0	0	0	0	0	0	**0.18**
Operational Easement b/	0	0	7.65	0	0	0.06	1.61	0	0	22.32	33.24	.73	15.21	0.02	0	0	0	0	**80.84**
Permanent Access Roads c/	0	0	0.03	0	0	0	0	0	0	0	0.13	0	0.03	0	0	0	0	0	**0.18**
30-Foot Maintenance Corridor	0	0	2	0	0	<1	<1	1	0	27	0	<1	19	<1	0	0	0	0	**50**
Medford BLM																			
Construction a/	0.01	0	5.64	0	0	11.62	55.78	2.73	30.86	71.82	64.23	0	30.19	0.40	0.05	0	0.07	0	**273.38**
Aboveground Facilities Outside the ROW	0	0	0	0	0	0	0.09	0	0	0	0	0	0	0	0	0	0	0	**0.09**
Operational Easement b/	0	0	1.75	0	0	3.90	19.09	1.30	10.51	23.93	20.30	0	10.84	0.14	0.03	0	0.03	0.0	**91.83**
Permanent Access Roads c/	0	0	0.03	0	0	0.01	0.12	0	0	0	0	0	0	0	0	0	0	0	**0.16**
30-Foot Maintenance Corridor	0	0	1	0	0	3	11	<1	8	13	11	<1	8	<1	<1	<1	0	<1	**55**
Lakeview BLM																			
Construction a/	0	0	1.19	0	0	0	0.67	0.64	0	15.85	0	0	0	0.02	0	0	0	0	**18.37**
Aboveground Facilities Outside the ROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Operational Easement b/	0	0	0.65	0	0	0	0.22	0.16	0	6.81	0	0	0	0.01	0	0	0	0	**7.85**
Permanent Access Roads c/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
30-Foot Maintenance Corridor	0	0	<1	0	0	0	<1	<1	0	4	0	0	0	<1	0	0	0	0	**5**
Umpqua National Forest																			
Construction a/	0	0	14	0	0	0	0	0	0	162	0	0	23	<1	<1	<1	<1	12	**211**
Aboveground Facilities Outside the ROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Operational Easement b/	0	0	4	0	0	0	0	0	0	52	0	0	9	<1	<1	<1	0	0	**66**

TABLE 4.7.3.1-2 (continued)

Federal Lands Required for Construction and Operation of the Pacific Connector Pipeline by Land Use Type (acres)

Jurisdiction/ Project Element	Residential	Industrial	Transportation/ Communication	Cropland/Pastureland	Orchards, Groves, Vineyards, Nurseries	Herbaceous Rangeland	Shrub/Brush Rangeland	Mixed Rangeland	Deciduous Forest Land	Evergreen Forest Land	Mixed Forest Land	Clearcut Forest Land	Regenerating Forest Land	Streams	Ditches	Forested Wetlands	Nonforested Wetlands	Strip Mines, Quarries, Gravel Pits	Total
Permanent Access Roads c/	0	0	<1	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	<1
30-Foot Maintenance Corridor	0	0	3	0	0	0	0	0	0	31	0	0	6	<1	<1	<1	0	0	**39**
Rogue River National Forest																			
Construction a/	0	0	15	0	0	<1	7	3	0	131	0	<1	109	<1	0	0	0	16	**283**
Aboveground Facilities Outside the ROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Operational Easement b/	0	0	5	0	0	<1	1	1	0	45	0	<1	32	<1	0	0	0	0	**83**
Permanent Access Roads c/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
30-Foot Maintenance Corridor	0	0	2	0	0	<1	1	1	0	27	0	<1	19	<1	0	0	0	0	**50**
Winema National Forest																			
Construction a/	0	0	3	0	0	1	0	0	0	56	0	<1	31	<1	0	<1	0	0	**92**
Aboveground Facilities Outside the ROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Operational Easement b/	0	0	1	0	0	<1	0	0	0	23	0	<1	12	<1	0	<1	0	0	**37**
Permanent Access Roads c/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
30-Foot Maintenance Corridor	0	0	<1	0	0	<1	0	0	0	14	0	<1	7	<1	0	<1	0	0	**22**
Bureau of Reclamation																			
Construction a/	0	0	0	<1	0	0	4	0	0	0	0	0	0	0	<1	0	0	0	**4**
Aboveground Facilities Outside the ROW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Operational Easement b/	0	0	0	<1	0	0	2	0	0	0	0	0	0	0	<1	0	0	0	**2**
Permanent Access Roads c/	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
30-Foot Maintenance Corridor	0	0	0	<1	0	0	1	0	0	0	0	0	0	0	<1	0	0	0	**1**

Note: Rows may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as “<1”.

a/ Construction disturbance associated with pipeline facilities including construction ROW, TEWAs, UCSAs, TARs, existing roads needing improvements, pipe yards, off-site source and disposal areas, and hydrostatic discharge locations outside the ROW.

b/ The operational ROW is located within the disturbed acreage of the construction ROW. It is not an addition to the construction impacts.

c/ Portions of some of the PARs are located within the construction ROW and, therefore, there is some duplication in the acreage calculations.

BLM Lands

The Pacific Connector pipeline would cross approximately 47 miles of BLM lands within the Coos Bay, Roseburg, Medford, and Lakeview Districts. Of the aboveground facilities, three MLVs would be located on BLM lands. Pacific Connector also proposes to construct one new TAR to support construction and three new PARs on BLM lands to support construction and operation.

Acres of BLM lands, by land use classification, that would be affected by pipeline construction and operation are listed above in table 4.7.3.1-2. For all of the BLM land crossed combined, construction of the Pacific Connector pipeline would affect about 669 acres of forest, 60 acres of rangeland, 54 acres of transportation-utility lands, less than 0.1 acre of agricultural land, 0.8 acre of wetlands, 1 acre of water, and about 2 acres of barren lands/quarries. The BLM expressed concerns regarding impact of the pipeline on current and future forest management activities on federally administered lands that might result from prohibited or restricted land management and use activities within or near the pipeline ROW. In response, Pacific Connector provided a list of activities that would be prohibited or restricted on the pipeline ROW (table 4.7.3.1-3).

TABLE 4.7.3.1-3

Land Management and Land Use Activities That Would be Prohibited or Restricted on the Proposed Pacific Connector Pipeline Construction and Operational Rights-of-Way

Location	Prohibited/ Restricted Activities	Duration
Directly over the pipeline	Obstructions that may endanger, hinder or conflict with the construction, operation, inspection, protection, maintenance and use of the pipeline (i.e. trees, engineered structures, buildings, roads-parallel, other utilities-parallel, logging, blasting, mining)	During the construction, operations, and maintenance of the pipeline facilities.
Within the pipeline ROW clearing limits	Obstructions that may endanger, hinder or conflict with the construction, operation, inspection, protection, maintenance and use of the pipeline (i.e. engineered structures, buildings, roads-parallel, limited logging, blasting, mining)	During the construction of the pipeline facilities.
Within the pipeline ROW	Obstructions that may endanger, hinder or conflict with the construction, operation, inspection, protection, maintenance and use of the pipeline (i.e. engineered structures, buildings, roads-parallel, limited logging, blasting, mining)	During the construction, operations, and maintenance of the pipeline facilities.
Within one-quarter mile of the pipeline	Some blasting and mining	During operation and maintenance of the pipeline facilities.
On existing federally managed roads and trails	Only when within the ROW, obstructions that may, endanger, hinder or conflict with the construction, operation, inspection, protection, maintenance, and use of the pipeline as described above; otherwise none	During the construction, operations, and maintenance of the pipeline facilities.

The BLM also expressed concerns about how prohibited or restricted activities within the pipeline ROW may affect parties who hold valid existing rights of federal lands in the Project area. In response, Pacific Connector stated that such situations would be handled on a case-by-case basis. In general, Pacific Connector would identify all landowners and interested parties in each of these situations and would work with them, following the guidelines in the Williams Gas Pipeline Developers' Handbook. The BLM also asked Pacific Connector to identify the requirements and timelines for notification to Pacific Connector when activities are planned on the federal lands, either by the agency or a third party. Pacific Connector responded that for any aboveground alterations Pacific Connector would rely on its Operations & Maintenance Manual Public Awareness and Damage Prevention (Policy 10.17.00.09). This policy requires the company to notify in writing at least once per year any landowner or interested party within 660 feet from either side of the pipeline. The notification would include written information of where the pipeline is and who and how to reach Pacific Connector for any concerns they may have with the pipeline. These notifications would provide the landowner or interested party with the information they need to contact the company to discuss any work around the pipeline or ROW.

National Forest System Lands

The pipeline would cross through approximately 30.6 miles of NFS lands within the Umpqua, Rogue River, and Winema National Forests. Acreages of NFS lands, by land use classification, that would be affected by pipeline construction or operation of the Pacific Connector pipeline and associated aboveground facilities are included above in table 4.1.3.1-2. On NFS land, the pipeline would affect about 512 acres of forest, 32 acres of transportation-utility lands, 28 acres of barren lands/quarries, 8 acres of rangelands, 0.5 acre of water, and 0.6 acre of wetlands.

Reclamation Lands

Between MPs 200.5 and 227.2, Pacific Connector's pipeline route would cross two parcels of withdrawn land totaling 0.7 mile, and 31 irrigation facilities that are managed by Reclamation's Klamath Basin Area Office of the Mid-Pacific Region. Acres of Reclamation land, by land use classification, that would be affected by the Project are included above in table 4.1.3.1-2. Construction of the Pacific Connector pipeline across Reclamation lands and facilities would affect less than half an acre of agricultural land, about 4 acres of rangeland, and less than a tenth of an acre of irrigation ditches.

Construction in the Klamath Basin would occur between October 15 and March 15 to minimize impacts to agricultural activities in the area and to cross the Reclamation irrigation facilities when they are not likely to be used or contain water. Pacific Connector included a *Klamath Facilities Crossing Plan* as Appendix O of its POD, and a *Winter Construction Plan for the* Klamath Basin as Appendix 1E in Resource Report 1 of its 2017 application to the FERC.

During construction across Reclamation lands and features, their use would be temporarily interrupted. However, after pipeline installation, Pacific Connector would restore those lands and features to their original condition and use.

4.7.3.2 Grazing Allotments on BLM and NFS Lands

The proposed Pacific Connector pipeline route would cross 11[146] livestock grazing allotments, 5 of which occur on NFS lands managed by the Umpqua, Rogue River, and Winema National Forests, and 6 of which occur on BLM lands managed by the Medford and Lakeview Districts (see table's 4.7.3.2-1 and 4.7.3.2-2). Pacific Connector believes grazing deferments would not be necessary for the Project because grazing is not a dominant land use crossed by the pipeline route. Pacific Connector has consulted with the BLM and the Forest Service regarding grazing resources.

[146] One additional allotment (Fish Lake) on the Rogue River National Forest would also be included. The pipeline corridor does not cross this allotment; the only portion affected by Pacific Connector is an old quarry which has been identified as a rock source and disposal area near MP 160.4.

TABLE 4.7.3.2-1

Grazing Allotments on National Forest System Lands Crossed by the Pacific Connector Pipeline Project

Allotment Number	Allotment Name/Pasture	MP	Allotment Acres	Management Category a/	Total AUMs b/	3-Year Average AUMs	Season Used	Livestock Kind	Grazing System	Notes
Umpqua National Forest – Tiller Ranger District										
00R12	Diamond Rock	105.4 - 113.2	23,565	PB: I, A, F	680	187	5/1-10/31	Cow/Calf	Continuous Season	Managed in conjunction with an adjoining allotment.
Rogue River National Forest – Ashland Ranger District										
00R08	South Butte	153.8 - 167.5	25,592	PB: A, F	230	230	6/1-10-15	Cow/Calf	Continuous	1035 AUs
00R07	Deadwood	167.5 - 167.9	21,337	PB: A, F	382/150 Total of 532	382/150	6/1-10/15 See notes	Cow/Calf	Deferred	Managed with BLM Odd yrs. = 6/1–8/15 on FS Even yrs. = 8/16–10/15 on FS
Winema National Forest – Klamath Ranger District										
OR250	Indian	167.9 - 171.3	10,619	PB: I,A, F	906	665	7/1-10/15	Cow/Calf	Continuous Season	Managed with Buck Allotment as 1 Allotment.
OR220	Buck	171.3 - 172.4	15,932	PB: I,A, F	906	665	7/1-10/15	Cow/Calf	Continuous Season	Same as Indian, managed as 1 Allotment.

a/ 'PB' classification indicates that allotments that have potential to be managed under a quality management strategy. Basic resource damage is not occurring.
P = lack of permittee interest participation;
I = lack of total AMP implementation;
A = lack of reliable range analysis data, and
F = lack of funding to implement quality management.
b/ AUM = animal unit month

TABLE 4.7.3.2-2

Grazing Allotments on BLM Lands Crossed by the Pacific Connector Pipeline Project

Allotment Number	Allotment Name/Pasture	MP	Allotment Acres	Management Category a/	Total AUMs	3-Year Average AUMs	Season Used	Livestock Kind	Grazing System b/	Notes
Medford District										
10038	Crowfoot	123.5 - 128.4	7,400	I			4\15-6\30	Cattle	SS	
10031	Summit Prairie/McNeil	131.4 - 131.8	30,578	I	1,158	827	6\1-10\30	Cattle	DF	
10024	Big Butte	133.6 - 141.9	21,802	I	1,663	301	4\16-5\31	Cattle	SL	Rice Place pasture now closed to grazing
00126	Heppsie Mountain	148.8 - 153.8	4,105	I	294	277	5/1-10/15	Cattle	SL	
Lakeview District										
0147	Grubb Spring	178.3 - 189.1	3,564 e/	C	130 c/	130 c/	5/1 – 9/15	Cattle	d/	
0848	Pope	216.5 - 216.8	446 f/	C	48 c/	63 c/	5/1 – 7/31	Cattle	d/	

a/ I = intensive management
C = custodial
M = maintain

b/ SS = Spring/Summer: Use throughout the critical growing season annually.
DF = Deferred: Delay of livestock grazing on an area for an adequate period of time to provide for plant reproduction, establishment of new plants, or restoration of vigor of existing plants.
SL = Season Long: Season long use annually, including during the growing season (spring, summer, and fall).

c/ BLM licensed AUMs only.

d/ Grazing is every year for the listed season; no other specific grazing system.

e/ BLM Klamath Falls Resource Area acres only listed

f/ A portion of the allotment was recently sold reducing the acreage.

Potential impacts to grazing allotments may occur from the temporary loss of forage from Project vegetation clearing and grading activities. In addition, construction activities could disturb improvements such as developed springs and fences or other barriers that restrict livestock to the allotment. From current survey activities, Pacific Connector is not aware of any range improvements such as springs that would be impacted. Pacific Connector does not believe it is necessary to remove livestock from the allotments during construction activities because of the significant size of most of the allotments crossed. Prior to construction, Pacific Connector would coordinate with the BLM and Forest Service regarding lease holder notifications.

Pacific Connector would mitigate impacts on grazing allotments during construction by installing temporary fences as needed to control livestock movement. After construction, permanent repairs to fences and natural barriers or other improvements that were disrupted by construction activities would occur to equivalent or better standards to ensure that livestock do not trail outside the allotment. Additional permanent fences may also be required during operation. After the pipeline is installed, the ROW would be restored and revegetated, as discussed in section 4.4. Revegetation is expected to return allotment forage quantity and values to preconstruction conditions within one to two growing seasons.

4.7.3.3 BLM and Forest Service Land Use Plans and Land Allocations

Federal lands are managed under a framework of laws passed by Congress, regulations promulgated through the federal rule-making process by the Secretaries of the Interior and Agriculture to implement these laws passed, Executive Orders issued by the President, and policies developed by the agencies to govern day-to-day actions. Each administrative unit of the BLM and Forest Service has a land management plan that provides a framework for on-the-ground implementation of these various laws, regulations and agency policies.

Overview of Statutes Applicable to Federal Land Use Planning

Although a number of federal statutes apply to the Pacific Connector pipeline where it crosses federal lands, there are six primary federal land-use laws that provide the framework for federal land use plans:

- The Multiple Use, Sustained Yield Act of 1960 (MUSY)
- The National Environmental Policy Act of 1969 (NEPA),
- The Endangered Species Act of 1973 (ESA),
- The Federal Land Policy and Management Act of 1976 (FLPMA),
- The National Forest Management Act of 1976 (NFMA), and
- The Oregon and California Revested Lands Sustained Yield Management Act of 1937 (O&C Act).

Three of these statutes—NEPA, ESA, and FLPMA—apply to both the BLM and the Forest Service. The relevance of NEPA and ESA to federal land management along the route of the Pacific Connector pipeline is discussed in chapter 1 of this EIS. For the Pacific Connector pipeline, the O&C Act applies primarily to BLM lands and to a lesser degree to NFS lands. BLM's RMPs are based on the requirements of FLPMA. The Forest Service's LRMPs are based on the requirements of the NFMA. FLPMA and NFMA were enacted in a manner to complement each other. Reclamation does not have any land use plans or land allocations administered by the

Klamath Basin Area Office that would be amended or modified or which need to be addressed in this EIS.

The O&C Act of 1937 applies to lands granted by the federal government to the Oregon and California Railroad Company. These lands were reconveyed to the federal government when the Oregon and California Railroad (O&C) went bankrupt. A similar, but smaller land grant in 1869 to the Southern Oregon Company was associated with the Coos Bay Wagon Road. These lands were also subsequently reconveyed to the federal government. The O&C Act of 1937 requires the Secretary of the Interior to manage Coos Bay Wagon Road lands and O&C lands for permanent forest production in conformity with the principle of sustained yield. These lands must also be managed in accordance with BLM RMPs in addition to applicable environmental laws such as the ESA. The O&C and Coos Bay Wagon Road land grants resulted in a patchwork of alternating federal and non-federal parcels across western Oregon and northern California. Table 4.7.3.3-1 lists the O&C and Coos Bay Wagon Road lands crossed by the Pacific Connector pipeline.

TABLE 4.7.3.3-1

O&C Lands, Coos Bay Wagon Road Lands, and Reserved Public Domain Lands Crossed by the Pacific Connector Pipeline (miles) a/

Jurisdiction	O&C Lands	Coos Bay Wagon Road Lands	Reserved Public Domain Lands b/	Total
BLM – Coos Bay District	1.14	15.8	0.13	17.07
BLM – Roseburg District	10.84	1.79	0.72	13.35
BLM – Medford District	12.29	0.0	2.86	15.15
BLM – Lakeview District	1.03	0.0	0.26	1.29
Total BLM	**25.3**	**17.59**	**3.97**	**46.86**
Forest Service– Umpqua NF	3.44	0.0	7.37	10.81
Forest Service– Rogue River NF	0.0	0.0	13.72	13.72
Forest Service – Winema NF	0.0	0.0	6.05	6..05
Total NFS	**3.44**	**0.0**	**27.14**	**30.58**
Total	**28.5**	**17.59**	**30.98**	**77.44**

Note: Rows and columns may not sum correctly due to rounding. Miles are rounded to the nearest tenth of a mile (values below 0.1 are shown as "<0.1").
a/ Source: Table 8.5-5, Resource Report 3, p. 36.
b/ Reserved Public Domain Lands are the remaining lands not classified as O&C or Coos Bay Wagon Road lands

Enacted in 1976, the FLPMA established a unified, comprehensive, and systematic approach to managing and conserving public lands to provide for multiple uses and sustained yield of goods and services from public lands. The act includes provisions for withdrawing or otherwise designating or dedicating federal lands for specified purposes. It also establishes procedures for disposing of public lands, acquiring non-federal lands for public purposes, exchanging lands consistent with the prescribed mission of the department or agency involved and for issuing ROW Grants across lands administered by multiple federal agencies. The BLM is the authorizing agency for the Pacific Connector pipeline ROW grant application.

The BLM under Title II of the FLPMA, and the Forest Service under the provisions of the MUSY, are required to manage lands sustainably for multiple uses. Although there are distinct differences between the BLM and Forest Service planning regulations, the following elements are common to the two agencies:

- use of a systematic, interdisciplinary approach that utilizes information from the physical, biological, economic, and other sciences;
- considering present and potential uses of public lands;
- giving priority to areas of critical environmental concern;
- considering the relative scarcity of the various values of public lands;
- weighing long-term and short-term public benefits;
- complying with applicable pollution control laws; and
- coordinating land-use planning with other relevant federal and state agencies.

The Forest Service is also subject to the requirements of the NFMA, which was enacted as an amendment to the 1974 Forest and Rangeland Renewable Resources Planning Act. In NFMA, Congress established a comprehensive notice and comment process for adopting, amending, and revising LRMPs for units of the NFS (e.g., National Forests). Planning regulations later promulgated by the Secretary of Agriculture explain that National Forest planning and decision making occurs at four levels: nationwide, region wide, LRMPs, and projects. One of the statutory requirements of the NFMA is to "specify…guidelines for LRMPs developed to achieve the goal of providing for diversity of plant and animal communities based on the suitability and capability of the specific lands area in order to meet multiple use objectives." This biodiversity requirement led to the development of the NWFP, which currently guides the management of NFS lands in southwest Oregon and meets the NFMA's biodiversity goal.

Northwest Forest Plan

In 1994, the Secretaries of Agriculture and Interior jointly signed a *Record of Decision for Amendments to Forest Service and BLM Planning Documents within the Range of the Northern Spotted Owl* (otherwise known as the Northwest Forest Plan (NWFP); Forest Service and BLM 1994a). This decision amended national forest LRMPs and established the following land allocations to be used on NFS lands in the area covered by the NWFP.[147]

- **Congressionally Reserved Areas -** Lands reserved by act of Congress including National Parks and Monuments, Wilderness Areas, Wild and Scenic Rivers, National Wildlife Refuges and Department of Defense lands.

- **Late-Successional Reserves** (LSRs) - in combination with other land allocations and standards and guidelines are intended to maintain functional, interactive LSOG forest ecosystems for species that are dependent on this type of habitat.[148]

- **Adaptive Management Areas -** Areas designed to develop and test new management approaches to integrate and achieve ecological, economic and other social and community objectives.

[147] When the NWFP was signed in 1994, it applied to both national forest and BLM lands in the range of the northern spotted owl. Subsequently in August 2016 the BLM revised its management plans in southwest Oregon and replaced the management direction from the NWFP. As a result, the NWFP no longer applies to BLM lands.
[148] Appendix F.3 of this EIS provides a comprehensive discussion of LSRs as they relate to the Project.

- **Administratively Withdrawn Areas—**Areas identified in Forest Service LRMPs not scheduled for timber harvest (e.g., recreation sites, administrative facilities).
- **Key Watersheds—**Large watersheds that are a system of refugia that either provide, or are expected to provide, high-quality habitat that is crucial for maintaining and recovering habitat for at-risk stocks of anadromous salmonids and resident fish species. Key Watersheds are not a designated area or matrix but overlay all land allocations. Tier 1 Key Watersheds contribute directly to conservation of at-risk stocks of anadromous salmonids, bull trout and resident fish. While Tier 2 Key Watersheds may not contain at-risk fish species, they are important sources of high-quality water.
- **Riparian Reserves—**Areas along all streams, wetlands, ponds, lakes and unstable and potentially unstable areas where the conservation of aquatic and riparian-dependent terrestrial resources receives primary emphasis. Riparian Reserves are also intended to serve as connectivity corridors between other reserves and the Matrix lands.[149] Riparian Reserves exist within all land allocations of the NWFP.
- **Matrix—**The lands outside the other designated areas listed above. Matrix lands are the area in which most timber harvest and other silvicultural activities would be conducted.

Attachment A to the NWFP ROD, "Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Species within the Range of the Northern Spotted Owl," provides detailed requirements and instructions for how land managers should treat forest lands subject to the NWFP (Forest Service and BLM 1994b).[150] Some standards and guidelines apply to all NFS lands, while others are only applicable to certain land allocations or activities. More than one set of standards and guidelines may apply in some areas. Where standards and guidelines overlap, both are applied. Where there are conflicts, the standard and guideline that provides the most protection for LSOG-associated species governs. The acres of NWFP allocations affected by the Pacific Connector pipeline are displayed in table 4.7.3.3-2.

Forest Service Land and Resource Management Plans

Current Forest Service LRMPs for the Rogue River, Umpqua, and Winema National Forests were adopted in the early 1990s (Forest Service 1990a, 1990b, and 1990c). In 1994, the NWFP ROD amended the LRMPs for those portions of National Forests within the range of the NSO to include the NWFP land allocations and standards and guidelines in addition to the existing direction in those plans. Wherever there were conflicts between the NWFP and the underlying land management plan, the direction that provided the most protection for late-successional and old-growth–dependent species was adopted.

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[149] Appendix F.4 of this EIS provides a comprehensive discussion of Riparian Reserves as they relate to the Project.

[150] Standards and Guidelines: "the rules and limits governing actions, and the principles specifying environmental conditions or level to be achieved or maintained" (Forest Service and BLM 1994b: C-1).

TABLE 4.7.3.3-2

Forest Service NWFP Land Allocations – Acres Impacted by the Pipeline a/

Project Component	Late Successional Reserves	Unmapped LSRs	Matrix	Riparian Reserves b/
Forest Service – Umpqua				
Construction ROW	57.18	0.00	66.74	8.92
TEWAs	10.05	0.00	30.66	5.60
UCSAs	17.23	0.00	23.57	0.00
Off-site Source/Disposal	4.93	0.00	15.87	3.93
Temporary Access Roads (TAR)	0.00	0.00	0.16	0.00
Existing Roads Improvements	0.73	0.00	0.88	0.92
Total Temporary Impacts	90.12	0.00	137.88	19.37
Permanent Easement	30.33	0.00	35.16	4.76
Permanent Access Roads (PAR)	0.00	0.00	0.06	0.00
30-Foot Maintained	18.19	0.00	21.11	2.85
Forest Service – Rogue River-Siskiyou				
Construction ROW	157.11	0.00	0.00	2.66
TEWAs	49.99	0.00	0.00	0.89
UCSAs	69.53	0.00	0.00	0.93
Off-site Source/Disposal	15.27	0.00	4.91	0.00
Temporary Access Roads (TAR)	0.00	0.00	0.00	0.00
Existing Roads Improvements	0.00	1.00	0.00	1.00
Total Temporary Impacts	291.90	1.00	4.91	5.48
Permanent Easement	83.17	0.00	0.06	1.52
Permanent Access Roads (PAR)	0.00	0.00	0.00	0.00
Aboveground Facilities	0.00	0.00	0.00	0.00
30-Foot Maintained	49.90	0.00	0.00	0.90
Forest Service – Fremont-Winema				
Construction ROW	0.00	0.00	68.64	3.94
TEWAs	0.49	0.00	11.55	0.29
UCSAs	0.00	0.00	11.55	0.43
Temporary Access Roads (TAR)	0.00	0.00	0.00	0.00
Existing Roads Improvements	0.00	0.00	0.00	0.00
Total Temporary Impacts	**0.49**	**0.00**	**91.74**	**4.66**
Permanent Easement	0.00	0.00	36.67	2.20
30-Foot Maintained	0.00	0.00	22.00	1.34

a/ Due to differences between the landownership and land use allocation shapefiles, the acres will vary slightly when compared to the vegetation and land use tables organized by jurisdiction.
b/ Riparian Reserves overlay other land use allocations.

BLM Resource Management Plans

The BLM revised its management plans in August 2016. Land allocations in BLM plans provide a sustained yield of timber, contribute to the conservation and recovery of an threatened and endangered species, provide clean water in watersheds, provide recreation opportunities, and coordinate management of land surrounding the Coquille Forest with the Coquille Tribe.

The **Northwestern and Coastal Region Record of Decision** applies to the Coos Bay and the Swiftwater Field Office of Roseburg District. Land allocations are as follows:

- **Congressionally Reserved Lands and National Conservation Areas –** Lands reserved by act of Congress including National Parks and Monuments, Wilderness Areas, Wild and Scenic Rivers, National Wildlife Refuges, and Department of Defense lands.
- **District Designated Reserves –** Lands reserved from sustained-yield timber production for other purposes
    - **Areas of Critical Environmental Concern –** Lands managed to maintain or restore relevant and important values in Areas of Critical Environmental Concern, including Research Natural Areas and Outstanding Natural Areas.
    - **Timber Production Capability Classification –** Manage areas identified as unsuitable for sustained-yield timber production through the Timber Production Capability Classification system, for other uses if those uses are compatible with the reason for which the BLM has reserved these lands (as identified by the Timber Production Capability Classification codes).
    - **Lands Managed for their Wilderness Characteristics –** Protect wilderness characteristics (i.e., roadlessness, naturalness, opportunities for solitude and primitive unconfined recreation, and identified supplemental values), while allowing competing resource demands that do not conflict with preserving long-term wilderness characteristics.
- **Harvest Land Base—** Manage forest stands to achieve continual timber production that can be sustained through a balance of growth and harvest.
    - **Low Intensity Timber Area –** Use low intensity management to provide complex early-successional ecosystems, develop diverse late-successional ecosystems for a portion of the rotation and provide a variety of forest structural stages distributed both temporally and spatially.
    - **Moderate Intensity Timber Area –** Use moderate intensity management to provide complex early-successional ecosystems, develop diverse late-successional ecosystems for a portion of the rotation and provide a variety of forest structural stages distributed both temporally and spatially.
- **Late Successional Reserve –** Lands are managed to maintain nesting-roosting habitat for the northern spotted owl and nesting habitat for the marbled murrelet, promote the development of nesting-roosting habitat for the northern spotted owl in stands that do not currently support northern spotted owl nesting and roosting, promote the development of nesting habitat for the marbled murrelet in stands that do not currently meet nesting habitat criteria, promote the development and maintenance of foraging habitat for the northern spotted owl, including creating and maintaining habitat to increase diversity and abundance of prey for the northern spotted owl.
- **Riparian Reserves –**Areas along streams and wetlands where the conservation of aquatic and riparian-dependent terrestrial resources receives primary emphasis. Riparian Reserves exist in all land allocations. Conservation and recovery of ESA-listed fish species and their

habitats and provide for conservation of Bureau Special Status fish and other Bureau Special Status riparian-associated species.

The **Southwestern Oregon Record of Decision and Approved Resource Management Plan** applies to the Klamath Falls Field Office of Lakeview District, Medford District, and South River Field Office of Roseburg District. Land allocations are as follows:

- **Congressionally Reserved Lands and National Conservation Areas –** Lands reserved by act of Congress including National Parks and Monuments, Wilderness Areas, Wild and Scenic Rivers, National Wildlife Refuges, and Department of Defense lands.

- **District Designated Reserves –** Lands reserved from sustained-yield timber production or for other purposes.

  - **Areas of Critical Environmental Concern –** Lands managed to maintain or restore relevant and important values in Areas of Critical Environmental Concern, including Research Natural Areas and Outstanding Natural Areas.

  - **Timber Production Capability Classification –** Manage areas identified as unsuitable for sustained-yield timber production through the Timber Production Capability Classification system, for other uses if those uses are compatible with the reason for which the BLM has reserved these lands (as identified by the Timber Production Capability Classification codes).

  - **Lands Managed for their Wilderness Characteristics –** Protect wilderness characteristics (i.e., roadlessness, naturalness, opportunities for solitude and primitive unconfined recreation, and identified supplemental values), while allowing competing resource demands that do not conflict with preserving long-term wilderness characteristics.

- **Harvest Land Base—** Manage forest stands to achieve continual timber production that can be sustained through a balance of growth and harvest.

  - **Low Intensity Timber Area –** Use low intensity management to provide complex early-successional ecosystems, develop diverse late-successional ecosystems for a portion of the rotation and provide a variety of forest structural stages distributed both temporally and spatially.

  - **Moderate Intensity Timber Area –** Use moderate intensity management to provide complex early-successional ecosystems, develop diverse late-successional ecosystems for a portion of the rotation and provide a variety of forest structural stages distributed both temporally and spatially.

  - **Harvest Land Base –** Uneven Aged Timber Area – Use uneven – aged timber management to increase diversity of stocking levels and size classes within and among the stands.

- **Late Successional Reserve –** Lands are managed to maintain nesting-roosting habitat for the northern spotted owl and nesting habitat for the marbled murrelet, promote the development of nesting-roosting habitat for the northern spotted owl in stands that do not currently support northern spotted owl nesting and roosting, promote the development of nesting habitat for the marbled murrelet in stands that do not currently meet nesting habitat criteria, promote the development and maintenance of foraging habitat for the northern spotted owl, including creating and maintaining habitat to increase diversity and abundance of prey for the northern spotted owl.

- **Late-Successional Reserve Dry –** Applied variously on drier sites, lands are managed to Enable forests to: (1) recover from past management measures, (2) respond positively to climate-driven stresses, wildfire and other disturbance with resilience, (3) ensure positive or neutral ecological impacts from wildfire, and (4) contribute to northern spotted owl recovery.

- **Riparian Reserves –**Areas along streams and wetlands where the conservation of aquatic and riparian-dependent terrestrial resources receives primary emphasis. Riparian Reserves exist in all land allocations. Conservation and recovery of ESA-listed fish species and their habitats and provide for conservation of Bureau Special Status fish and other Bureau Special Status riparian-associated species. Riparian Reserves are further disaggregated into moist and dry zones that recognize the broad diversity of BLM landscapes by applying different implementing standards and guidelines.

Although Late Successional Reserves and Riparian Reserves are land allocations on both BLM and NFS lands and have similar objectives, implementing standards and guidelines in BLM management plans vary significantly from those on NFS lands because of the greater geologic and geographic diversity of BLM lands. BLM east-side management area land allocations do not apply to the Pacific Connector project area. The acres of BLM RMP allocations affected by the Pacific Connector pipeline is displayed in table 4.7.3.3-3.

TABLE 4.7.3.3-3

BLM RMP Land Allocations – Acres Impacted by the Pacific Connector Pipeline

Pipeline Component	District-Designated Reserve (No Harvest)	District-Designated Reserve (Non-Forest)	Eastside Manage-ment Area	Harvest Land Base (Low Intensity Timber Area)	Harvest Land Base (Moderate Intensity Timber Area)	Harvest Land Base (Uneven-Aged Timber Area)	Late-Succes-sional Reserve (Dry Forest)	Late-Succes-sional Reserve (Moist Forest)	Riparian Reserve (Dry Forest)	Riparian Reserve (Moist Forest)	Totals
BLM – Coos Bay District											
Construction ROW	0.47	4.74	0.00	8.24	23.36	0.00	0.00	67.69	0.00	15.97	120.47
TEWAs	0.08	1.34	0.00	1.27	7.76	0.00	0.00	17.03	0.00	6.07	33.55
UCSAs	0.36	0.16	0.00	0.65	1.75	0.00	0.00	10.91	0.00	1.05	14.88
Off-Site Source/Disposal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.51	0.00	1.50	4.01
Temporary Access Roads (TAR)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.69	0.69
Total Temporary Impacts	**0.91**	**6.24**	**0.00**	**10.16**	**32.87**	**0.00**	**0.00**	**98.14**	**0.00**	**25.28**	**173.60**
Permanent Easement	0.22	2.89	0.00	4.36	12.13	0.00	0.00	38.09	0.00	8.54	66.23
Aboveground Facilities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30-Foot Maintained	0.13	1.69	0.00	2.62	7.32	0.00	0.00	22.96	0.00	5.03	39.75
BLM – Roseburg District											
Construction ROW	0.72	18.74	0.00	0.09	23.37	29.62	56.80	17.50	2.03	1.33	150.20
TEWAs	0.09	7.56	0.00	0.00	10.77	10.44	19.54	2.27	1.26	0.42	52.35
UCSAs	1.96	4.87	0.00	0.00	18.44	34.93	54.37	3.18	4.67	0.00	122.42
Off-site Source/Disposal	0.37	1.20	0.00	0.00	2.26	0.49	2.13	0.14	0.00	0.00	6.59
Temporary Access Roads (TAR)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Temporary Impacts	**3.14**	**32.37**	**0.00**	**0.09**	**54.84**	**75.48**	**132.84**	**23.09**	**7.96**	**1.75**	**331.56**
Permanent Easement	0.45	11.07	0.00	0.01	11.60	14.45	30.51	9.16	0.96	0.69	78.90
Aboveground Facilities	0.00	0.00	0.00	0.00	0.09	0.00	0.09	0.00	0.00	0.00	0.18
30-Foot Maintained	0.24	7.13	0.00	0.00	6.81	8.57	18.14	5.49	0.55	0.41	47.34
BLM – Medford District											
Construction ROW	58.57	25.82	0.00	7.78	0.00	23.02	48.42	0.00	10.72	0.00	174.33
Hydrostatic Test Site [3]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TEWAs	18.97	9.12	0.00	1.70	0.00	7.12	25.46	0.00	2.19	0.00	64.56
UCSAs	8.26	2.71	0.00	3.24	0.00	9.71	9.51	0.00	0.87	0.00	34.30
Temporary Access Roads (TAR)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Temporary Impacts	**85.80**	**37.65**	**0.00**	**12.72**	**0.00**	**39.85**	**83.39**	**0.00**	**13.78**	**0.00**	**273.19**
Permanent Easement	30.52	13.92	0.00	4.16	0.00	12.13	25.50	0.00	5.59	0.00	91.82
Aboveground Facilities	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.09
30-Foot Maintained	18.31	8.41	0.00	2.49	0.00	7.25	15.30	0.00	3.35	0.00	55.11

TABLE 4.7.3.3-3 (continued)

BLM RMP Land Allocations – Acres Impacted by the Pacific Connector Pipeline

Pipeline Component	District-Designated Reserve (No Harvest)	District-Designated Reserve (Non-Forest)	Eastside Manage-ment Area	Harvest Land Base (Low Intensity Timber Area)	Harvest Land Base (Moderate Intensity Timber Area)	Harvest Land Base (Uneven-Aged Timber Area)	Late-Succes-sional Reserve (Dry Forest)	Late-Succes-sional Reserve (Moist Forest)	Riparian Reserve (Dry Forest)	Riparian Reserve (Moist Forest)	Totals
LM – Lakeview District											
Construction ROW	0.00	0.74	2.96	0.00	0.00	10.90	0.00	0.00	0.22	0.00	14.82
TEWAs	0.00	0.18	0.58	0.00	0.00	2.72	0.00	0.00	0.06	0.00	3.54
Temporary Access Roads (TAR)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Temporary Impacts	**0.00**	**0.92**	**3.54**	**0.00**	**0.00**	**13.62**	**0.00**	**0.00**	**0.28**	**0.00**	**18.36**
Permanent Easement	0.00	0.29	1.56	0.00	0.00	5.88	0.00	0.00	0.11	0.00	7.84
30-Foot Maintained	0.00	0.16	0.94	0.00	0.00	3.54	0.00	0.00	0.07	0.00	4.71

4.7.3.4 Proposed Amendments to BLM and Forest Service Land Management Plans

Amendment of BLM Resource Management Plans

BLM lands are managed according to the direction in Resource Management Plans (RMP). Approximately 46.9 miles of the proposed Pacific Connector pipeline route would cross federal land administered by the BLM in southwest Oregon. The Coos Bay District and the Roseburg District-Swiftwater Field Office are managed according to the provisions of the Northwestern and Coastal Oregon RMP (BLM 2016a). The Lakeview District-Klamath Field Office, Medford District and the Roseburg District-South River Field Office are managed according to the provisions of the Southwestern Oregon RMP (BLM 2016b).

FLPMA as amended, and its implementing regulations in Title 43, CFR part 1600 requires all projects on BLM lands, including third-party projects authorized by permits or right of way grants, to be consistent with the RMP of the administrative unit where the project occurs. Where projects would not be consistent with the underlying RMP, the project cannot be implemented unless the RMP is amended to make provision for the project, or the project is modified to be consistent with RMP direction. An RMP does not authorize projects or activities or commit the BLM to act. A plan may constrain the agency from authorizing or carrying out projects and activities, or the manner in which they may occur.

For the Pacific Connector pipeline project, the BLM worked cooperatively with the FERC staff, other cooperating agencies, and the applicant to incorporate BMPs, design features and project requirements which would avoid, minimize, rectify, reduce or eliminate environmental consequences (40 CFR 1502.14(f) and 1508.20(a-d)). The BMPs, design features, or requirements specific to BLM lands are included as attachments to the project proponent's POD. There are 28 appendices in the POD; they include draft monitoring elements to ensure that the actions are implemented. Collectively, the POD is incorporated into the project's description, and is summarized in section 2.6.3 of the DEIS.

Given the linear nature of the pipeline corridor, resources on BLM lands and the topography of BLM lands in southwest Oregon it is not possible for the Pacific Connector project to conform to every requirement of the respective BLM RMPs. Pacific Connector has cooperated with the BLM to make its proposal consistent with the BLM RMPs as much as is feasible, but even with route adjustments, modified project design features, and BMPs, the proposed ROW for the Project on BLM-managed lands would not conform to the Southwestern Oregon RMP and the Northwestern and Coastal RMP (RMPs for Western Oregon). Amendment of these RMPs would be necessary to make provision for the project to allow it to proceed.

The RMPs for Western Oregon allow for the construction of linear rights-of-way within the LSR "as long as northern Spotted Owl (NSO) nesting-roosting habitat continues to support nesting and roosting at the stand level, and NSO dispersal habitat continues to support movement and survival at the landscape level", and construction of linear rights-of-way "as long as the occupied stand continues to support marbled murrelet nesting" (Southwestern Oregon ROD page 71, Northwestern and Coastal ROD, page 65). BLM staff initially evaluated that the proposed ROW would cross approximately 268 acres of LSR and approximately 116 acres of known or presumed occupied MAMU habitat and/or NSO nesting-roosting habitat within the LSR land allocation. Additional analysis concluded that the clearing and removal of vegetation required within the LSR for the proposed Project would result in the loss of stand-level NSO nesting and roosting habitat and MAMU nesting habitat in the project corridor.

BLM management direction in the RMPs for Western Oregon specific to wildlife prohibits activities that "disrupt marbled murrelet nesting at occupied sites ... within all land use allocations within 35 miles of the Pacific Coast and... within reserved land use allocation between 35-50 miles of the Pacific Coast" (Southwestern Oregon ROD, page 118, Northwestern and Coastal ROD, page 98). BLM staff concluded that construction of the Project would likely result in disruption of MAMU nesting at some occupied sites within these two discrete geographic ranges.

In order to consider the ROW Grant, the BLM must address these inconsistencies by amending the affected RMPs to make provisions for the Pacific Connector project. BLM therefore proposes to amend the RMPs to re-allocate all lands within the proposed temporary use area and ROW to a District-Designated Reserve, with management direction to manage said lands for the purposes of the Pacific Connector Gas Pipeline ROW. Approximately 885 acres would be re-allocated from existing land allocations in the affected RMPs to the District Designated Reserves (see Resource Report 8).

District-Designated Reserve is an existing land use allocation in both the Northwestern and Coastal Oregon RMP and the Southwestern Oregon RMP. Under these RMPs, District-Designated Reserves encompass a wide variety of lands, including constructed facilities, infrastructure, roads, communication sites, seed orchards, quarries, lands biologically or physically unsuitable for timber production, Areas of Critical Environmental Concern, and lands managed for their wilderness characteristics. District-Designated Reserves are reserved from sustained-yield timber production in order to manage them for another set of specific values and resources. Within the District-Designated Reserve, the BLM would maintain the values and resources necessary for construction, operation, maintenance, and decommissioning of the proposed Pacific Connector project.

Specifically, BLM proposes to add the following text to the RMPs for Western Oregon (Northwestern and Coastal ROD, page 59, Southwestern Oregon ROD, page 57):

<u>District-Designated Reserve – Pacific Connector Gas Pipeline</u>

Management Objectives

- *See District-Designated Reserves management objectives.*
- Maintain the values and resources for which the BLM has granted the ROW for the Pacific Connector Gas Pipeline Project.

Management Direction

Allow the construction, operation, maintenance, and decommissioning of the Pacific Gas Connector Pipeline, notwithstanding the restrictions and requirements of management direction described for resource programs.

District-Designated Reserve allocations establish specific management for a specific use or to protect specific values and resources. The project-specific amendment would not change RMP requirements for other projects or authorize any other actions within the *District-Designated Reserve – Pacific Connector Gas Pipeline* .Other uses that are compatible with the purpose of the District-Designated Reserve maybe authorized on a case-by-case basis following completion of environmental analysis. The environmental consequences of this proposed amendment are the same as the environmental consequences of construction and operation of the Pacific Connector project and are discussed at length elsewhere in this EIS.

Therefore, the resource impacts of the proposed plan amendments are those associated with construction, operation, maintenance and decommissioning of the proposed pipeline. With this amendment, the granting of a ROW on BLM-managed lands for the Pacific Connector Project would conform to the Southwestern Oregon Record of Decision and Resource Management Plan (BLM 2016b) and the Northwestern and Coastal Oregon ROD and RMP (BLM 2016a).

Amendments to Forest Service Land and Resource Management Plans

This section summarizes DEIS appendix F2 (Forest Service Forest Plan Amendments and Compensatory Mitigation), which contains the full text of the independent Forest Service analysis. Reviewers who seek additional information should review the applicable sections in appendix F.2. Section numbers that refer to sections in the appendix are so noted.

The Forest Service amendment process is described in section 1.3.3 of this DEIS and in section 1.1 of appendix F.2. The proposed amendments to Forest Service LRMPs are described in section 2.1.3.2 of this DEIS and in section 2 of appendix F.2. The Forest Service compensatory mitigation plans are discussed in sections 1.3.3 and 2.1.5 of this DEIS and throughout appendix F.2. The proposed Forest Plan amendments and related compensatory mitigation evaluated in this section are unique for each national forest and are addressed separately in the following sections.

Evaluation of Umpqua National Forest Proposed Forest Plan Amendments

The proposed Pacific Connector pipeline incorporates the most up-to-date engineering and technological practices for pipeline construction and operation. However, even with following these practices, it has been determined that one Forest Plan standard associated with rare and/or isolated species (Survey and Manage), and three Forest Plan standards associated with the soil, water, and riparian resources, would need to be modified so that the proposed construction and operation of the Pacific Connector pipeline can be in compliance with the Umpqua National Forest LRMP as amended by the NWFP and the January 2001 Record of Decision for Amendments to the Survey and Manage Protection Buffer, and Other Mitigation Measures Standards and Guidelines (Survey and Manage ROD). One additional amendment proposes to reallocate acres from the Matrix land allocation to the LSR land allocation.

Forest Plan Amendments Related to Rare Aquatic and Terrestrial Plant and Animal Communities (FS-1, UNF-4):

Amendment FS-1: Project-Specific Amendment to Exempt Management Recommendations for Survey and Manage Species on the Umpqua National Forest.

One Forest Plan standard associated with rare and/or isolated species (Survey and Manage) would need to be modified so that the proposed construction and operation of the Pacific Connector pipeline can be in compliance with the Umpqua National Forest LRMP as amended. This standard is:

- Management Direction: Manage All Known Sites (Survey and Manage ROD, Standards and Guidelines Page 8). Current and future known sites will be managed according to the

Management Recommendation for the species. Professional judgment, Appendix J2 in the Northwest Forest Plan Final SEIS, and appropriate literature will be used to guide individual site management for those species that do not have Management Recommendations.

The proposed amendment to this standard is:

- Management Direction: Manage All Known Sites (Survey and Manage ROD, Standards and Guidelines Page 8). Current and future known sites will be managed according to the Management Recommendation for the species, with the exception of the operational ROW and the construction zone for the Pacific Connector Pipeline, for which the applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented. Professional judgment, Appendix J2 in the Northwest Forest Plan Final SEIS, and appropriate literature will be used to guide individual site management for those species that do not have Management Recommendations. (Proposed amendment FS-1 on the Umpqua National Forest)

While the amendment would provide an exception to meeting this standard, there would also be requirements to do what is appropriate, applicable and feasible to minimize, maintain or restore, any effects of the pipeline's construction and operation on Survey and Manage species within the area affected by the pipeline. Consequently, each amended standard includes the requirement that the "applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented".

The purpose of this project-level amendment is to make the proposed Pacific Connector pipeline project consistent with the Umpqua National Forest LRMP. Thus, the substantive planning rule requirements that are directly related to this amendment are:

- 36 CFR 219.9(a)(2)(ii) – [the plan must include plan components to maintain or restore] "Rare aquatic and terrestrial plant and animal communities."
- 36 CFR 219.9(b)(1) – "The responsible official shall determine whether or not the plan components required by paragraph (a) provide ecological conditions necessary to: …maintain viable populations of each species of conservation concern within the plan area."

Because the proposed amendment is "directly related" to these two substantive requirements, the Responsible Official must apply the requirements within the scope and scale of the proposed amendment (36 CFR 219.13 (b)(5)).

In considering the "scope and scale" of the amendment, it is important to recognize that the applicable sections of 36 CFR 219.9(a) and (b) that are described above, requires plan components to maintain or restore rare aquatic and terrestrial plant and animal communities, across the entire planning area (i.e., the Umpqua National Forest). This plan amendment does not alter these LRMP plan requirements for managing rare plant and animal communities across 99.98 percent of the Umpqua National Forest. The proposed pipeline construction corridor including the temporary extra work areas (TEWAs) and the uncleared storage areas (UCSAs) is approximately 205 acres of the 983,129 acre Umpqua National Forest. Within this 205 acre construction corridor surveys have identified 107 Survey and Manage sites that could be potentially impacted by construction activities. The proposed amendment does not waive the persistence objective for Survey and Manage species. The analysis that was conducted (see section 4.6.4.3 of the DEIS and appendix F.5) determined the Survey and Manage persistence objectives would be met. This means that for Umpqua National Forest lands within the project area, individual sites of Survey and Manage species may be impacted or lost to construction activities, but affected species are expected to persist within the range of the NSO despite the loss of these individual sites.

The amendment modifies this standard so that in the 205 acres of the project construction area the project need not be in compliance with this standard' specific requirements but instead, it is the "applicable mitigation measures identified in the POD and the Pacific Connector Project design requirements" that must be implemented. Or stated in another way, for the 205 acres of National Forest lands that would be within the operational ROW and construction zone for the Pacific Connector Pipeline, the management requirement described above would be replaced with the full set of management requirements that comprise the "applicable mitigation measures identified in the POD and Pacific Connector Project Design requirements". The inclusion of these management requirements as a part of the plan component language for the LRMP in this plan amendment, addresses the applicable 36 CFR 219.9(a) and (b) rule requirements within the "scope and scale" of the proposed plan amendments. The sections below describe in more detail how the applicable 36 CFR 219.9(a) and (b) requirements are being addressed.

How the Required Mitigation Measures would Maintain or Restore Effects to Rare Aquatic and Terrestrial Plant and Animal Communities and Meet the Applicable 36 CFR 219.9(a) and 36 CFR 219.9 (b) Requirements

The Forest Service has worked to inventory, analyze, and evaluate rare aquatic, terrestrial plant and animal communities that could be affected by this project. In addition, a third-party consultant for technical support was also utilized in reviewing the information gathered for the project. The POD is a document developed between the Forest Service, BLM, FERC, and Pacific Connector that contains the design features, mitigation measures, roles and responsibilities, monitoring, and procedures for the construction and operation of the pipeline on NFS lands. In addition, FERC's applicant prepared Plan and Procedures for construction and restoration enforceable, where applicable, for additional design features and mitigation. The design requirements and mitigation measures of the POD would be required by the modified standards and incorporated into BLM's ROW grant.

The mitigation measures incorporated into amendments for Survey and Manage species are designed to minimize, maintain or restore the potential for habitat fragmentation, edge effects, and loss of long-term habitats associated with effected species. To ensure adequate restoration and revegetation of the ROW, design features are identified in the *Erosion Control and Revegetation Plan* (POD I), *Right-of-Way Clearing Plan* (POD U), *Leave Tree Protection Plan* (POD P). In addition, routing considerations were identified during project development to ensure avoidance of known populations of rare plant and animal communities (See Chapter 3, DEIS Route Design and Modifications on Forest Service Managed Lands). As well as, appendix F.5, *Survey and Manage Persistence Evaluations*, and proposed amendment UNF-4 Reallocation of Matrix Lands to LSR.

As a basis for Survey and Manage determinations, appendix F.5 provides background research on Survey and Manage species that could be affected by the Pacific Connector Project; a review of survey reports prepared by others for the Pacific Connector Project; and processing and analysis of spatial data obtained from the BLM, Forest Service, and other sources over the past 12 years. Background information was used in combination with new information available as a result of surveys for the Pacific Connector Project and recent surveys in other portions of old growth forests to discuss the currently known distribution of the species in old growth forests within the NSO range. Impacts to sites as a result of the Pacific Connector Project were analyzed to determine if the species would continue to have a reasonable assurance of persistence in the NSO range following implementation of the Pacific Connector Project, taking into consideration the status and distribution of the species and general habitat in the NSO range.

Some of the required mitigation measures in the POD sections to protect rare plant and animal communities include: flagging existing snags on the edges of the construction ROW or TEWAs where feasible to save from clearing; snags would be saved as and used in LWD placement post-construction to benefit primary and secondary cavity nesting birds, mammals, reptiles, and amphibians; other large diameter trees on the edges of the construction ROW and TEWAs would also be flagged to save/protect as green recruitment or habitat/shade trees, where feasible; trees would be girdled to create snags to augment the number of snags along the ROW to benefit cavity nesting birds, mammals, reptiles, and amphibians. See POD's P & U and 4.7—*Land Use* of the DEIS for a complete list of applicable mitigation measures for pipeline construction. Additional measures include low ground weight (pressure) vehicles would be used; logging machinery would be restricted to the 30-foot permanent ROW wherever possible to prevent soil compaction; the removal of soil duff layers would be avoided in order to maintain a cushion between the soil and the logs and the logging equipment; designed skid trails would be used to restrict detrimental soil disturbance (compaction and displacement) to a smaller area of the ROW over the pipeline trenching area; and the temporary construction area would be restored and revegetated using native seeds, to the extent possible, and saplings (POD I).

In an effort to minimize, maintain or restore the impacts to Survey and Manage species, Pacific Connector adopted route variations to avoid certain species identified in the Survey and Manage Persistence Evaluations by co-locating the proposed construction corridor adjacent to existing roads, through managed timber stands or otherwise avoid unique LSOG habitats to the maximum extent practicable (See chapter 3, DEIS Route Design and Modifications on Forest Service Managed Lands).

During construction of the Project, Compliance Monitors representing FERC are present on a full-time basis to inspect construction procedures and mitigation measures and provide regular feedback on compliance issues to FERC and the Forest Service. Objectives of the Compliance Monitoring program are to facilitate the timely resolution of compliance issues in the field; provide continuous information to FERC regarding noncompliance issues and their resolution; and review, process, and track construction-related variance requests. Changes to previously approved mitigation measures, construction procedures, and construction work areas due to unforeseen or unavoidable site conditions would require various levels of regulatory approval from the applicable land management agencies. FERC would have the authority to stop any activity that violates an environmental condition of the FERC authorization issued to Pacific Connector.

Additionally, environmental compliance oversight responsibilities for Pacific Connector, FERC, Forest Service and BLM are described in the POD (Environmental Briefings and Compliance Plan, POD G) that would apply to the construction, operation, and maintenance of the project specifically on NFS lands. The Forest Service Authorized Officer would coordinate with the BLM in administering and enforcing ROW grant provisions and would have stop-work authority. The Forest Service Authorized Officer's designated representatives would ensure that the stipulations and mitigation measures included in the POD that are designed to minimize, maintain or restore the effects to soil, water and riparian resources, are adhered to during project construction, operation, and maintenance. The BLM Authorized Officer would coordinate with the Forest Service to ensure the work is being conducted in accordance with the ROW grant and agreed upon conditions. BLM and the Forest Service would have stop-work authority. Field variance requests would be coordinated with the Authorized Officers.

Amendment UNF-4: Reallocation of Matrix Lands to LSR

The other proposed Forest Plan amendment related to rare aquatic and terrestrial plant and animal communities on the Umpqua National Forest is UNF-4. This proposed amendment would change the designation of approximately 585 acres from the Matrix land allocation to the LSR land allocation in Sections 7, 18, and 19, T.32S., R.2W.; and Sections 13 and 24, T.32S., R.3W., W.M., OR. (see figure 2.1-4). This change in land allocation is proposed as mitigation for the potential adverse impact of the Pacific Connector Pipeline project on LSR 223 on the Umpqua National Forest. This is a plan level amendment that would change future management direction for the lands reallocated from Matrix to LSR (for additional information on consistency with LSR Standards and Guidelines see section 4.7.3.6. and appendix F.3 of the DEIS).

The purpose of this amendment is to make the proposed Pacific Connector pipeline project consistent with the Umpqua National Forest LRMP. Thus, the substantive planning rule requirements that are directly related to this amendment are:

- 36 CFR 219.8(a)(1)(i) – [the plan must include plan components to maintain or restore] "Interdependence of terrestrial and aquatic ecosystems in the plan area."
- 36 CFR 219.8(b)(1) – [the plan must include plan components to guide the plan area's contribution to social and economic sustainability] "Social, cultural and economic conditions relevant to the area influenced by the plan."
- 36 CFR219.9(b)(1) "The responsible official shall determine whether or not the plan components required by paragraph (a) of this section provide the ecological conditions necessary to: contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern within the plan area,"
- 36 CFR 219.9(a)(2)(ii) – [the plan must include plan components to maintain or restore] "Rare aquatic and terrestrial plant and animal communities."

Because the proposed amendment is "directly related" to these four substantive requirements, the Responsible Official must apply the requirements within the scope and scale of the proposed amendment (36 CFR 219.13 (b)(5)). However, because this proposed amendment would simply modify the area to which existing direction applies, the existing formatting for the planning requirements listed above would be retained (36 CFR 219.13(b)(4)).

In considering the "scope and scale" of the amendment, it is important to recognize that the applicable sections of 36 CFR 219.8 and 219.9 that are described above, requires plan components to maintain or restore rare aquatic and terrestrial plant and animal communities, and provide for social and economic sustainability across the entire planning area (i.e., the Umpqua National Forest). This plan amendment does not alter these LRMP plan requirements across 99.94 percent of the Umpqua National Forest. The proposed land reallocation is approximately 585 acres of the 983,129 acre Umpqua National Forest. The proposed amendment would benefit rare aquatic and terrestrial plant and animal communities by placing these acres in a late successional reserve where providing habitat for these species is the primary goal.

The timber probable sale quantity (directly related to economic conditions) would not be affected before the Umpqua National Forest LRMP is revised because the Forest has the capacity to maintain probable sale quantity without the acres of matrix lands that would be reallocated to LSR. If a linear relationship between acres and outputs is assumed, the potential effect would be less than two-tenths of one percent of the Forest's probable sale quantity since this proposed amendment would affect less than two-tenths of one percent of the Forest's matrix land base. This proposed amendment would not prevent future vegetation management activities such as thinning that would benefit LSR habitat and could also contribute to the local forest products industry.

How the Compensatory Mitigation Actions would help to Maintain or Restore Rare Aquatic and Terrestrial Plant and Animal Communities in the Plan Area (36 CFR 219.9(a), 36 CFR 219.9 (b)).

In addition to reallocation of 585 acres of Matrix to LSR, the CMP on the Umpqua National Forest includes proposals for stand density fuel breaks on 3,105 acres, stand density management on 816 acres, terrestrial habitat improvements on 478 acres and decommissioning approximately 5 miles of roads that would benefit rare plant and animal communities. The CMP on the Umpqua National Forest also includes proposals to improve aquatic and riparian habitat that would benefit rare aquatic plant and animal communities (see the discussion of *How the Compensatory Mitigation Actions would help to Maintain or Restore the Ecological Integrity of Riparian Areas, Soils, and Soil productivity in the Plan Area (36 CFR 219.8(a)(3)(i), (36 CFR 219.8(a)(2)(ii))* below for a discussion of benefits to aquatic habitats).

Stand density fuel breaks would reduce the threat of losing late-successional habitat to fire. High intensity fire has been identified as the single factor most impacting late successional and old growth forest habitats on federal lands in the area of the NWFP. Construction of the pipeline and associated activities removes both mature and developing stands and would increase fire suppression complexity; however the corridor also provides a fuel break. Fuels reduction adjacent to the corridor would increase the effectiveness of the corridor as a fuel break. Density management would increase longevity of existing mature stands by reducing losses from disease, insects and fire. Stand density management and fuels reduction would lower the risk of loss of developing and existing mature stands and other valuable habitats to high-intensity fire.

Stand density management would enhance LSOG habitat by increasing the growth, health, and vigor of the trees remaining in the stands, and restoring species and structural diversity to those considered characteristic under a natural disturbance regime. Thinning of young stands is a recognized treatment within LSR if designed to accelerate development of late-successional habitat characteristics. The proposed treatments include 228 acres of pre-commercial thinning, 288 acres of commercial thinning and 300 acres of off-site pine removal. The Pacific Connector pipeline would result in additional fragmentation and preclude the recovery of fragmented habitat for those stands adjacent to the pipeline corridor. Both mature stands and developing stands would be removed during pipeline construction. Density management of forested stands would assist in the recovery of late-seral habitat, impact from fragmentation, reduction in edge effects and enhance resilience of mature stands over time. Accelerating development of mature forest characteristics would shorten the impacts of those biological services loss due to pipeline construction.

Terrestrial habitat improvements include proposals for large woody debris placement on 164 acres, snag creation on 324 acres, noxious weed treatments on 6.7 miles of road and 124 acres of Lupine meadow restoration. Large wood replacement would partially mitigate for the barrier effect of the corridor by creating structure across the corridor for use by small wildlife species. Placement in wood deficient areas adjacent to the corridor allows for scattering of stockpiled wood, reducing localized fuel loads while improving habitat in deficient stands. Larger logs maintain moisture longer and are less likely to be fully consumed by fire. Managing for the proposed levels provide for a greater assurance of species abundance. The objective of snag creation is to mitigate for the immediate and future impacts to snag habitat from the clearing of the pipeline ROW. The construction and operation of the pipeline project has the potential to create vectors for noxious weeds. The proposed noxious weed treatments are intended to reduce populations of noxious weeds that are in close proximity to the pipeline project ROW. The long-term benefits of meadow restoration would include the restoring of native plant populations and species diversity. Restoring native plant communities and increasing vegetation diversity generally contributes to restoring habitat for a broad group of plant and animal species.

Although the Pacific Connector project has been routed to avoid LSOG habitat as much as possible, the project would cause habitat fragmentation within LSR 223. Road decommissioning reduces the edge effects over time by revegetating road surfaces and eliminating road corridors. Revegetating selected roads in conjunction with the density management proposed for adjacent plantations would create larger blocks of late successional habitat in the future.

These projects have been designed by an interdisciplinary team of resource professionals on the Umpqua National Forest with input and coordination with the U.S. Fish and Wildlife Service, NOAA Fisheries, and State agencies. They were planned within the watersheds that would be affected by the Pacific Connector pipeline project. They are a component of the Pacific Connector application and would be a requirement of the ROW grant. Overall, these projects would help maintain and restore rare aquatic and terrestrial plant and animal communities on the Umpqua National Forest (see table 2.1.1-3 and 2.1.1-4 and figure 2.1-1 through 2.1-5 in appendix F.2 for additional information).

Forest Plan Amendments Related to Soil, Water and Riparian Areas (UNF-1, UNF-2, and UNF-3):

Three Forest Plan standards associated with the soil, water, and riparian resources would need to be modified so that the proposed construction and operation of the Pacific Connector pipeline can be in compliance with the Umpqua National Forest LRMP. These standards are:

- Standard & Guideline 1 (UNF LRMP IV-33). Maintain all effective shading vegetation on perennial streams. Utilize silvicultural practices to establish shade on perennial streams where currently lacking.

- Prescriptions C2-II (LRMP IV-173 par.1, 1st sentence) and C2-IV (LRMP IV-177 last par. last sentence) Utility/transportation corridors, roads or transmission lines may cross but must not parallel streams and lake shores within the riparian unit.
- Standard & Guideline 1 (UNF LRMP IV-67). The combined total amount of unacceptable soil condition (detrimental compaction, displacement, puddling or severely burned) within an activity area (e g., cutting unit, range allotment, site preparation area) should not exceed 20 percent. All roads and landings, unless rehabilitated to natural conditions, are considered to be in detrimental condition, and are included as part of this 20 percent.

The proposed amendments to these standards are:

- Standard & Guideline 1 (UNF LRMP IV-33). Maintain all effective shading vegetation on perennial streams, with the exception of the operational ROW and the construction zone for the Pacific Connector Pipeline, for which the applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented. Utilize silvicultural practices to establish shade on perennial streams where currently lacking. (proposed amendment UNF-1)
- Prescriptions C2-II (LRMP IV-173 par.1, 1st sentence) and C2-IV (LRMP IV-177 last par. last sentence) Utility/transportation corridors, roads or transmission lines may cross but must not parallel streams and lake shores within the riparian unit, with the exception of the operational ROW and the construction zone for the Pacific Connector Pipeline, for which the applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented. (proposed amendment UNF-2)
- Standard and Guideline 1 (UNF LRMP IV-67). The combined total amount of unacceptable soil condition (detrimental compaction, displacement, puddling or severely burned) within an activity area (e g., cutting unit, range allotment, site preparation area) should not exceed 20 percent. All roads and landings, unless rehabilitated to natural conditions, are considered to be in detrimental condition, and are included as part of this 20 percent, with the exception of the operational ROW and the construction zone for the Pacific Connector Pipeline, for which the applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented. (proposed amendment UNF-3)

While the amendments would provide an exception to meeting these standards, there would also be requirements to do what is appropriate, applicable and feasible to minimize, maintain or restore any effects of the pipeline's construction and operation on the soil, water and riparian resources within the area affected by the pipeline. Consequently, each amended standard includes the requirement that the "applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented".

The purpose of these three project-level amendments is to make the proposed Pacific Connector pipeline project consistent with the Umpqua National Forest LRMP. Thus, the substantive planning rule requirements that are directly related to these three amendments are:

- 36 CFR 219.8(a)(3)(i) – The plan must include plan components "to maintain or restore the ecological integrity of riparian areas in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity.

- 36 CFR 219.8(a)(2)(ii) – [The plan must include plan components to maintain or restore] "soils and soil productivity, including guidance to reduce soil erosion and sedimentation."

Because the three proposed amendments are "directly related" to these two substantive requirements, the Responsible Official must apply the requirements within the scope and scale of the proposed amendments (36 CFR 219.13 (b)(5)).

In considering the "scope and scale" of the three amendments, it is important to recognize that the applicable sections of 36 CFR 219.8(a) that are described above, requires plan components to "maintain or restore" the soil, water and riparian resources across the entire planning area (i.e., the Umpqua National Forest). These plan amendments do not alter these LRMP plan requirements for managing the soil, water, and riparian resources across 99.98 percent of the Umpqua National Forest. The proposed pipeline construction corridor including the TEWAs and the UCSAs is approximately 205 acres of the 983,129 acre Umpqua National Forest. Of the 205 acres of pipeline corridor construction it is estimated that approximately 4 of these acres would not meet the standards for riparian area management described above and approximately 54 to 127 acres would not meet standards for soils described above.

The amendments modify three standards so that in the 205 acres of the project construction area the project need not be in compliance with these standards' specific requirements but instead, it is the "applicable mitigation measures identified in the POD and the Pacific Connector Project design requirements" that must be implemented. Or stated in another way, for the 205 acres of National Forest lands that would be within the operational ROW and construction zone for the Pacific Connector Pipeline, the three management requirements described above would be replaced with the full set of management requirements that comprise the "applicable mitigation measures identified in the POD and Pacific Connector Project Design requirements". The inclusion of these management requirements as a part of the plan component language for the LRMP in this plan amendment, addresses the applicable 36 CFR 219.8(a) rule requirements within the "scope and scale" of these proposed plan amendments. The sections below describe in more detail how the applicable 36 CFR 219.8(a) requirements are being addressed.

How the Required Mitigation Measures would Maintain or Restore Effects to Soil, Water, and Riparian Resources and Meet the Applicable 36 CFR 219.8(a) Requirements

The Forest Service has worked with Pacific Connector Gas Pipeline to inventory, analyze, and evaluate the geologic, soil, and hydrologic resources that could be affected by this project. In addition, a third-party consultant for technical support was also utilized in reviewing the information gathered for the project. The POD is a document developed between the Forest Service, BLM, FERC, and Pacific Connector that contains the design features, mitigation measures, roles and responsibilities, monitoring, and procedures for the construction and operation of the pipeline on NFS lands. In addition, FERC's applicant prepared Plan and Procedures for construction and restoration are enforceable, where applicable, for additional design features and mitigation. The design requirements and mitigation measures of the POD would be required by the modified standards and incorporated into BLM's ROW grant.

The mitigation measures, incorporated into amendments for soil, water, and riparian resources are designed to minimize, maintain or restore the potential for soil movement, slope stability, water quality, and to ensure adequate restoration and revegetation. These measures are identified in: the

Erosion Control and Revegetation Plan (POD I); *Right-of-Way Clearing Plan* (POD U); *Wetland and Waterbody Crossing Plan* (POD BB); the *Forest Service Site Specific Stream Crossing Prescriptions* (NSR 2014); the *Stream Crossing Risk Analysis*; and *Stream Crossing Risk Analysis Addendum* (GeoEngineers 2017d, 2018a). Pacific Connector would also follow the FERC's applicant prepared Wetland Procedures and the Best Management Practices for the State of Oregon. To further reduce potential for landslides on steep slopes, the Forest Service, BLM, and FERC are also recommending additional industry best management practices and measures identified from the *Technical Report on Soil Risk and Sensitivity Assessment* (NSR 2014) be incorporated into Pacific Connector's terms and conditions of the ROW Grant as described in the POD's identified above. See 4.2.3.3 of the DEIS for a description of soil risk and sensitivity assessment.

Areas with soils rated moderate to very high for risk or sensitivity (39 acres total) would be recommended for more site-specific validation of the risk criteria used in the *Technical Report on Soil Risk and Sensitivity Assessment* (NSR 2014) to confirm that specific locations merit consideration of the more aggressive soil remediation measures, such as: a 2- to 3-inch organic mulch surface application (80 percent coverage) of woodchips, logging slash, and/or straw; adaptive seed mixes and vegetation to better fit site conditions; deep subsoil decompaction with hydraulic excavators that leave constructed corridor mounded and rough with maximum water infiltration so that water cannot flow downhill for any appreciable distance; more aggressive use of constructed surface water runoff dispersion structures such as closely placed and more pronounced slope dips and water bars, etc.; more aggressive use of constructed surface runoff entrapments such as silt fencing, sediment settling basins, or straw bale structures, etc.; more aggressive placement (100 percent coverage) and depth (3 to 4 inches) of ground cover using woodchips, logging slash, straw bales, wattles (see POD's U and I). In efforts to protect soil productivity, topsoil segregation would be required for pipeline construction at wetland and waterbody crossings on NFS lands (POD U).

Some of the required mitigation measures in the POD BB and *Forest Service Site Specific Stream Crossing Prescriptions* (NSR 2014) to protect wetlands and minimize, maintain or restore compaction include: limiting the construction ROW width to 75 feet through wetlands; placing equipment on mats; using low-pressure ground equipment; limiting equipment operation and construction traffic along the ROW; locating temporary workspace (TEWAS) more than 50 feet away from wetland boundaries; cutting vegetation at ground level; limiting stump removal to the construction trench; segregating the top 12 inches of soil, or to the depth of the topsoil horizon; using "push-pull" techniques in saturated wetlands; limiting the amount of time that the trench is open by not trenching until the pipe is assembled and ready for installation; not using imported rock and soils for backfill; and not using fertilizer, lime, or mulch during restoration in wetlands. Pacific Connector must also follow the FERC Waterbody and Wetland Construction and Mitigation Procedures. See 4.3.3.2 of the DEIS for a complete list of applicable mitigation measures for pipeline construction at specific waterbody and stream crossings.

In an effort to minimize, maintain or restore the impacts to streams and riparian areas, Pacific Connector adopted route variations to co-locate the proposed construction corridor adjacent to existing roads and along dry ridge tops (See Chapter 3, DEIS Route Design and Modifications on Forest Service Managed Lands). In addition, Pacific Connector has committed to limit construction at waterbody crossings to times of dry weather or low water flow. Pacific Connector would implement the required erosion control measures at the proposed stream crossings to minimize, maintain or restore potential erosion and sedimentation impacts. The applicable mitigation measures and monitoring requirements in the POD relating to water waterbody crossings are included in the *Site Specific Forest Service Stream Crossing Prescriptions, and Wetland and Waterbody Crossing Plan* (POD BB). In addition, applicable mitigation measures from the FERC approved applicant prepared Procedures for Wetland and Waterbody Crossings would be required.

During construction of the Project, Compliance Monitors representing FERC are present on a full-time basis to inspect construction procedures and mitigation measures and provide regular feedback on compliance issues to FERC and the Forest Service. Objectives of the Compliance Monitoring program are to: facilitate the timely resolution of compliance issues in the field; provide continuous information to FERC regarding noncompliance issues and their resolution; and review, process, and track construction-related variance requests. Changes to previously approved mitigation measures, construction procedures, and construction work areas due to unforeseen or unavoidable site conditions would require various levels of regulatory approval from the applicable land management agencies. FERC would have the authority to stop any activity that violates an environmental condition of the FERC authorization issued to Pacific Connector.

Additionally, environmental compliance oversight responsibilities for Pacific Connector, FERC, Forest Service and BLM are described in the POD (Environmental Briefings and Compliance Plan, POD G) that would apply to the construction, operation, and maintenance of the project specifically on NFS lands. The Forest Service Authorized Officer would coordinate with the BLM in administering and enforcing ROW grant provisions and would have stop-work authority. The Forest Service Authorized Officer's designated representatives would ensure that the stipulations and mitigation measures included in the POD that are designed to minimize, maintain or restore the effects to soil, water and riparian resources, are adhered to during project construction, operation, and maintenance. The BLM Authorized Officer would coordinate with the Forest Service to ensure the work is being conducted in accordance with the ROW grant and agreed upon conditions. BLM and the Forest Service would have stop-work authority. Field variance requests would be coordinated with the Authorized Officers.

How the Compensatory Mitigation Actions would help to Maintain or Restore the Ecological Integrity of Riparian Areas, Soils, and Soil productivity in the Plan Area (36 CFR 219.8(a)(3)(i), (36 CFR 219.8(a)(2)(ii)).

Part of the CMP on the Umpqua National Forest includes proposals to remove eleven old culverts that may block fish passage either by poor design or by failure over time, decommission approximately 7.2 miles and storm proof approximately 11.4 miles of road.

Removing culverts that block fish passage and replacing them with fish-friendly designs can allow fish and other aquatic organisms to access previously unavailable habitat. Stream crossing replacement would directly improve stream connectivity and habitat for aquatic species by immediately restoring access to formerly inaccessible habitats. Indirectly, these projects would reduce potential sediment levels in the long term by decreasing the potential for road failure. Stream crossing projects also reduce stream velocities by increasing stream crossing sizes, eliminating flow restrictions and allowing passage to additional reaches of habitat by removing barriers to aquatic species which improves access to spawning and rearing habitat and allows unrestricted movement throughout stream reaches during seasonal changes in water levels (Hoffman 2007).

Decommissioning and storm proofing roads can substantially reduce sediment delivery to streams (Madej 2000; Keppeler et al. 2007). Proposed road decommissioning and storm proofing would increase infiltration of precipitation, reduce surface runoff, and reduce sediment production from road-related surface erosion in the watershed where the impacts from the Project would occur. Decommissioning roads would restore natural drainage patterns and thereby avoid large volumes of added sediment to the stream network that would be likely to eventually occur. In addition limited road maintenance dollars could be focused on the remaining road systems resulting in more maintenance of culverts and ditchlines resulting in less potential for catastrophic failure. Madej (2000) concluded that by eliminating the risk of stream diversions and culvert failures, road removal treatments significantly reduce long-term sediment production from retired logging roads.

These projects have been designed by an interdisciplinary team of resource professionals on the Umpqua National Forest with input and coordination with the U.S. Fish and Wildlife Service, NOAA Fisheries, and State agencies. They were planned within the watersheds that would be affected by the Pacific Connector pipeline project. They are a component of the Pacific Connector application and would be a requirement of the ROW grant. Overall, these projects would help maintain and restore riparian and soil resources on the Umpqua National Forest (see table 2.1.1-3 and 2.1.1-4 and figure 2.1-1 through 2.1-5 in appendix F.2 for additional information).

Evaluation of Rogue River National Forest Proposed Forest Plan Amendments

The proposed Pacific Connector pipeline incorporates the most up-to-date engineering and technological practices for pipeline construction and operation. However, even with following these practices, it has been determined that one Forest Plan standard associated with rare and/or isolated species (Survey and Manage), two Forest Plan standards associated with the soil, water, and riparian resources, and four Forest Plan standards associated with visual resources would need to be modified so that the proposed construction and operation of the Pacific Connector pipeline can be in compliance with the Rogue River National Forest LRMP as amended by the NWFP and the January 2001 Survey and Manage ROD.

Forest Plan Amendments Related to Rare Aquatic and Terrestrial Plant and Animal Communities (FS-1, RRNF-7):

*Amendment FS-1**:** Project-Specific Amendment to Exempt Management Recommendations for Survey and Manage Species on the Rogue River National Forest.*

One Forest Plan standard associated with rare and/or isolated species (Survey and Manage) would need to be modified so that the proposed construction and operation of the Pacific Connector pipeline can be in compliance with the Rogue River National Forest LRMP as amended by the NWFP and the January 2001 Survey and Manage ROD. This standard is:

- Management Direction: Manage All Known Sites (Survey and Manage ROD, Standards and Guidelines Page 8). Current and future known sites will be managed according to the Management Recommendation for the species. Professional judgment, Appendix J2 in the Northwest Forest Plan Final SEIS, and appropriate literature will be used to guide individual site management for those species that do not have Management Recommendations.

The proposed amendment to this standard is:

- Management Direction: Manage All Known Sites (Survey and Manage ROD, Standards and Guidelines Page 8). Current and future known sites will be managed according to the Management Recommendation for the species, with the exception of the operational ROW and the construction zone for the Pacific Connector Pipeline, for which the applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented. Professional judgment, Appendix J2 in the Northwest Forest Plan Final SEIS, and appropriate literature will be used to guide individual site management for those species that do not have Management Recommendations. (Proposed amendment FS-1 on the Rogue River National Forest)

While the amendment would provide an exception to meeting this standard, there would also be requirements to do what is appropriate, applicable and feasible to minimize, maintain or restore any effects of the pipeline's construction and operation on Survey and Manage species within the area affected by the pipeline. Consequently, each amended standard includes the requirement that the "applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented".

The purpose of this project-level amendment is to make the proposed Pacific Connector pipeline project consistent with the Rogue River National Forest LRMP. Thus, the substantive planning rule requirements that are directly related to this amendment are:

- 36 CFR 219.9(a)(2)(ii) – [the plan must include plan components to maintain or restore] "Rare aquatic and terrestrial plant and animal communities."
- 36 CFR 219.9(b)(1) – "The responsible official shall determine whether or not the plan components required by paragraph (a) provide ecological conditions necessary to: …maintain viable populations of each species of conservation concern within the plan area."

Because the proposed amendment is "directly related" to these two substantive requirements, the Responsible Official must apply the requirements within the scope and scale of the proposed amendment (36 CFR 219.13 (b)(5)).

In considering the "scope and scale" of the amendment, it is important to recognize that the applicable sections of 36 CFR 219.9(a) and (b) that are described above, requires plan components to maintain or restore rare aquatic and terrestrial plant and animal communities, across the entire planning area (i.e., the Rogue River National Forest). This plan amendment does not alter these LRMP plan requirements for managing rare plant and animal communities across 99.97 percent of the Rogue River National Forest. The proposed pipeline construction corridor including the TEWAs and the UCSAs is approximately 206 acres of the 628,443 acre Rogue River National Forest. Within this 206 acre construction corridor surveys have identified 36 Survey and Manage sites that could be potentially impacted by construction activities. The proposed amendment does not waive the persistence objective for Survey and Manage species. The analysis that was conducted (see section 4.6.4.3 of the DEIS and appendix F.5) determined the Survey and Manage persistence objectives would be met. This means that for Rogue River National Forest lands within the project area, individual sites of Survey and Manage species may be impacted or lost to construction activities, but affected species are expected to persist within the range of the NSO despite the loss of these individual sites.

The amendment modifies this standard so that in the 206 acres of the project construction area the project need not be in compliance with this standard' specific requirements but instead, it is the "applicable mitigation measures identified in the POD and the Pacific Connector Project design requirements" that must be implemented. Or stated in another way, for the 206 acres of National Forest lands that would be within the operational ROW and construction zone for the Pacific Connector Pipeline, the management requirement described above would be replaced with the full set of management requirements that comprise the "applicable mitigation measures identified in the POD and Pacific Connector Project Design requirements". The inclusion of these management requirements as a part of the plan component language for the LRMP in this plan amendment, addresses the applicable 36 CFR 219.9(a) and (b) rule requirements within the "scope and scale" of the proposed plan amendments. The sections below describe in more detail how the applicable 36 CFR 219.9(a) and (b) requirements are being addressed.

How the Required Mitigation Measures would Maintain or Restore Effects to Rare Aquatic and Terrestrial Plant and Animal Communities and Meet the Applicable 36 CFR 219.9(a) and 36 CFR 219.9 (b) Requirements

The Forest Service has worked to inventory, analyze, and evaluate rare aquatic, terrestrial plant and animal communities that could be affected by this project. In addition, a third-party consultant for technical support was also utilized in reviewing the information gathered for the project. The POD is a document developed between the Forest Service, BLM, FERC, and Pacific Connector that contains the design features, mitigation measures, roles and responsibilities, monitoring, and procedures for the construction and operation of the pipeline on NFS lands. In addition, FERC's applicant prepared Plan and Procedures for construction and restoration enforceable, where applicable, for additional design features and mitigation. The design requirements and mitigation measures of the POD would be required by the modified standards and incorporated into BLM's ROW grant.

The mitigation measures incorporated into amendments for Survey and Manage species are designed to minimize, maintain or restore the potential for habitat fragmentation, edge effects, and loss of long-term habitats associated with effected species. To ensure adequate restoration and revegetation of the ROW, design features are identified in the *Erosion Control and Revegetation Plan* (POD I), *Right-of-Way Clearing Plan* (POD U), *Leave Tree Protection Plan* (POD P). In addition, routing considerations were identified during project development to ensure avoidance of known populations of rare plant and animal communities (See Chapter 3, DEIS Route Design and Modifications on Forest Service Managed Lands). As well as, appendix F.5, *Survey and Manage Persistence Evaluations*, and proposed amendment RRNF-7 Reallocation of Matrix Lands to LSR.

As a basis for Survey and Manage determinations, appendix F.5 provides background research on Survey and Manage species that could be affected by the Pacific Connector Project; a review of survey reports prepared by others for the Pacific Connector Project; and processing and analysis of spatial data obtained from the Bureau of Land Management (BLM), Forest Service, and other sources over the past 12 years. Background information was used in combination with new information available as a result of surveys for the Pacific Connector Project and recent surveys in other portions of old growth forests to discuss the currently known distribution of the species in old growth forests within the NSO range. Impacts to sites as a result of the Pacific Connector Project were analyzed to determine if the species would continue to have a reasonable assurance of persistence in the NSO range following implementation of the Pacific Connector Project, taking into consideration the status and distribution of the species and general habitat in the NSO range.

Some of the required mitigation measures in the POD sections to protect rare plant and animal communities include: flagging existing snags on the edges of the construction ROW or TEWAs where feasible to save from clearing; snags would be saved as and used in LWD placement post-construction to benefit primary and secondary cavity nesting birds, mammals, reptiles, and amphibians; other large diameter trees on the edges of the construction ROW and TEWAs would also be flagged to save/protect as green recruitment or habitat/shade trees, where feasible; trees would be girdled to create snags to augment the number of snags along the ROW to benefit cavity nesting birds, mammals, reptiles, and amphibians. See POD's P & U and 4.7—*Land Use* of the DEIS for a complete list of applicable mitigation measures for pipeline construction. Additional measures include low ground weight (pressure) vehicles would be used; logging machinery would be restricted to the 30-foot permanent ROW wherever possible to prevent soil compaction; the removal of soil duff layers would be avoided in order to maintain a cushion between the soil and the logs and the logging equipment; designed skid trails would be used to restrict detrimental soil disturbance (compaction and displacement) to a smaller area of the ROW over the pipeline trenching area; and the temporary construction area would be restored and revegetated using native seeds, to the extent possible, and saplings (POD I).

In an effort to minimize, maintain or restore the impacts to Survey and Manage species, Pacific Connector adopted route variations to avoid certain species identified in the Survey and Manage Persistence Evaluations by co-locating the proposed construction corridor adjacent to existing roads, through managed timber stands or otherwise avoid unique LSOG habitats to the maximum extent practicable (See Chapter 3, DEIS Route Design and Modifications on Forest Service Managed Lands).

During construction of the Project, Compliance Monitors representing FERC are present on a full-time basis to inspect construction procedures and mitigation measures and provide regular feedback on compliance issues to FERC and the Forest Service. Objectives of the Compliance Monitoring program are to facilitate the timely resolution of compliance issues in the field; provide continuous information to FERC regarding noncompliance issues and their resolution; and review, process, and track construction-related variance requests. Changes to previously approved mitigation measures, construction procedures, and construction work areas due to unforeseen or unavoidable site conditions would require various levels of regulatory approval from the applicable land management agencies. FERC would have the authority to stop any activity that violates an environmental condition of the FERC authorization issued to Pacific Connector.

Additionally, environmental compliance oversight responsibilities for Pacific Connector, FERC, Forest Service and BLM are described in the POD (Environmental Briefings and Compliance Plan, POD G) that would apply to the construction, operation, and maintenance of the project specifically on NFS lands. The Forest Service Authorized Officer would coordinate with the BLM in administering and enforcing ROW grant provisions and would have stop-work authority. The Forest Service Authorized Officer's designated representatives would ensure that the stipulations and mitigation measures included in the POD that are designed to minimize, maintain or restore the effects to soil, water and riparian resources, are adhered to during project construction, operation, and maintenance. The BLM Authorized Officer would coordinate with the Forest Service to ensure the work is being conducted in accordance with the ROW grant and agreed upon conditions. BLM and the Forest Service would have stop-work authority. Field variance requests would be coordinated with the Authorized Officers.

Amendment RRNF-7: Reallocation of Matrix Lands to LSR

The other proposed Forest Plan amendment related to rare aquatic and terrestrial plant and animal communities on the Rogue River National Forest is RRNF-7. This proposed amendment would change the designation of approximately 522 acres from the Matrix land allocation to the LSR land allocation in Section 32, T.36S., R.4E. W.M., OR. (see figure 2.2-1). This change in land allocation is proposed as mitigation for the potential adverse impact of the Pacific Connector Pipeline project on LSR 227 on the Rogue River National Forest. This is a plan level amendment that would change future management direction for the lands reallocated from Matrix to LSR (for additional information on consistency with LSR Standards and Guidelines see section 4.7.3.6. and appendix F.3 of the DEIS).

The purpose of this amendment is to make the proposed Pacific Connector pipeline project consistent with the Rogue River National Forest LRMP. Thus, the substantive planning rule requirements that are directly related to this amendment are:

- 36 CFR 219.8(a)(1)(i) – [the plan must include plan components to maintain or restore] “Interdependence of terrestrial and aquatic ecosystems in the plan area.”
- 36 CFR 219.8(b)(1) – [the plan must include plan components to guide the plan area’s contribution to social and economic sustainability] “Social, cultural and economic conditions relevant to the area influenced by the plan.”
- 36 CFR219.9(b)(1) “The responsible official shall determine whether or not the plan components required by paragraph (a) of this section provide the ecological conditions necessary to: contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern within the plan area,”
- 36 CFR 219.9(a)(2)(ii) – [the plan must include plan components to maintain or restore] “Rare aquatic and terrestrial plant and animal communities.”

Because the proposed amendment is “directly related” to these four substantive requirements, the Responsible Official must apply the requirements within the scope and scale of the proposed amendment (36 CFR 219.13 (b)(5)). However, because this proposed amendment would simply modify the area to which existing direction applies, the existing formatting for the planning requirements listed above would be retained (36 CFR 219.13(b)(4)).

In considering the “scope and scale” of the amendment, it is important to recognize that the applicable sections of 36 CFR 219.8 and 219.9 that are described above, requires plan components to maintain or restore rare aquatic and terrestrial plant and animal communities, and provide for social and economic sustainability across the entire planning area (i.e., the Rogue River National Forest). This plan amendment does not alter these LRMP plan requirements across 99.92 percent of the Rogue River National Forest. The proposed land reallocation is approximately 522 acres of the 628,443 acre Rogue River National Forest. The proposed amendment would benefit rare aquatic and terrestrial plant and animal communities by placing these acres in a late successional reserve where providing habitat for these species is the primary goal.

The timber probable sale quantity (directly related to economic conditions) would not be affected before the Rogue River National Forest LRMP is revised because the Forest has the capacity to maintain probable sale quantity without the acres of matrix lands that would be reallocated to LSR. If a linear relationship between acres and outputs is assumed, the potential effect would be less than one-half of one percent of the Forest's probable sale quantity since this proposed amendment would affect less than one-half of one percent of the Forest's matrix land base. This proposed amendment would not prevent future vegetation management activities such as thinning that would benefit LSR habitat and could also contribute to the local forest products industry.

How the Compensatory Mitigation Actions would help to Maintain or Restore Rare Aquatic and Terrestrial Plant and Animal Communities in the Plan Area (36 CFR 219.9(a), 36 CFR 219.9 (b)).

In addition to the reallocation of 522 acres of Matrix to LSR, the CMP on the Rogue River National Forest includes proposals for stand density management on 618 acres, terrestrial habitat improvements on 1153 acres and decommissioning approximately 57.5 miles of roads that would benefit rare plant and animal communities. The CMP on the Rogue River National Forest also includes proposals to improve aquatic and riparian habitat that would benefit rare aquatic plant and animal communities (see the discussion of **How the Compensatory Mitigation Actions would help to Maintain or Restore the Ecological Integrity of Riparian Areas, Soils, and Soil productivity in the Plan Area (36 CFR 219.8(a)(3)(i), (36 CFR 219.8(a)(2)(ii))** below for a discussion of benefits to aquatic habitats).

Stand density management would enhance LSOG habitat by increasing the growth, health, and vigor of the trees remaining in the stands, and restoring species and structural diversity to those considered characteristic under a natural disturbance regime. Thinning of young stands is a recognized treatment within LSR if designed to accelerate development of late-successional habitat characteristics. The proposed treatments include 618 acres of pre-commercial thinning. The Pacific Connector pipeline would result in additional fragmentation and preclude the recovery of fragmented habitat for those stands adjacent to the pipeline corridor. Both mature stands and developing stands would be removed during pipeline construction. Density management of forested stands would assist in the recovery of late-seral habitat, impact from fragmentation, reduction in edge effects and enhance resilience of mature stands over time. Accelerating development of mature forest characteristics would shorten the impacts of those biological services loss due to pipeline construction.

Terrestrial habitat improvements include proposals for large woody debris placement on 511 acres, snag creation on 622 acres, and 20 acres of habitat planting for the Mardon Skipper butterfly. Large wood replacement would partially mitigate for the barrier effect of the corridor by creating structure across the corridor for use by small wildlife species. Placement in wood deficient areas adjacent to the corridor allows for scattering of stockpiled wood, reducing localized fuel loads while improving habitat in deficient stands. Larger logs maintain moisture longer and are less likely to be fully consumed by fire. Managing for the proposed levels provide for a greater assurance of species abundance. The objective of snag creation is to mitigate for the immediate and future impacts to snag habitat from the clearing of the pipeline ROW. The Dead Indian Plateau region is one of four known sites for Mardon Skipper butterflies in the world. It is also adjacent to a known site for Short-horned grasshoppers. Both of these species are on the Regional Forester's Sensitive Species list. As a long-term opening, the pipeline corridor would provide a unique opportunity to develop habitat for these two species. Planting the corridor with plants preferred by these species has the potential to increase the habitat and local range for both species. This action would provide both short-term and long-term habitat for the local population of Mardon Skipper butterflies and Short-horned grasshoppers.

Although the Pacific Connector project has been routed to avoid LSOG habitat as much as possible, the project would cause habitat fragmentation within LSR 227. Road decommissioning reduces the edge effects over time by revegetating road surfaces and eliminating road corridors. Revegetating selected roads in conjunction with the density management proposed for adjacent plantations would create larger blocks of late successional habitat in the future.

These projects have been designed by an interdisciplinary team of resource professionals on the Rogue River National Forest with input and coordination with the U.S. Fish and Wildlife Service, NOAA Fisheries, and State agencies. They were planned within the watersheds that would be affected by the Pacific Connector pipeline project. They are a component of the Pacific Connector application and would be a requirement of the ROW grant. Overall, these projects would help maintain and restore rare aquatic and terrestrial plant and animal communities on the Rogue River National Forest (see table 2.2.1-3 and 2.2.1-4 and figure 2.2-1 and 2.2-2 in appendix F.2 for additional information).

Forest Plan Amendments Related to Soil, Water and Riparian Areas (RRNF -5, RRNF-6):

Two Forest Plan standards associated with the soil, water, and riparian resources would need to be modified so that the proposed construction and operation of the Pacific Connector pipeline can be in compliance with the Rogue River National Forest LRMP. These standards are:

- Management Prescription 26 Restricted Riparian Standard & Guidelines for Facilities (10), (RRNF LRMP 4-308). Helispots and transmission corridors should be located outside this management area.
- Standard & Guideline for Soils (3) (RRNF LRMP 4-41, 4-83, 4-97, 4-123, 4-177, 4-307). No more than 10 percent of an activity area should be compacted, puddled or displaced upon completion of project (not including permanent roads or landings). No more than 20 percent of the area should be displaced or compacted under circumstances resulting from previous management practices, including roads and landings. Permanent recreation facilities or other permanent facilities are exempt.

The proposed amendments to these standards are:

- Management Prescription 26 Restricted Riparian Standard & Guidelines for Facilities (10), (RRNF LRMP 4-308). Helispots and transmission corridors should be located outside this management area, **with the exception of the operational right-of-way and the construction zone for the Pacific Connector Pipeline, for which the applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented**. (Proposed amendment RRNF-5)

- Standard & Guideline for Soils (3) (RRNF LRMP 4-41, 4-83, 4-97, 4-123, 4-177, 4-307). No more than 10 percent of an activity area should be compacted, puddled or displaced upon completion of project (not including permanent roads or landings). No more than 20 percent of the area should be displaced or compacted under circumstances resulting from previous management practices, including roads and landings, with the exception of the operational ROW and the construction zone for the Pacific Connector Pipeline, for which the applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented. Permanent recreation facilities or other permanent facilities are exempt. (Proposed amendment RRNF-6)

While the amendments would provide an exception to meeting these standards, there would also be requirements to do what is appropriate, applicable and feasible to minimize, maintain or restore any effects of the pipeline's construction and operation on the soil, water and riparian resources within the area affected by the pipeline. Consequently, each amended standard includes the requirement that the "applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented".

The purpose of these two project-level amendments is to make the proposed Pacific Connector pipeline project consistent with the Rogue River National Forest LRMP. Thus, the substantive planning rule requirements that are directly related to these three amendments are:

- 36 CFR 219.8(a)(3)(i) – The plan must include plan components "to maintain or restore the ecological integrity of riparian areas in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity
- 36 CFR 219.8(a)(2)(ii) – [The plan must include plan components to maintain or restore] "soils and soil productivity, including guidance to reduce soil erosion and sedimentation."

Because the two proposed amendments are "directly related" to these two substantive requirements, the Responsible Official must apply the requirements within the scope and scale of the proposed amendments (36 CFR 219.13 (b)(5)).

In considering the "scope and scale" of the two amendments, it is important to recognize that the applicable sections of 36 CFR 219.8(a) that are described above, requires plan components to "maintain or restore" the soil, water and riparian resources across the entire planning area (i.e., the Rogue River National Forest). These plan amendments do not alter these LRMP plan requirements for managing the soil, water, and riparian resources across 99.97 percent of the Rogue River National Forest. The proposed pipeline construction corridor including the TEWAs and the UCSAs is approximately 206 acres of the 628,443 acre Rogue River National Forest. Of the 206 acres of pipeline corridor construction it is estimated that approximately 2.5 of these acres would not meet the standards for riparian area management described above and approximately 62 to 144 acres would not meet standards for soils described above.

The amendments modify two standards so that in the 206 acres of the project construction area the project need not be in compliance with these standards' specific requirements but instead, it is the "applicable mitigation measures identified in the POD and the Pacific Connector Project design requirements" that must be implemented. Or stated in another way, for the 206 acres of National Forest lands that would be within the operational ROW and construction zone for the Pacific Connector Pipeline, the two management requirements described above would be replaced with the full set of management requirements that comprise the "applicable mitigation measures identified in the POD and Pacific Connector Project Design requirements". The inclusion of these management requirements as a part of the plan component language for the LRMP in this plan amendment, addresses the applicable 36 CFR 219.8(a) rule requirements within the "scope and scale" of these proposed plan amendments. The sections below describe in more detail how the applicable 36 CFR 219.8(a) requirements are being addressed.

How the Required Mitigation Measures would Maintain or Restore Effects to Soil, Water, and Riparian Resources and Meet the Applicable 36 CFR 219.8(a) Requirements.

The Forest Service has worked with Pacific Connector Gas Pipeline to inventory, analyze, and evaluate the geologic, soil, and hydrologic resources that could be affected by this project. In addition, a third-party consultant for technical support was also utilized in reviewing the information gathered for the project. The POD is a document developed between the Forest Service, BLM, FERC, and Pacific Connector that contains the design features, mitigation measures, roles and responsibilities, monitoring, and procedures for the construction and operation of the pipeline on NFS lands. In addition, FERC's applicant prepared Plan and Procedures for construction and restoration are enforceable, where applicable, for additional design features and mitigation. The design requirements and mitigation measures of the POD would be required by the modified standards and incorporated into BLM's ROW grant.

The mitigation measures, incorporated into amendments for soil, water, and riparian resources are designed to minimize, maintain or restore the potential for soil movement, slope stability, water quality, and to ensure adequate restoration and revegetation. These measures are identified in: the *Erosion Control and Revegetation Plan* (POD I); *Right-of-Way Clearing Plan* (POD U); *Wetland and Waterbody Crossing Plan* (POD BB); the *Forest Service Site Specific Stream Crossing Prescriptions* (NSR 2014); the *Stream Crossing Risk Analysis*; and *Stream Crossing Risk Analysis Addendum* (GeoEngineers2017d, 2018a). Pacific Connector would also follow the FERC's applicant prepared Wetland Procedures and the Best Management Practices for the State of Oregon. To further reduce potential for landslides on steep slopes, the Forest Service, BLM, and FERC are also recommending additional industry best management practices and measures identified from the *Technical Report on Soil Risk and Sensitivity Assessment* (NSR 2014) be incorporated into Pacific Connector's terms and conditions of the ROW Grant as described in the POD's identified above. See 4.2.3.3 of the DEIS for a description of soil risk and sensitivity assessment.

Areas with soils rated moderate to very high for risk or sensitivity (17 acres total) would be recommended for more site-specific validation of the risk criteria used in the *Technical Report on Soil Risk and Sensitivity Assessment* (NSR 2014) to confirm that specific locations merit consideration of the more aggressive soil remediation measures, such as: a 2- to 3-inch organic mulch surface application (80 percent coverage) of woodchips, logging slash, and/or straw; adaptive seed mixes and vegetation to better fit site conditions; deep subsoil decompaction with hydraulic excavators that leave constructed corridor mounded and rough with maximum water infiltration so that water cannot flow downhill for any appreciable distance; more aggressive use of constructed surface water runoff dispersion structures such as closely placed and more pronounced slope dips and water bars, etc.; more aggressive use of constructed surface runoff entrapments such as silt fencing, sediment settling basins, or straw bale structures, etc.; more aggressive placement (100 percent coverage) and depth (3 to 4 inches) of ground cover using woodchips, logging slash, straw bales, wattles (see POD's U and I). In efforts to protect soil productivity, topsoil segregation would be required for pipeline construction at wetland and waterbody crossings on NFS lands (POD U).

Some of the required mitigation measures in the POD BB and *Forest Service Site Specific Stream Crossing Prescriptions* (NSR 2014) to protect wetlands and minimize, maintain or restore compaction include: limiting the construction ROW width to 75 feet through wetlands; placing equipment on mats; using low-pressure ground equipment; limiting equipment operation and construction traffic along the ROW; locating temporary workspace (TEWAS) more than 50 feet away from wetland boundaries; cutting vegetation at ground level; limiting stump removal to the construction trench; segregating the top 12 inches of soil, or to the depth of the topsoil horizon; using "push-pull" techniques in saturated wetlands; limiting the amount of time that the trench is open by not trenching until the pipe is assembled and ready for installation; not using imported rock and soils for backfill; and not using fertilizer, lime, or mulch during restoration in wetlands. Pacific Connector must also follow the FERC Waterbody and Wetland Construction and Mitigation Procedures. See 4.3.3.2 of the DEIS for a complete list of applicable mitigation measures for pipeline construction at specific waterbody and stream crossings.

In an effort to minimize, maintain or restore the impacts to streams and riparian areas, Pacific Connector adopted route variations to co-locate the proposed construction corridor adjacent to existing roads and along dry ridge tops (See Chapter 3, DEIS Route Design and Modifications on Forest Service Managed Lands). In addition, Pacific Connector has committed to limit construction at waterbody crossings to times of dry weather or low water flow. Pacific Connector would implement the required erosion control measures at the proposed stream crossings to minimize, maintain or restore potential erosion and sedimentation impacts. The applicable mitigation measures and monitoring requirements in the POD relating to water waterbody crossings are included in the *Site Specific Forest Service Stream Crossing Prescriptions, and Wetland and Waterbody Crossing Plan* (POD BB). In addition, applicable mitigation measures from the FERC approved applicant prepared Procedures for Wetland and Waterbody Crossings would be required.

During construction of the Project, Compliance Monitors representing FERC are present on a full-time basis to inspect construction procedures and mitigation measures and provide regular feedback on compliance issues to FERC and the Forest Service. Objectives of the Compliance Monitoring program are to: facilitate the timely resolution of compliance issues in the field; provide continuous information to FERC regarding noncompliance issues and their resolution; and review, process, and track construction-related variance requests. Changes to previously approved mitigation measures, construction procedures, and construction work areas due to unforeseen or unavoidable site conditions would require various levels of regulatory approval from the applicable land management agencies. FERC would have the authority to stop any activity that violates an environmental condition of the FERC authorization issued to Pacific Connector.

Additionally, environmental compliance oversight responsibilities for Pacific Connector, FERC, Forest Service and BLM are described in the POD (Environmental Briefings and Compliance Plan, POD G) that would apply to the construction, operation, and maintenance of the project specifically on NFS lands. The Forest Service Authorized Officer would coordinate with the BLM in administering and enforcing ROW grant provisions and would have stop-work authority. The Forest Service Authorized Officer's designated representatives would ensure that the stipulations and mitigation measures included in the POD that are designed to minimize, maintain or restore the effects to soil, water and riparian resources, are adhered to during project construction, operation, and maintenance. The BLM Authorized Officer would coordinate with the Forest Service to ensure the work is being conducted in accordance with the ROW grant and agreed upon conditions. BLM and the Forest Service would have stop-work authority. Field variance requests would be coordinated with the Authorized Officers.

How the Compensatory Mitigation Actions would help to Maintain or Restore the Ecological Integrity of Riparian Areas, Soils, and Soil Productivity in the Plan Area (36 CFR 219.8(a)(3)(i), 36 CFR 219.8(a)(2)(ii)).

Part of the CMP on the Rogue River National Forest includes proposals to place large woody debris in-stream for 1.5 miles, repair stream crossings at 32 sites, and decommission approximately 57.5 miles of road.

Placement of LWD in streams adds structural complexity to aquatic systems by creating pools and riffles, trapping fine sediments and can contribute to reductions in stream temperatures over time (Tippery et al. 2010). Placing LWD in streams affects channel morphology, the routing and storage of water and sediment, and provides structure and complexity to stream systems. Complex pools and side channels created by instream wood provide overwintering habitat to stream salmonids and other aquatic organisms (Solazzi et. al. 2000). They also provide cover from predators during summer low flow periods when predation is at its highest. Providing more stream channel structure results in better over wintering habitat, improved summer pool habitat, and more abundant spawning gravels.

Restoring stream crossings reconnects aquatic habitats by allowing the passage of aquatic biota and restoring riparian vegetation. Stream crossing replacement would directly improve stream connectivity and habitat for aquatic species by immediately restoring access to formerly inaccessible habitats. Indirectly, these projects would reduce potential sediment levels in the long term by decreasing the potential for road failure. Stream crossing projects also reduce stream velocities by increasing stream crossing sizes, eliminating flow restrictions and allowing passage to additional reaches of habitat by removing barriers to aquatic species which improves access to spawning and rearing habitat and allows unrestricted movement throughout stream reaches during seasonal changes in water levels (Hoffman 2007).

Decommissioning roads can substantially reduce sediment delivery to streams (Madej 2000; Keppeler et al. 2007). Proposed road decommissioning and stormproofing would increase infiltration of precipitation, reduce surface runoff, and reduce sediment production from road-related surface erosion in the watershed where the impacts from the Project would occur. Decommissioning roads would restore natural drainage patterns and thereby avoid large volumes of added sediment to the stream network that would be likely to eventually occur. In addition limited road maintenance dollars could be focused on the remaining road systems resulting in more maintenance of culverts and ditchlines resulting in less potential for catastrophic failure. Madej (2000) concluded that by eliminating the risk of stream diversions and culvert failures, road removal treatments significantly reduce long-term sediment production from retired logging roads.

These projects have been designed by an interdisciplinary team of resource professionals on the Rogue River National Forest with input and coordination with the U.S. Fish and Wildlife Service, NOAA Fisheries, and State agencies. They were planned within the watersheds that would be affected by the Pacific Connector pipeline project. They are a component of the Pacific Connector application and would be a requirement of the ROW grant. Overall, these projects would help maintain and restore riparian and soil resources on the Rogue River National Forest (see table 2.2.1-3 and 2.2.1-4 and figure 2.2-1 and 2.2-2 in appendix F.2 for additional information).

Forest Plan Amendments Related Visual Resources (RRNF -2, RRNF-3, RRNF-4):

- Four Forest Plan standards associated with visual resources would need to be modified so that the proposed construction and operation of the Pacific Connector pipeline can be in compliance with the Rogue River National Forest LRMP. These standards are:
- Management Strategy 6, Foreground Retention, Standard and Guideline (1), (RRNF LRMP 4-72). Manage the area for Retention Visual Quality Objective. Catastrophic occurrences may dictate a need for short term departure from Retention. Assess the impacts to visual resources in all project environmental analysis. Specifically address how the visual quality objective will be met.
- Management Strategy 7, Foreground Partial Retention, Standard and Guideline (4), (RRNF LRMP 4-86). Correct unacceptable form, line, color or texture as a result of management activities either during the operation or within two years after completion of the activity.
- Management Strategy 7, Foreground Partial Retention, Standard and Guideline (1), (RRNF LRMP, 4-86). Manage the area for Partial Retention Visual Quality Objective. Catastrophic occurrences may dictate a need for short-term departure from Partial Retention Visual Quality Objective. Blend and shape regeneration openings with the natural terrain to the extent possible. Assess the impacts to visual resources in all project environmental analysis. Specifically address how the visual quality objective will be met.
- Management Strategy 9, Middle Ground Partial Retention, Standard and Guideline (1), (RRNF LRMP, 4-112). Manage the area for Partial Retention Visual Quality Objective. Catastrophic occurrences may dictate a need for short-term departure from Partial Retention Visual Quality Objective. Blend and shape regeneration openings with the natural terrain to the extent possible. Assess the impacts to visual resources in all project environmental analysis. Specifically address how the visual quality objective will be met.

The proposed amendments to these standards are:

- Management Strategy 6, Foreground Retention, Standard and Guideline (1), (RRNF LRMP 4-72). Manage the area for Retention Visual Quality Objective (VQO), with the exception of the Pacific Connector Pipeline ROW, where the VQO would be amended to Foreground Partial Retention where the pipeline would cross the Big Elk Road. The applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented. Catastrophic occurrences may dictate a need for short term departure from Retention. Assess the impacts to visual resources in all project environmental analysis. Specifically address how the visual quality objective will be met. (Proposed amendment RRNF-2)
- Management Strategy 7, Foreground Partial Retention, Standard and Guideline (4), (RRNF LRMP 4-86). Correct unacceptable form, line, color or texture as a result of management activities either during the operation or within two years after completion of the activity,

with the exception of the Pacific Connector Pipeline ROW which shall attain the amended VQO within 10 - 15 years after completion of the construction phase of the project where the pipeline crosses the Big Elk Road. The applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented. (Proposed amendment RRNF-2)

- Management Strategy 7, Foreground Partial Retention, Standard and Guideline (1), (RRNF LRMP, 4-86). Manage the area for Partial Retention Visual Quality Objective. Catastrophic occurrences may dictate a need for short-term departure from Partial Retention Visual Quality Objective (VQO), with the exception of the Pacific Connector Pipeline ROW, where the VQO would be amended to Modification where the pipeline would cross the Pacific Crest Trail. The applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented**.** Blend and shape regeneration openings with the natural terrain to the extent possible. Assess the impacts to visual resources in all project environmental analysis. Specifically address how the visual quality objective will be met. (proposed amendment RRNF-3)
- Management Strategy 7, Foreground Partial Retention, Standard and Guideline (4), (RRNF LRMP 4-86). Correct unacceptable form, line, color or texture as a result of management activities either during the operation or within two years after completion of the activity, with the exception of the Pacific Connector Pipeline ROW which shall attain the amended VQO within 15 - 20 years after completion of the construction phase of the project where the pipeline crosses the Pacific Crest Trail. The applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented. (Proposed amendment RRNF-3)
- Management Strategy 9, Middle Ground Partial Retention, Standard and Guideline (1), (RRNF LRMP, 4-112). Manage the area for Partial Retention Visual Quality Objective, with the exception of the Pacific Connector Pipeline ROW which shall attain the VQO within 10 - 15 years after completion of the construction phase of the project where the pipeline is adjacent to Highway 140.[151] The applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented. Catastrophic occurrences may dictate a need for short-term departure from Partial Retention Visual Quality Objective. Blend and shape regeneration openings with the natural terrain to the extent possible. Assess the impacts to visual resources in all project environmental analysis. Specifically address how the visual quality objective will be met. (Proposed amendment RRNF-4)

While the amendments would provide an exception to meeting these standards, there would also be requirements to do what is appropriate, applicable and feasible to minimize, maintain or restore any effects of the pipeline's construction and operation on the visual resources within the area affected by the pipeline. Consequently, each amended standard includes the requirement that the "applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented".

[151] Duration of impact specifications are found in the National Forest Landscape Management Handbook 462 (USDA Forest Service 1974). The recommended duration to meet standards for Middleground Partial Retention is 3 years (see RRNF LRMP FEIS p. III-119).

The purpose of these five project-level amendments is to make the proposed Pacific Connector pipeline project consistent with the Rogue River National Forest LRMP. Thus, the substantive planning rule requirements that are directly related to these five amendments are:

- 36 CFR 219.10(a)(1) – […the responsible official shall consider: …] "(1) Aesthetic values,… scenery,... viewsheds...".
- 36 CFR 219.10(b)(i) – [the responsible official shall consider] "Sustainable recreation; including recreation settings, opportunities,…and scenic character…"

Because the proposed amendments are "directly related" to these two substantive requirements, the Responsible Official must apply the requirements within the scope and scale of the proposed amendments (36 CFR 219.13 (b)(5)).

In considering the "scope and scale" of the five amendments, it is important to recognize that the applicable sections of 36 CFR 219.10 that are described above, requires plan components to provide for aesthetic values and scenic character across the entire planning area (i.e., the Rogue River National Forest). These plan amendments do not alter these LRMP plan requirements for managing visual resources across 99.99 percent of the Rogue River National Forest. The proposed pipeline construction corridor including the TEWAs and the UCSAs is approximately 206 acres of the 628,443 acre Rogue River National Forest. Of the 206 acres of pipeline corridor construction it is estimated that approximately 19 of these acres would not meet the standards for visual resources described above.

The amendments modify four standards so that in the 206 acres of the project construction area the project need not be in compliance with these standards' specific requirements but instead, it is the "applicable mitigation measures identified in the POD and the Pacific Connector Project design requirements" that must be implemented. Or stated in another way, for the 206 acres of National Forest lands that would be within the operational ROW and construction zone for the Pacific Connector Pipeline, the four management requirements described above would be replaced with the full set of management requirements that comprise the "applicable mitigation measures identified in the POD and Pacific Connector Project Design requirements". The inclusion of these management requirements as a part of the plan component language for the LRMP in this plan amendment, addresses the applicable 36 CFR 219.10 rule requirements within the "scope and scale" of these proposed plan amendments. The sections below describe in more detail how the applicable 36 CFR 219.10 requirements are being addressed.

How the Required Mitigation Measures would Consider, Minimize, Maintain or Restore Effects to Aesthetic Values and Scenic Character and Meet the Applicable 36 CFR 219.10(a) and 36 CFR 219.10(b) Requirements.

The Forest Service has worked to inventory, analyze, and evaluate visual resources, view sheds, and aesthetics that could be affected by this project. Forest Service landscape architect provided technical support to FERC and Forest Service third-party contractors by reviewing the information gathered for the project. The POD is a document developed between the Forest Service, BLM, FERC, and Pacific Connector that contains the design features, mitigation measures, roles and responsibilities, monitoring, and procedures for the construction and operation of the pipeline on NFS lands. In addition, FERC's applicant prepared Plan and Procedures for construction and restoration enforceable, where applicable, for additional design features and mitigation. The design requirements and mitigation measures of the POD would be required by the modified standards and incorporated into BLM's ROW grant.

The mitigation measures incorporated into amendments for Visual Quality Objectives, are designed to minimize, maintain or restore the potential for long-term impacts to visually sensitive areas. To ensure adequate restoration and revegetation of the ROW, design features are identified in the *Erosion Control and Revegetation Plan* (POD I), *Right-of-Way Clearing Plan* (POD U), *Leave Tree Protection Plan* (POD P), *Aesthetics Management Plan* (POD A), and *Recreation Management Plan* (POD S). In addition, routing considerations were identified during project development to ensure reduced visual impacts at the Pacific Crest Trail crossing by modifying the route to include a 45 degree angle and avoiding straight line impacts to trail users. (See Chapter 3, DEIS Route Design and Modifications on Forest Service Managed Lands)

A visual assessment was conducted to determine the potential effects on visual resources associated with the pipeline. Representative viewpoint points (also referred to as KOPs) were identified within the view shed for the pipeline, defined as the area from which the pipeline would be potentially visible. Photographs of existing visual conditions were used in preparing computerized visual simulations for each KOP. Because the appearance of the pipeline ROW would change with time, a series of simulations were prepared to illustrate how the pipeline ROW would look at different timeframes following construction. These KOPs would also serve as monitoring points for mitigation.

Pacific Connector produced POD A that outlined measures to reduce visual impacts along its pipeline route. To the extent feasible, Pacific Connector would use revegetation efforts to shape and blend the pipeline easement, enhance the setting, and mimic the natural features of the landscape. These measures would consist of revegetating all disturbed areas and replanting trees in TEWAs and any other areas of the temporary construction ROW that were forested prior to construction (see POD I).

On Forest Service lands, Pacific Connector would maintain a cleared 30-foot width centered over the pipe allowing the remainder of the permanent easement to be reforested. This allows trees to naturally reestablish along the edges of the permanent easement at a staggered, more natural-looking interval. Replacing slash in forested areas of the ROW during restoration activities would immediately affect the visual contrast in color and texture of the disturbed ROW areas. Over time, as the ROW revegetates and narrows in width and changes in form, texture and color, potential visual impacts would diminish.

Additionally, a row, or if necessary, clusters of trees and/or shrubs would be planted across the ROW to provide visual screens at key road and trail crossings in sensitive view sheds. For all revegetation practices, Pacific Connector and/or its contractors would only use agency-approved tree and plant species, in compliance with management plan objectives and in consultation with agency specialists.

Site Specific Crossing Prescriptions:

<u>Big Elk Road (MP 161.41).</u> Within the Rogue River National Forest, the Pipeline crosses an area managed for Foreground Retention with high scenic integrity. Pacific Connector would neck down to a width of 50 feet immediately adjacent to either side of the Big Elk Road crossing. The construction ROW would then expand from 50 feet to the full 95-foot construction ROW width at

100 feet from either side of the road. To ensure that the appropriate large trees are conserved on either side of Big Elk Road, Pacific Connector's Environmental Inspectors would verify the limits of the staked construction limits in conjunction with a Forest Service representative (see POD P). Pacific Connector would implement the mitigation recommendations detailed in Section 3.2 and 3.3 and further described in the POD I to minimize, maintain or restore potential visual effects at this road crossing, and a buffer of vegetation would mask the ROW on both sides of the road. Pacific Connector would additionally revegetate the ROW using large native trees and shrubs to begin the mitigation process.

<u>Pacific Crest National Scenic Trail Corridor.</u> The area where the Pipeline intersects the PCT on the Rogue River National Forest supports a stand of old-growth forest and is managed for Foreground Partial Retention to maintain the aesthetic forest appeal for trail users. The typical construction ROW width is 95 feet, which could devalue this trail crossing segment during construction. To minimize, maintain or restore impacts to the scenic quality of the area, Pacific Connector would "neck down" the construction ROW from 95 feet to 75 feet in width for a distance of more than 300 feet on either side of the trail. UCSAs (no tree clearing) have also been located behind these neck downs, outside of the immediate foreground visual area, to minimize, maintain or restore disturbance. These UCSAs would be used to store slash and stumps during construction that would be redistributed across the ROW during restoration. To further minimize, maintain or restore potential visual impacts at the PCT crossing, the route was realigned at the request of the Forest Service to shorten the potential visual corridor down the ROW. Additional impact minimization measures include:

- Identifying trees along the edge of the construction ROW that can be saved from clearing, based on hazard tree and construction safety.
- Scalloping adjacent edges of timber as directed by the Forest Service landscape architect.
- Salvaging topsoil (duff and A horizon) to a depth of 12-inches along the trench line, segregate from spoil material, and replace during restoration.
- Minimizing grading within the 75-foot construction ROW based on safety requirements. Stumps would be removed, or gridded as necessary to provide a safe equipment working plane.
- Replanting a 75-foot wide visual screen on either side of the trail with nursery trees and shrubs within 6 days of final grading, dependent on seasonal planting constraints (and not within the 30 foot-operational easement). Replanting would be with mixed conifer species of differing age class per the Forest Service landscape plan and would include hydro-mulch seeding.
- Revegetating the remaining ROW with nursery trees and shrubs planted along the edges of the ROW in scalloped arrangement.
- Hydro-mulch seeding all disturbed soils.
- Placing logs and LWD in the construction ROW as directed by the Forest Service landscape plan.
- Using a gravity drip irrigation system with a water source from the well at Brown Mountain Shelter, to improve replanting establishment.
- Replanting would occur if mortality exceeds 30 percent.

Construction of the trail crossing would also be completed as a "tie-in" so that trenching, pipe stringing, and installation activities do not interrupt trail users for extended periods. It is expected that construction of the trail tie-in would be completed within 48 hours or less to minimize, maintain or restore potential impacts to trail users and reduce the need for trail detours.

Upon completion of construction in the area, Pacific Connector would revegetate the construction ROW using native trees (not within the 30 foot-operational easement), shrubs, and plants. Section 3.0 of the POD A describes additional measures to be used on federal lands for protecting and mitigating for visual resources. Pacific Connector would coordinate with the Forest Service and the Pacific Crest Trail Association regarding the need for and location of trail detours.

During construction of the Project, Compliance Monitors representing FERC are present on a full-time basis to inspect construction procedures and mitigation measures and provide regular feedback on compliance issues to FERC and the Forest Service. Objectives of the Compliance Monitoring program are to: facilitate the timely resolution of compliance issues in the field; provide continuous information to FERC regarding noncompliance issues and their resolution; and review, process, and track construction-related variance requests. Changes to previously approved mitigation measures, construction procedures, and construction work areas due to unforeseen or unavoidable site conditions would require various levels of regulatory approval from the applicable land management agencies. FERC would have the authority to stop any activity that violates an environmental condition of the FERC authorization issued to Pacific Connector.

Additionally, environmental compliance oversight responsibilities for Pacific Connector, FERC, Forest Service and BLM are described in the POD (*Environmental Briefings and Compliance Plan*, POD G) that would apply to the construction, operation, and maintenance of the project specifically on NFS lands. The Forest Service Authorized Officer would coordinate with the BLM in administering and enforcing ROW grant provisions and would have stop-work authority. The Forest Service Authorized Officer's designated representatives would ensure that the stipulations and mitigation measures included in the POD that are designed to minimize, maintain or restore the effects to visual resources and recreational resources are adhered to during project construction, operation, and maintenance. The BLM Authorized Officer would coordinate with the Forest Service to ensure the work is being conducted in accordance with the ROW grant and agreed upon conditions. BLM and the Forest Service would have stop-work authority. Field variance requests would be coordinated with the Authorized Officers.

Evaluation of Winema National Forest Proposed Forest Plan Amendments

The proposed Pacific Connector pipeline incorporates the most up-to-date engineering and technological practices for pipeline construction and operation. However, even with following these practices, it has been determined that one Forest Plan standard associated with rare and/or isolated species (Survey and Manage), two Forest Plan standards associated with the soil, water, and riparian resources, and three Forest Plan standards associated with visual resources would need to be modified so that the proposed construction and operation of the Pacific Connector pipeline can be in compliance with the Winema National Forest LRMP as amended by the NWFP and the January 2001 Survey and Manage ROD.

Forest Plan Amendments Related to Rare Aquatic and Terrestrial Plant and Animal Communities (FS-1):

One Forest Plan standard associated with rare and/or isolated species (Survey and Manage) would need to be modified so that the proposed construction and operation of the Pacific Connector pipeline can be in compliance with the Winema National Forest LRMP as amended by the NWFP and the January 2001 Survey and Manage ROD. This standard is:

- Management Direction: Manage All Known Sites (Survey and Manage ROD, Standards and Guidelines Page 8). Current and future known sites will be managed according to the Management Recommendation for the species. Professional judgment, Appendix J2 in the Northwest Forest Plan Final SEIS, and appropriate literature will be used to guide individual site management for those species that do not have Management Recommendations.

The proposed amendment to this standard is:

- Management Direction: Manage All Known Sites (Survey and Manage ROD, Standards and Guidelines Page 8). Current and future known sites will be managed according to the Management Recommendation for the species, with the exception of the operational ROW and the construction zone for the Pacific Connector Pipeline, for which the applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented. Professional judgment, Appendix J2 in the Northwest Forest Plan Final SEIS, and appropriate literature will be used to guide individual site management for those species that do not have Management Recommendations. (Proposed amendment FS-1 on the Winema National Forest)

While the amendment would provide an exception to meeting this standard, there would also be requirements to do what is appropriate, applicable and feasible to minimize, maintain or restore any effects of the pipeline's construction and operation on Survey and Manage species within the area affected by the pipeline. Consequently, each amended standard includes the requirement that the "applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented".

The purpose of this project-level amendment is to make the proposed Pacific Connector pipeline project consistent with the Winema National Forest LRMP. Thus, the substantive planning rule requirements that are directly related to this amendment are:

- 36 CFR 219.9(a)(2)(ii) – [the plan must include plan components to maintain or restore] "Rare aquatic and terrestrial plant and animal communities."
- 36 CFR 219.9(b)(1) – "The responsible official shall determine whether or not the plan components required by paragraph (a) provide ecological conditions necessary to: …maintain viable populations of each species of conservation concern within the plan area."

Because the proposed amendment is "directly related" to these two substantive requirements, the Responsible Official must apply the requirements within the scope and scale of the proposed amendment (36 CFR 219.13 (b)(5)).

In considering the “scope and scale” of the amendment, it is important to recognize that the applicable sections of 36 CFR 219.9(a) and (b) that are described above, requires plan components to maintain or restore rare aquatic and terrestrial plant and animal communities, across the entire planning area (i.e., the Winema National Forest). This plan amendment does not alter these LRMP plan requirements for managing rare plant and animal communities across 99.99 percent of the Winema National Forest. The proposed pipeline construction corridor including the TEWAs and the UCSAs is approximately 92 acres of the 1,043,547 acre Winema National Forest. Within this 92 acre construction corridor surveys have identified 45 Survey and Manage sites that could be potentially impacted by construction activities. The proposed amendment does not waive the persistence objective for Survey and Manage species. The analysis that was conducted (see section 4.6.4.3 of the DEIS and appendix F.5) determined the Survey and Manage persistence objectives would be met. This means that for Winema National Forest lands within the project area, individual sites of Survey and Manage species may be impacted or lost to construction activities, but affected species are expected to persist within the range of the NSO despite the loss of these individual sites.

The amendment modifies this standard so that in the 92 acres of the project construction area the project need not be in compliance with this standard’ specific requirements but instead, it is the “applicable mitigation measures identified in the POD and the Pacific Connector Project design requirements” that must be implemented. Or stated in another way, for the 92 acres of National Forest lands that would be within the operational ROW and construction zone for the Pacific Connector Pipeline, the management requirement described above would be replaced with the full set of management requirements that comprise the “applicable mitigation measures identified in the POD and Pacific Connector Project Design requirements”. The inclusion of these management requirements as a part of the plan component language for the LRMP in this plan amendment, addresses the applicable 36 CFR 219.9(a) and (b) rule requirements within the “scope and scale” of the proposed plan amendments. The sections below describe in more detail how the applicable 36 CFR 219.9(a) and (b) requirements are being addressed.

How the Required Mitigation Measures would Maintain or Restore Effects to Rare Aquatic and Terrestrial Plant and Animal Communities and Meet the Applicable 36 CFR 219.9(a) and 36 CFR 219.9 (b) Requirements

The Forest Service has worked to inventory, analyze, and evaluate rare aquatic, terrestrial plant and animal communities that could be affected by this project. In addition, a third-party consultant for technical support was also utilized in reviewing the information gathered for the project. The POD is a document developed between the Forest Service, BLM, FERC, and Pacific Connector that contains the design features, mitigation measures, roles and responsibilities, monitoring, and procedures for the construction and operation of the pipeline on NFS lands. In addition, FERC’s applicant prepared Plan and Procedures for construction and restoration enforceable, where applicable, for additional design features and mitigation. The design requirements and mitigation measures of the POD would be required by the modified standards and incorporated into BLM’s ROW grant.

The mitigation measures incorporated into amendments for Survey and Manage species are designed to minimize, maintain or restore the potential for habitat fragmentation, edge effects, and loss of long-term habitats associated with effected species. To ensure adequate restoration and revegetation of the ROW, design features are identified in the *Erosion Control and Revegetation*

Plan (POD I), *Right-of-Way Clearing Plan* (POD U), *Leave Tree Protection Plan* (POD P). In addition, routing considerations were identified during project development to ensure avoidance of known populations of rare plant and animal communities (See Chapter 3, DEIS Route Design and Modifications on Forest Service Managed Lands, as well as, appendix F.5, *Survey and Manage Persistence Evaluations*).

As a basis for Survey and Manage determinations, appendix F.5 provides background research on Survey and Manage species that could be affected by the Pacific Connector Project; a review of survey reports prepared by others for the Pacific Connector Project; and processing and analysis of spatial data obtained from the Bureau of Land Management (BLM), Forest Service, and other sources over the past 12 years. Background information was used in combination with new information available as a result of surveys for the Pacific Connector Project and recent surveys in other portions of old growth forests to discuss the currently known distribution of the species in old growth forests within the NSO range. Impacts to sites as a result of the Pacific Connector Project were analyzed to determine if the species would continue to have a reasonable assurance of persistence in the NSO range following implementation of the Pacific Connector Project, taking into consideration the status and distribution of the species and general habitat in the NSO range.

Some of the required mitigation measures in the POD sections to protect rare plant and animal communities include: flagging existing snags on the edges of the construction ROW or TEWAs where feasible to save from clearing; snags would be saved as and used in LWD placement post-construction to benefit primary and secondary cavity nesting birds, mammals, reptiles, and amphibians; other large diameter trees on the edges of the construction ROW and TEWAs would also be flagged to save/protect as green recruitment or habitat/shade trees, where feasible; trees would be girdled to create snags to augment the number of snags along the ROW to benefit cavity nesting birds, mammals, reptiles, and amphibians. See POD's P & U and 4.7—*Land Use* of the DEIS for a complete list of applicable mitigation measures for pipeline construction. Additional measures include low ground weight (pressure) vehicles would be used; logging machinery would be restricted to the 30-foot permanent ROW wherever possible to prevent soil compaction; the removal of soil duff layers would be avoided in order to maintain a cushion between the soil and the logs and the logging equipment; designed skid trails would be used to restrict detrimental soil disturbance (compaction and displacement) to a smaller area of the ROW over the pipeline trenching area; and the temporary construction area would be restored and revegetated using native seeds, to the extent possible, and saplings (POD I).

In an effort to minimize, maintain or restore the impacts to Survey and Manage species, Pacific Connector adopted route variations to avoid certain species identified in the Survey and Manage Persistence Evaluations by co-locating the proposed construction corridor adjacent to existing roads, through managed timber stands or otherwise avoid unique LSOG habitats to the maximum extent practicable (See Chapter 3, DEIS Route Design and Modifications on Forest Service Managed Lands).

During construction of the Project, Compliance Monitors representing FERC are present on a full-time basis to inspect construction procedures and mitigation measures and provide regular feedback on compliance issues to FERC and the Forest Service. Objectives of the Compliance Monitoring program are to facilitate the timely resolution of compliance issues in the field; provide continuous information to FERC regarding noncompliance issues and their resolution; and review, process, and track construction-related variance requests. Changes to previously approved mitigation measures, construction procedures, and construction work areas due to unforeseen or unavoidable site conditions would require various levels of regulatory approval from the applicable land management agencies. FERC would have the authority to stop any activity that violates an environmental condition of the FERC authorization issued to Pacific Connector.

Additionally, environmental compliance oversight responsibilities for Pacific Connector, FERC, Forest Service and BLM are described in the POD (Environmental Briefings and Compliance Plan, POD G) that would apply to the construction, operation, and maintenance of the project specifically on NFS lands. The Forest Service Authorized Officer would coordinate with the BLM in administering and enforcing ROW grant provisions and would have stop-work authority. The Forest Service Authorized Officer's designated representatives would ensure that the stipulations and mitigation measures included in the POD that are designed to minimize, maintain or restore the effects to soil, water and riparian resources, are adhered to during project construction, operation, and maintenance. The BLM Authorized Officer would coordinate with the Forest Service to ensure the work is being conducted in accordance with the ROW grant and agreed upon conditions. BLM and the Forest Service would have stop-work authority. Field variance requests would be coordinated with the Authorized Officers.

How the Compensatory Mitigation Actions would help to Maintain or Restore Rare Aquatic and Terrestrial Plant and Animal Communities in the Plan Area (36 CFR 219.9(a), 36 CFR 219.9 (b)).

The CMP on the Winema National Forest includes proposals to improve aquatic and riparian habitat that would benefit rare aquatic plant and animal communities (see the discussion of *How the Compensatory Mitigation Actions would help to Maintain or Restore the Ecological Integrity of The Soils and Soil Productivity, including guidance to reduce soil erosion and sedimentation in the Plan Area (36 CFR 219.8(a)(2)(ii))* below for a discussion of benefits to aquatic habitats). The CMP also includes proposals to decommission approximately 29.2 miles of road.

Although the Pacific Connector project has been routed to avoid LSOG habitat as much as possible and is aligned along existing roads, the project would still cause some habitat fragmentation. Road decommissioning reduces the edge effects over time by revegetating road surfaces and eliminating road corridors. Revegetating selected roads could create larger blocks of late successional habitat in the future.

These projects have been designed by an interdisciplinary team of resource professionals on the Winema National Forest with input and coordination with the U.S. Fish and Wildlife Service, NOAA Fisheries, and State agencies. They were planned within the watersheds that would be affected by the Pacific Connector pipeline project. They are a component of the Pacific Connector application and would be a requirement of the ROW grant. Overall, these projects would help maintain and restore rare aquatic and terrestrial plant and animal communities on the Winema National Forest (see table 2.3.1-3 and 2.3.1-4 and figure 2.3-1 and 2.3-2 in appendix F.2 for additional information).

Forest Plan Amendments Related to Soil, Water and Riparian Areas (WNF -4, WNF-5):

Two Forest Plan standards associated with the soil, water, and riparian resources would need to be modified so that the proposed construction and operation of the Pacific Connector pipeline can be in compliance with the Winema National Forest LRMP. These standards are:

- Detrimental Soils Conditions, Standard and guideline 12-5, (WNF LRMP, 4-73). The cumulative effects of detrimental soil conditions should not exceed 20 percent of the total acreage within the activity area: any reason for exceeding the limitation shall be documented in an environmental assessment. Detrimental soil conditions include compaction, displacement, puddling, and moderately or severely burned soil from all activities (including roads, skid trails, and landings). Sites where the standards for displacement, puddling, and compaction are not currently met will require rehabilitation such as ripping, backblading, or fertilization. The potential for creating detrimental soil conditions will be specifically addressed through project environmental analyses. If needed, alternative management practices will be developed, and mitigating measures will be planned and implemented.
- Soil and Water, Standard & Guideline 3 (WNF LRMP 4-137). The cumulative total area of detrimental soil conditions in riparian areas shall not exceed 10 percent of the total riparian acreage within an activity area. Detrimental soil conditions include compaction, displacement, puddling, and moderately or severely burned soil.

The proposed amendments to these standards are:

- Detrimental Soils Conditions, Standard and guideline 12-5, (WNF LRMP, 4-73). The cumulative effects of detrimental soil conditions should not exceed 20 percent of the total acreage within the activity area: any reason for exceeding the limitation shall be documented in an environmental assessment, with the exception of the operational ROW and the construction zone for the Pacific Connector Pipeline, for which the applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented. Detrimental soil conditions include compaction, displacement, puddling, and moderately or severely burned soil from all activities (including roads, skid trails, and landings). Sites where the standards for displacement, puddling, and compaction are not currently met will require rehabilitation such as ripping, backblading, or fertilization. The potential for creating detrimental soil conditions will be specifically addressed through project environmental analyses. If needed, alternative management practices will be developed, and mitigating measures will be planned and implemented. (Proposed amendment WNF-4)
- Soil and Water, Standard & Guideline 3 (WNF LRMP 4-137). The cumulative total area of detrimental soil conditions in riparian areas shall not exceed 10 percent of the total riparian acreage within an activity area, with the exception of the operational ROW and the construction zone for the Pacific Connector Pipeline, for which the applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented. Permanent recreation facilities or other permanent facilities are exempt. (Proposed amendment WNF-5)

While the amendments would provide an exception to meeting these standards, there would also be requirements to do what is appropriate, applicable and feasible to minimize, maintain or restore any effects of the pipeline's construction and operation on the soil, water and riparian resources within the area affected by the pipeline. Consequently, each amended standard includes the requirement that the "applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented".

The purpose of these two project-level amendments is to make the proposed Pacific Connector pipeline project consistent with the Winema National Forest LRMP. Thus, the substantive planning rule requirements that are directly related to these two amendments are:

- 36 CFR 219.8(a)(2)(ii) – [The plan must include plan components to maintain or restore] "soils and soil productivity, including guidance to reduce soil erosion and sedimentation."

Because the two proposed amendments are "directly related" to this substantive requirement, the Responsible Official must apply the requirements within the scope and scale of the proposed amendments (36 CFR 219.13 (b)(5)).

In considering the "scope and scale" of the two amendments, it is important to recognize that the applicable sections of 36 CFR 219.8(a) that are described above, requires plan components to "maintain or restore" the soil resources across the entire planning area (i.e., the Winema National Forest). These plan amendments do not alter these LRMP plan requirements for managing the soil resources across 99.99 percent of the Winema National Forest. The proposed pipeline construction corridor including the TEWAs and the UCSAs is approximately 92 acres of the 1,043,547 acre Winema National Forest. Of the 92 acres of pipeline corridor construction it is estimated that approximately 27 to 62 acres would not meet standards for soils described above.

The amendment modifies 2 standards so that in the 92 acres of the project construction area the project need not be in compliance with these standards' specific requirements but instead, it is the "applicable mitigation measures identified in the POD and the Pacific Connector Project design requirements" that must be implemented. Or stated in another way, for the 92 acres of National Forest lands that would be within the operational ROW and construction zone for the Pacific Connector Pipeline, the two management requirements described above would be replaced with the full set of management requirements that comprise the "applicable mitigation measures identified in the POD and Pacific Connector Project Design requirements". The inclusion of these management requirements as a part of the plan component language for the LRMP in this plan amendment, addresses the applicable 36 CFR 219.8(a) rule requirements within the "scope and scale" of these proposed plan amendments. The sections below describe in more detail how the applicable 36 CFR 219.8(a) requirements are being addressed.

How the Required Mitigation Measures would Maintain or Restore Effects to Soil, Water, and Riparian Resources and Meet the Applicable 36 CFR 219.8(a) Requirements.

The Forest Service has worked with Pacific Connector Gas Pipeline to inventory, analyze, and evaluate the geologic, soil, and hydrologic resources that could be affected by this project. In addition, a third-party consultant for technical support was also utilized in reviewing the information gathered for the project. The POD is a document developed between the Forest Service, BLM, FERC, and Pacific Connector that contains the design features, mitigation measures, roles and responsibilities, monitoring, and procedures for the construction and operation of the pipeline on NFS lands. In addition, FERC's applicant prepared Plan and Procedures for construction and restoration are enforceable, where applicable, for additional design features and mitigation. The design requirements and mitigation measures of the POD would be required by the modified standards and incorporated into BLM's ROW grant.

The mitigation measures, incorporated into amendments for soil, water, and riparian resources are designed to minimize, maintain or restore the potential for soil movement, slope stability, water quality, and to ensure adequate restoration and revegetation. These measures are identified in: the *Erosion Control and Revegetation Plan* (POD I); *Right-of-Way Clearing Plan* (POD U); *Wetland and Waterbody Crossing Plan* (POD BB); the *Forest Service Site Specific Stream Crossing Prescriptions* (NSR 2014); the *Stream Crossing Risk Analysis*; and *Stream Crossing Risk Analysis Addendum* (GeoEngineers2017d, 2018a). Pacific Connector would also follow the FERC's applicant prepared Wetland Procedures and the Best Management Practices for the State of Oregon. To further reduce potential for landslides on steep slopes, the Forest Service, BLM, and FERC are also recommending additional industry best management practices and measures identified from the *Technical Report on Soil Risk and Sensitivity Assessment* (NSR 2014) be incorporated into Pacific Connector's terms and conditions of the ROW Grant as described in the POD's identified above. See 4.2.3.3 of the DEIS for a description of soil risk and sensitivity assessment.

Areas with soils rated moderate to very high for risk or sensitivity (28 acres total) would be recommended for more site-specific validation of the risk criteria used in the *Technical Report on Soil Risk and Sensitivity Assessment* (NSR 2014) to confirm that specific locations merit consideration of the more aggressive soil remediation measures, such as: a 2- to 3-inch organic mulch surface application (80 percent coverage) of woodchips, logging slash, and/or straw; adaptive seed mixes and vegetation to better fit site conditions; deep subsoil decompaction with hydraulic excavators that leave constructed corridor mounded and rough with maximum water infiltration so that water cannot flow downhill for any appreciable distance; more aggressive use of constructed surface water runoff dispersion structures such as closely placed and more pronounced slope dips and water bars, etc.; more aggressive use of constructed surface runoff entrapments such as silt fencing, sediment settling basins, or straw bale structures, etc.; more aggressive placement (100 percent coverage) and depth (3 to 4 inches) of ground cover using woodchips, logging slash, straw bales, wattles (see POD's U and I). In efforts to protect soil productivity, topsoil segregation would be required for pipeline construction at wetland and waterbody crossings on NFS lands (POD U).

Some of the required mitigation measures in the POD BB and *Forest Service Site Specific Stream Crossing Prescriptions* (NSR 2014) to protect wetlands and minimize, maintain or restore compaction include: limiting the construction ROW width to 75 feet through wetlands; placing equipment on mats; using low-pressure ground equipment; limiting equipment operation and construction traffic along the ROW; locating temporary workspace (TEWAS) more than 50 feet away from wetland boundaries; cutting vegetation at ground level; limiting stump removal to the construction trench; segregating the top 12 inches of soil, or to the depth of the topsoil horizon; using "push-pull" techniques in saturated wetlands; limiting the amount of time that the trench is open by not trenching until the pipe is assembled and ready for installation; not using imported rock and soils for backfill; and not using fertilizer, lime, or mulch during restoration in wetlands. Pacific Connector must also follow the FERC Waterbody and Wetland Construction and

Mitigation Procedures. See 4.3.3.2 of the DEIS for a complete list of applicable mitigation measures for pipeline construction at specific waterbody and stream crossings.

In an effort to minimize, maintain or restore the impacts to streams and riparian areas, Pacific Connector adopted route variations to co-locate the proposed construction corridor adjacent to existing roads and along dry ridge tops (See Chapter 3, DEIS Route Design and Modifications on Forest Service Managed Lands). In addition, Pacific Connector has committed to limit construction at waterbody crossings to times of dry weather or low water flow. Pacific Connector would implement the required erosion control measures at the proposed stream crossings to minimize, maintain or restore potential erosion and sedimentation impacts. The applicable mitigation measures and monitoring requirements in the POD relating to water waterbody crossings are included in the *Site Specific Forest Service Stream Crossing Prescriptions, and Wetland and Waterbody Crossing Plan* (POD BB). In addition, applicable mitigation measures from the FERC approved applicant prepared Procedures for Wetland and Waterbody Crossings would be required.

During construction of the Project, Compliance Monitors representing FERC are present on a full-time basis to inspect construction procedures and mitigation measures and provide regular feedback on compliance issues to FERC and the Forest Service. Objectives of the Compliance Monitoring program are to: facilitate the timely resolution of compliance issues in the field; provide continuous information to FERC regarding noncompliance issues and their resolution; and review, process, and track construction-related variance requests. Changes to previously approved mitigation measures, construction procedures, and construction work areas due to unforeseen or unavoidable site conditions would require various levels of regulatory approval from the applicable land management agencies. FERC would have the authority to stop any activity that violates an environmental condition of the FERC authorization issued to Pacific Connector.

Additionally, environmental compliance oversight responsibilities for Pacific Connector, FERC, Forest Service and BLM are described in the POD (Environmental Briefings and Compliance Plan, POD G) that would apply to the construction, operation, and maintenance of the project specifically on NFS lands. The Forest Service Authorized Officer would coordinate with the BLM in administering and enforcing ROW grant provisions and would have stop-work authority. The Forest Service Authorized Officer's designated representatives would ensure that the stipulations and mitigation measures included in the POD that are designed to minimize, maintain or restore the effects to soil, water and riparian resources, are adhered to during project construction, operation, and maintenance. The BLM Authorized Officer would coordinate with the Forest Service to ensure the work is being conducted in accordance with the ROW grant and agreed upon conditions. BLM and the Forest Service would have stop-work authority. Field variance requests would be coordinated with the Authorized Officers.

How the Compensatory Mitigation Actions would help to Maintain or Restore the Ecological Integrity of The Soils and Soil Productivity, including guidance to reduce soil erosion and sedimentation in the Plan Area (36 CFR 219.8(a)(2)(ii)).

Part of the CMP on the Winema National Forest includes proposals to place large woody debris in-stream for 1.0 miles, repair stream crossings at 25 sites, provide Riparian Planting for 0.5 miles, provide Riparian Fencing for 6.5 miles, and decommission approximately 29.2 miles of road.

Placement of LWD in streams adds structural complexity to aquatic systems by creating pools and riffles, trapping fine sediments and can contribute to reductions in stream temperatures over time (Tippery et al. 2010). Placing LWD in streams affects channel morphology, the routing and storage of water and sediment, and provides structure and complexity to stream systems. Complex pools and side channels created by instream wood provide overwintering habitat to stream salmonids and other aquatic organisms (Solazzi et. al. 2000). They also provide cover from predators during summer low flow periods when predation is at its highest. Providing more stream channel structure results in better over wintering habitat, improved summer pool habitat, and more abundant spawning gravels.

Riparian planting is proposed along Spencer Creek just upstream of Buck Lake. This is a meadow site that has lost streamside vegetation and has compacted soils. There is an overall need to restore health and vigor to riparian stands by maintaining and improving riparian reserve habitat. Shade provided by the plantings would contribute to moderating water temperatures in Spencer Creek. Root strength provided by new vegetation would increase bank stability, decrease erosion and sediment depositions to Spencer Creek and provide habitat for species that use riparian habitats. Riparian fencing would serve to divide the Buck Indian Allotment into pastures north and south at Clover Creek Road. This fence would keep cattle from grazing newly revegetated areas in the construction corridor, including areas where the corridor crosses Spencer Creek, thus helping to ensure that erosion control and revegetation objectives are met. It would also serve to separate anticipated increased cattle grazing of the construction corridor from the highway; greatly reducing a safety hazard for vehicles traveling the Clover Creek road.

Restoring stream crossings reconnects aquatic habitats by allowing the passage of aquatic biota and restoring riparian vegetation. Over time, these actions reduce sediment and restore shade. Restoration of these crossings includes riparian planting as a mitigation which would help offset the impact of shade removal at pipeline crossings. The proposed pipeline would cross Spencer Creek upstream of Buck Lake. It is occupied by redband trout. Spencer Creek has been identified by NMFS as habitat for federally listed Southern Oregon/Northern California Coast Coho salmon. Additionally, once fish passage is provided through the Klamath River hydro facilities, steelhead would re-colonize Spencer Creek. Improving habitat quality at Spencer Creek provides the opportunity to be pro-active in providing quality habitat for SONC Coho, mitigating for any detrimental effects to other SONC Coho habitats, while improving habitat for redband trout and other aquatic species. Spencer Creek appears on the Oregon DEQ 303(d) list as water quality impaired from increased sedimentation. Improvements at this location would immediately benefit all downstream aquatic habitats and the species associated with those habitats.

Decommissioning roads can substantially reduce sediment delivery to streams (Madej 2000; Keppeler et al. 2007). Proposed road decommissioning and stormproofing would increase infiltration of precipitation, reduce surface runoff, and reduce sediment production from road-related surface erosion in the watershed where the impacts from the Project would occur. Decommissioning roads would restore natural drainage patterns and thereby avoid large volumes of added sediment to the stream network that would be likely to eventually occur. In addition limited road maintenance dollars could be focused on the remaining road systems resulting in more maintenance of culverts and ditchlines resulting in less potential for catastrophic failure. Madej (2000) concluded that by eliminating the risk of stream diversions and culvert failures, road removal treatments significantly reduce long-term sediment production from retired logging roads.

These projects have been designed by an interdisciplinary team of resource professionals on the Winema National Forest with input and coordination with the U.S. Fish and Wildlife Service, NOAA Fisheries, and State agencies. These projects have been planned within the watersheds that would be affected by the Pacific Connector pipeline project. These projects have been proposed by the Applicant as part of their application and would be a requirement of the ROW grant. These projects would help maintain and restore soil resources including reducing soil erosion and sedimentation on the Winema National Forest (see table 2.3.1-3 and 2.3.1-4 and figure 2.3-1 and 2.3-2 in appendix F.2 for additional information).

Forest Plan Amendments Related Visual Resources (WNF -1, WNF-2, WNF-3):

Three Forest Plan standards associated with visual resources would need to be modified so that the proposed construction and operation of the Pacific Connector pipeline can be in compliance with the Winema National Forest LRMP. These standards are:

- Management Area 3, Lands, Standard and Guideline (4), (WNF LRMP 4-103). This management area is an avoidance area for new transportation and utility corridors.
- Management Area 3A, Foreground Retention, Standard and Guideline Scenic (1), (WNF LRMP 4-103 and 104). Evidence of management activities from projects that produce slash (tree harvest) or charred bark (underburning) will not be noticeable one year after the work has been completed.
- Management 3B, Foreground Partial Retention, Standard and Guideline Scenic (1), (WNF LRMP, 4-107). Evidence of management activities from projects that produce slash (tree harvest) or charred bark (underburning) should not be noticeable from two to three years after the work has been completed.

The proposed amendments to these standards are:

- Management Area 3, Lands, Standard and Guideline (4), (WNF LRMP 4-103). This management area is an avoidance area for new transportation and utility corridors, with the exception of the Pacific Connector Pipeline ROW. The applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented. (Proposed amendment WNF-1)
- Management Area 3A, Foreground Retention, Standard and Guideline Scenic (1), (WNF LRMP 4-103 and 104). Evidence of management activities from projects that produce slash (tree harvest) or charred bark (underburning) will not be noticeable one year after the work has been completed, with the exception of the Pacific Connector Pipeline ROW which shall attain the VQO within 10 - 15 years after completion of the construction phase of the project where the pipeline crosses Management area 3A. The applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented. (Proposed amendment WNF-2)
- Management 3B, Foreground Partial Retention, Standard and Guideline Scenic (1), (WNF LRMP, 4-107). Evidence of management activities from projects that produce slash (tree harvest) or charred bark (underburning) should not be noticeable from two to three years after the work has been completed, with the exception of the Pacific Connector Pipeline ROW, which shall attain the VQO within 10 - 15 years after completion of the construction phase of the project where the pipeline crosses Management area 3B. The applicable

mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented. (proposed amendment WNF-3)

While the amendments would provide an exception to meeting these standards, there would also be requirements to do what is appropriate, applicable and feasible to minimize, maintain or restore any effects of the pipeline's construction and operation on the visual resources within the area affected by the pipeline. Consequently, each amended standard includes the requirement that the "applicable mitigation measures identified in the POD and Pacific Connector project design requirements must be implemented".

The purpose of these three project-level amendments is to make the proposed Pacific Connector pipeline project consistent with the Winema National Forest LRMP. Thus, the substantive planning rule requirements that are directly related to these three amendments are:

- 36 CFR 219.10(a)(1) – […the responsible official shall consider: …] "(1) Aesthetic values,… scenery,... viewsheds...".
- 36 CFR 219.10(b)(i) – [the responsible official shall consider] "Sustainable recreation; including recreation settings, opportunities,…and scenic character…"

Because the proposed amendments are "directly related" to these two substantive requirements, the Responsible Official must apply the requirements within the scope and scale of the proposed amendments (36 CFR 219.13 (b)(5)).

In considering the "scope and scale" of the three amendments, it is important to recognize that the applicable sections of 36 CFR 219.10 that are described above, requires plan components to provide for aesthetic values and scenic character across the entire planning area (i.e., Winema National Forest). These plan amendments do not alter these LRMP plan requirements for managing visual resources across 99.99 percent of the Winema National Forest. The proposed pipeline construction corridor including the TEWAs and the UCSAs is approximately 92 acres of the 1,043,547 acre Winema National Forest. Of the 92 acres of pipeline corridor construction it is estimated that approximately 70 of these acres would not meet the standards for visual resources described above.

The amendments modify three standards so that in the 92 acres of the project construction area the project need not be in compliance with these standards' specific requirements but instead, it is the "applicable mitigation measures identified in the POD and the Pacific Connector Project design requirements" that must be implemented. Or stated in another way, for the 92 acres of National Forest lands that would be within the operational ROW and construction zone for the Pacific Connector Pipeline, the three management requirements described above would be replaced with the full set of management requirements that comprise the "applicable mitigation measures identified in the POD and Pacific Connector Project Design requirements". The inclusion of these management requirements as a part of the plan component language for the LRMP in this plan amendment, addresses the applicable 36 CFR 219.10 rule requirements within the "scope and scale" of these proposed plan amendments. The sections below describe in more detail how the applicable 36 CFR 219.10 requirements are being addressed.

How the Required Mitigation Measures would Consider, Minimize, Maintain or Restore Effects to Aesthetic Values and Scenic Character and Meet the Applicable 36 CFR 219.10(a) and 36 CFR 219.10(b) Requirements.

The Forest Service has worked to inventory, analyze, and evaluate visual resources, view sheds, and aesthetics that could be affected by this project. Forest Service landscape architect provided technical support to FERC and Forest Service third-party contractors by reviewing the information gathered for the project. The POD is a document developed between the Forest Service, BLM, FERC, and Pacific Connector that contains the design features, mitigation measures, roles and responsibilities, monitoring, and procedures for the construction and operation of the pipeline on NFS lands. In addition, FERC's applicant prepared Plan and Procedures for construction and restoration enforceable, where applicable, for additional design features and mitigation. The design requirements and mitigation measures of the POD would be required by the modified standards and incorporated into BLM's ROW grant.

The mitigation measures incorporated into amendments for Visual Quality Objectives are designed to minimize, maintain or restore the potential for long-term impacts to visually sensitive areas. To ensure adequate restoration and revegetation of the ROW, design features are identified in the *Erosion Control and Revegetation Plan* (POD I), *Right-of-Way Clearing Plan* (POD U), *Leave Tree Protection Plan* (POD P), *Aesthetics Management Plan* (POD A), and *Recreation Management Plan* (POD S).

A visual assessment was conducted to determine the potential effects on visual resources associated with the pipeline. Representative viewpoint points (also referred to as KOPs) were identified within the view shed for the pipeline, defined as the area from which the pipeline would be potentially visible. Photographs of existing visual conditions were used in preparing computerized visual simulations for each KOP. Because the appearance of the pipeline ROW would change with time, a series of simulations were prepared to illustrate how the pipeline ROW would look at different timeframes following construction. These KOPs would also serve as monitoring points for mitigation.

Pacific Connector produced POD A that outlined measures to reduce visual impacts along its pipeline route. To the extent feasible, Pacific Connector would use revegetation efforts to shape and blend the pipeline easement, enhance the setting, and mimic the natural features of the landscape. These measures would consist of revegetating all disturbed areas and replanting trees in TEWAs and any other areas of the temporary construction ROW that were forested prior to construction (see POD I).

On Forest Service lands, Pacific Connector would maintain a cleared 30-foot width centered over the pipe allowing the remainder of the permanent easement to be reforested. This allows trees to naturally reestablish along the edges of the permanent easement at a staggered, more natural-looking interval. Replacing slash in forested areas of the ROW during restoration activities would immediately affect the visual contrast in color and texture of the disturbed ROW areas. Over time, as the ROW revegetates and narrows in width and changes in form, texture and color, potential visual impacts would diminish.

Additionally, a row, or if necessary, clusters of trees and/or shrubs would be planted across the ROW to provide visual screens at key road and trail crossings in sensitive view sheds. For all revegetation practices, Pacific Connector and/or its contractors would only use agency-approved tree and plant species, in compliance with management plan objectives and in consultation with agency specialists.

Site Specific Crossing Prescriptions:

Clover Creek Road (intersection of Dead Indian Memorial Highway and Clover Creek Road). Viewsheds in this area are managed for Foreground and Middleground Retention and Partial Retention, but also contain areas of private lands with recently harvested timber and several clusters of rural residential homes. The proposed alignment would cross the Dead Indian Memorial Highway perpendicularly in a thick forest foreground setting (at MP 168.83). Pacific Connector would implement the mitigation recommendations detailed in Section 3.2 and 3.3 and further described in the POD I. These pipeline restoration efforts would include regrading to the approximate original contours, reseeding, scattering slash across the ROW, and replanting, which would minimize, maintain or restore visual contrast of the ROW. During restoration, Pacific Connector would plant trees within forested areas to within 15 feet of the Pipeline, which would allow a strip of trees to establish along the easement and between the Pipeline and the road in this area. Because the Pipeline was recommended to abut the road and to eliminate the strip of trees between the road and the Pipeline easement, the Forest Service and BLM would specify if tree planting would occur on federal lands between the centerline and Clover Creek Road (but not within 15 feet of the pipeline). Pacific Connector would also implement the mitigation recommendations in the Federal Lands Scenery Management Analysis at this location which include:

During construction of the Project, Compliance Monitors representing FERC are present on a full-time basis to inspect construction procedures and mitigation measures and provide regular feedback on compliance issues to FERC and the Forest Service. Objectives of the Compliance Monitoring program are to: facilitate the timely resolution of compliance issues in the field; provide continuous information to FERC regarding noncompliance issues and their resolution; and review, process, and track construction-related variance requests. Changes to previously approved mitigation measures, construction procedures, and construction work areas due to unforeseen or unavoidable site conditions would require various levels of regulatory approval from the applicable land management agencies. FERC would have the authority to stop any activity that violates an environmental condition of the FERC authorization issued to Pacific Connector.

Additionally, environmental compliance oversight responsibilities for Pacific Connector, FERC, Forest Service and BLM are described in the POD (*Environmental Briefings and Compliance Plan*, POD G) that would apply to the construction, operation, and maintenance of the project specifically on NFS lands. The Forest Service Authorized Officer would coordinate with the BLM in administering and enforcing ROW grant provisions and would have stop-work authority. The Forest Service Authorized Officer’s designated representatives would ensure that the stipulations and mitigation measures included in the POD that are designed to minimize, maintain or restore the effects to visual resources and recreational resources are adhered to during project construction, operation, and maintenance. The BLM Authorized Officer would coordinate with the Forest Service to ensure the work is being conducted in accordance with the ROW grant and agreed upon conditions. BLM and the Forest Service would have stop-work authority. Field variance requests would be coordinated with the Authorized Officers.

How the Compensatory Mitigation Actions would help to Provide for Aesthetic Values and Scenic Character in the Plan Area (36 CFR 219.10(a)(1), 36 CFR 219.10(b)(i)).

Part of the CMP on the Winema National Forest includes a proposal to reduce stand densities on 114 acres in a way that would help soften the visual impact of the Pacific Connector Project. The Pacific Connector pipeline would create a hard line along the timbered edge of the corridor that does not fit with the visual objectives for the Clover Creek Road or the Dead Indian Memorial Highway. Thinning and fuels treatments can be used to soften the edge to a more natural appearing texture by restoring stand density to more natural levels and creating small openings that are consistent with the landscape. This proposal would restore stand density, species diversity, and structural diversity more characteristic under a natural disturbance regime.

This project has been designed by an interdisciplinary team of resource professionals on the Winema National Forest with input and coordination with the FWS, NOAA Fisheries, and State agencies. It was planned within the watersheds that would be affected by the Pacific Connector pipeline project. It is a component of the Pacific Connector application and would be a requirement of the ROW grant. This project would help to restore visual resources on the Winema National Forest (see table 2.3.1-3 and 2.3.1-4 and figure 2.3-1 and 2.3-2 in appendix F.2 for additional information).

4.7.3.5 Resource Values and Conditions on Federal Lands: The Aquatic Conservation Strategy on National Forest System Lands

Introduction

This section summarizes appendix F.4, Aquatic Conservation Strategy (ACS) Technical Report, which contains the full text of the independent Forest Service analysis. Those who seek additional information should review the applicable section in appendix F.4. Section, figure, and table numbers that refer to sections in appendix F.4 are so noted.

Background of the Aquatic Conservation Strategy

The ACS was developed as an element of the NWFP to "restore and maintain the ecological health of watersheds and aquatic ecosystems on public lands contained within them" within the range of the northern spotted owl (Forest Service and BLM 1994a, 1994b). The ACS applies on the Umpqua, Rogue River – Siskiyou national forests and portions of the Winema national forest within the range of the northern spotted owl. The ACS does not apply to lands managed by the BLM.[152]

The ACS established Riparian Reserves and Key Watersheds as land allocations on NFS lands. The ACS also established watershed assessment requirements, management objectives and special standards and guidelines for management and protection of aquatic resources. Forest Service line officers must determine whether activities that occur on NFS lands retard or prevent attainment of the ACS objectives on their respective national forests (Forest Service and BLM 1994a, 1994b;). Projects that retard or prevent attainment of the ACS objectives would not be consistent with the ACS. In making the ACS consistency finding (Goodman et al. 2007), the decision maker must:

[152] The ACS also applied to BLM lands managed under the BLM's 1995 Resource Management Plans (RMP) as amended. The ACS was replaced by Riparian Management Areas in BLM RMPs in 2016 when those RMPs were revised. As a result, the ACS is no longer applicable on BLM lands.

- Review projects against the ACS objectives at the project or site scale, rather than only at the watershed scale.
- Evaluate the immediate (short-term) impacts, as well as long-term impacts of an action.
- Provide a description of the existing watershed condition, including the important physical and biological components of the 5th field watershed.
- Provide written evidence that the decision maker considered relevant findings of watershed analysis.

Appendix F.4 and this summary provide the basis for Forest Supervisors of the Rogue River, Umpqua and Winema National Forests to independently determine whether the Pacific Connector Pipeline Project would retard or prevent attainment of ACS objectives or otherwise be inconsistent with the ACS objectives.

Overview of the Project

The Pacific Connector Pipeline Project would traverse approximately 31 miles of NFS lands and 47 miles of BLM lands on its 232 -mile route from Malin to Coos Bay, Oregon. This assessment and appendix F.4 apply only to the portion of the Pacific Connector Project on NFS lands.

Table 4.7.3.5-1 provides a breakdown of provinces, river basins and fifth field watersheds on NFS lands where the ACS applies.

TABLE 4.7.3.5-1

Provinces, River Basins and Watersheds on NFS Lands Subject to the ACS

Province	River basin	Fifth field Watershed	Hydrologic Unit Code	Key Water-shed	Total Miles All Owners	Umpqua NF Miles	Rogue River NF Miles	Winema NF Miles	Total Forest Service Miles
Klamath Siskiyou	Umpqua	Days Cr.-S. Umpqua	1710030205	Yes	19.15	1.56	0.00	0.00	1.56
Klamath Siskiyou — Western Cascades	Umpqua	Elk Cr.-S. Umpqua	1710030204	Yes	3.26	2.67	0.00	0.00	2.67
Klamath Siskiyou — Western Cascades	Umpqua	Upper Cow Cr.	1710030206	No	5.27	4.50	0.00	0.00	4.50
Western Cascades	Upper Rogue	Trail Cr.	1710030706	No	10.68	2.09	0.00	0.00	2.09
Western Cascades — High Cascades	Upper Rogue	Little Butte Cr.	1710030708	Yes	32.93	0.00	13.75	0.00	13.75
High Cascades	Upper Klamath	Spencer Cr.	1801020601	Yes	15.13	0.00	0.00	6.05	6.05
Total Project Miles where the ACS Applies					**—**	**9.82**	**13.75**	**6.05**	**30.62**

Ecological Provinces Crossed by the Pacific Connector Pipeline Project

<u>Klamath-Siskiyou Province MP 47–105, 118–153</u>

The Klamath-Siskiyou Province encompasses the Klamath and Siskiyou Mountains and lies between the Coast Range and the Cascades, south of the Willamette Valley. The Project would traverse the northeast corner of the Klamath-Siskiyou Province for approximately 93 miles (appendix F.4, figure 1-1). It includes parts of the Umpqua and Rogue River National Forests. This landscape is typified by deeply dissected valleys and jutting ridges and foothills. Much of this province lies within a rain shadow sheltered from the Pacific maritime influences by the mountains of the Coast Range. The region has a rugged landscape, with high peaks and deep canyons. Elevations range from about 1,000 to 7,000 feet above MSL.

The Klamath-Siskiyou Province is known for its highly complex geology. Most of the area is composed of highly deformed volcanic and marine sedimentary rocks with some metamorphic terranes. Also included are deformed pieces of oceanic crust and granitic intrusive bodies. Bedrock is often intensely metamorphosed and fractured. Well-developed floodplains and terraces near major rivers give way to highly dissected mountains with high-gradient streams. Many streams in this province flow only intermittently because of high gradients and low summer precipitation.

Erosional processes in the Klamath-Siskiyou Province are dominated by mass wasting associated high-intensity rainfall events. Erosional processes are accelerated where these rainfall events overlap with large, high severity stand-replacing fires. Precipitation gradients decrease from west to east, so landslide frequency decreases with decreased precipitation. Hydraulic mining during the 19th century dramatically altered landscapes and downstream channels where this activity occurred.

Western Cascades Province MP 105-113

Approximately eight miles of the pipeline corridor cross the north-south trending Western Cascades Province (appendix F.4, figure 1-1). This province, which drains westward to the Pacific Ocean, reaches elevations of 4,400 feet above MSL in watersheds crossed by the Pacific Connector Pipeline Project. Portions of the Upper Cow Creek and Trail Creek fifth-field watersheds are in the Western Cascades Province.

The landforms in the Western Cascades Province are distinguished from the High Cascades by older volcanic activity and longer glacial history. Ridge crests at generally similar elevations are separated by steep, deeply dissected valleys. Complex volcanoclastic formations juxtapose relatively stable volcanic deposits that weather to thick soils and are subject to earthflows. Unconsolidated alluvial and glacial deposits are subject to streambank erosion and landslides. Tributary channels flow at large angles into wide, glaciated valleys. Stream gradients are typically moderate to high (2 to 30 percent).

High Cascades Province MP 153-180

Approximately 23 miles of the Project corridor would be in the High Cascades Province (appendix F.4, figure 1-1). This Province consists of one north-south trending mountain chain that drains both westward to the Pacific Ocean and eastward into Klamath and Columbia Basins (see appendix F.4, figure 1-1). The High Cascades Province reaches a peak elevation of 9,493 feet MSL at the summit of Mt. McLoughlin. Portions of the Little Butte Creek and Spencer Creek fifth-field watersheds are in this province.

The province consists of volcanic landforms with varying degrees of historic glaciation. Lava flows form relatively stable plateaus, capped with pumice and ash deposits by the recent Cascade volcanoes. Drainages are generally not yet well developed or otherwise disperse into highly permeable volcanic deposits. Geologically recent volcanic pumice and ash deposits are subject to large debris flows when saturated by snowmelt. This province is composed primarily of approximately 3 million year old volcanic material, primarily andesite and basalt that were subsequently glaciated. Mountains in this province are moderately dissected. Headwater streams have medium to high gradients and are often associated with large meadow-spring complexes. Expansive pumice plateaus associated with the eruption of Mt. Mazama about 5,000 years ago (Dead Indian Plateau, Clover Creek) with droughty soils characterized by high snowmelt infiltration and low summer water retention fill valley floors adjacent to volcanic peaks.

Watersheds Crossed by the Pacific Connector Pipeline Project

The Project would cross portions of 19 fifth-field watersheds, six of which include NFS lands where the ACS applies. Figure 4.7-4 (reproduced from figure 1-1 in appendix F.4) shows watersheds and aquatic provinces crossed by the Pacific Connector Pipeline Project.

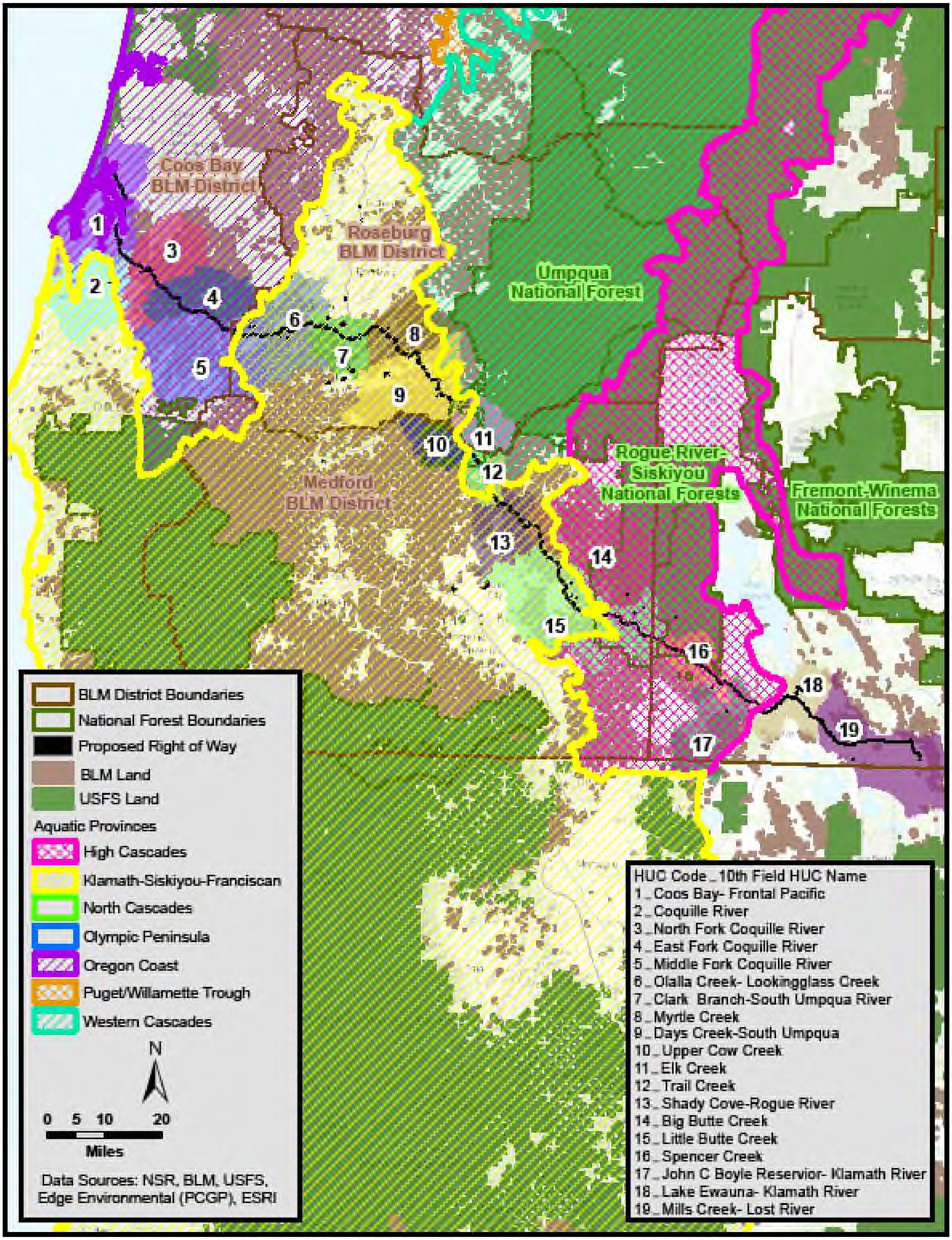


Figure 4.7-4. Provinces, and Watersheds Crossed by the Pacific Connector Pipeline Project

Table 4.7.3.5-2 summarizes (1) the number and acreage of Riparian Reserves of perennial and intermittent streams and forested wetlands that would be "crossed" by the pipeline NFS lands, and (2) the number and acreage of Riparian Reserves that would be "clipped" where a portion of the Riparian Reserve is impacted without the pipeline trench crossing a waterbody or wetland.

Table 4.7.3.5-3 shows the age-class structure of vegetation that would be cleared within the proposed Pacific Connector ROW. Most of the Pacific Connector Pipeline Project is routed on ridge tops to avoid stream and riparian-area crossings. To the degree possible, Project routing has avoided late-successional and old-growth forest in Riparian Reserves. Of the vegetation cleared in the construction corridor and TEWAs, approximately 67 percent or about 15.3 acres of the 22.7 acres are in in mid or early seral vegetation while approximately 33 percent or 7.4 acres are in late-successional or old-growth forest.

Table 4.7.3.5-4 (table 2-3 from appendix F.4) summarizes forest plan land allocations for the watersheds crossed by the Pacific Connector.

TABLE 4.7.3.5-2

Summary of Riparian Reserves, Stream Channels and Wetlands Crossed by the Pacific Connector Pipeline on NFS Lands by Administrative Unit

	Perennial Streams Crossed a/		Intermittent Streams Crossed		Wetlands Crossed b/		Total Stream Channels or Wetlands Crossed		Riparian Reserves Clipped without Stream or Wetland Crossings c/		Total d/	
Agency a/	**Stream Channels Crossed e/ (number)**	**Riparian Reserves Cleared (Acres)**	**Stream Channels Crossed (number)**	**Riparian Reserves Cleared (Acres)**	**Wetlands Crossed (number)**	**Riparian Reserves Cleared (Acres)**	**Total Crossed (number)**	**Total Riparian Reserves Cleared (Acres)**	**Riparian Reserves Clipped (number)**	**Total Riparian Reserves (Acres)**	**Affected Riparian Reserves (number)**	**Cleared (Acres)**
Umpqua National Forest	4	7.29	3	6.27	1	2	8	15.56	3	1.44	11	17
Rogue River National Forest	1	2.45	1	1.64	0	0.00	2	4.09	2	0.64	4	4.73
Winema National Forest	0	0.00	2	3.28	2	2.48	4	5.76	4	2.55	8	8.31
Total Forest Service	5	9.74	6	11.19	3	4.48	19	25.41	9	4.63	28	30.04

Data Source: Resource Report 3, table 2A-3A and FS Riparian Reserve Assessment, database.

a/ "Crossed" means that the pipeline trench (cleared or modified land) crosses the stream channel or delineated wetland area.

b/ "Wetlands" refers to delineated wetland areas that are not already counted as streams. Where the Riparian Reserve of a wetland is fully encompassed in the adjacent Riparian Reserve of a stream channel, the acres are counted as part of the stream channel to avoid double counting and are shown as 0 in this table.

c/ "Clipped" means that the Riparian Reserve associated with a stream channel or wetland was cleared as part of the construction corridor, Temporary Extra Work Area (TEWA) or Hydrostatic Test, but the pipeline trench did not cross the stream channel or delineated wetland area.

d/ This table includes only areas where vegetation is cleared in the construction corridor, hydrostatic test sites, and TEWAs. An additional 11.45 acres of Riparian Reserves are used as Uncleared Storage Areas (UCSA) where habitat may be modified but vegetation is not removed.

e/ Irrigation ditches or other man-made water conveyances are crossed by the Project, but they do not create Riparian Reserves and are not subject to the requirements of the ACS

TABLE 4.7.3.5-3

Vegetation Age Class Structure of Riparian Reserves Cleared in Construction Corridor and TEWAs by Administrative Unit, Forest Service

		LSOG (>80 Years) Forest Cleared (Acres)				Mid Seral (40-80 Years) Cleared (Acres)				Early Seral (0-40 Years) Cleared (Acres)							
Administrative Unit	**Waterbody Type**	**Conifer Forest**	**Hardwood Forest**	**Mixed Conifer and Hardwood Forest**	**Total LSOG Cleared**	**Conifer Forest**	**Hardwood Forest**	**Mixed Conifer and Hard-wood Forest**	**Total Mid-Seral Cleared**	**Conifer Forest**	**Mixed Conifer and Hardwood Forest**	**Shrub or Brush-field**	**Grass-lands and Non-forest**	**Total Early Seral Cleared**	**Total All Vegetation Classes (Acres)**	**Stream Channel or Wetland Area within Corridor (Acres)**	**Total within Cleared Area (Acres)**
Umpqua NF	Perennial Stream	2.83			2.83	0.82			0.82	3.02				3.02	6.67	0.19	6.86
	Intermittent Stream					3.04			3.04	0.47				0.47	3.51	0.05	3.56
	Wetland					1.56			1.56						1.56		1.56
	Total	2.83			2.83	5.42			5.42	3.49				3.49	11.74	0.24	11.98
Rogue River NF	Perennial Stream	1.33			1.33					1.04				1.04	2.37	0.04	2.41
	Intermittent Stream					0.12			0.12	0.72			0.19	0.91	1.03	0.1	1.13
	Wetland	0.13			0.13					0.39				0.39	0.52		0.52
	Total	1.46			1.46	0.12			0.12	2.15			0.19	2.34	3.92	0.14	4.06
Winema NF	Perennial Stream																
	Intermittent Stream	2.2			2.2					1.91				1.91	4.11	0.1	4.21
	Wetland	0.91			0.91	0.58	0.26		0.84	1.01			0.17	1.18	2.93	0.01	2.94
	Total	3.11			3.11	0.58	0.26		0.84	2.92			0.17	3.09	7.04	0.11	7.15
Total Forest Service	Perennial Stream	4.16			4.16	0.82			0.82	4.06				4.06	9.04	0.23	9.27
	Intermittent Stream	2.2			2.2	3.16			3.16	3.1			0.19	3.29	8.65	0.25	8.9
	Wetland	1.04			1.04	2.14	0.26		2.4	1.4			0.17	1.57	5.01	0.01	5.02
	Total	7.4			7.4	6.12	0.26		6.38	8.56			0.36	8.92	22.7	0.49	23.19

Note: Minor rounding differences may result in totals across rows tallying to slightly different totals than column totals and subtotals. These differences are on the order of hundredths of an acre and are not significant.

TABLE 4.7.3.5-4

Fifth-Field Watersheds and Land Allocations Crossed by the Pacific Connector Gas Pipeline Corridor ROW on NFS Lands

	LSR				Matrix				Riparian Reserves			
	Project Area (acres)		% of Total LSR in Unit		Project Area (acres)		% of Total Matrix in Unit		Project Area (acres)		% of Total Riparian Reserves in Unit	
Unit	**Cleared**	**Modified**	**Cleared**	**Modified**	**Cleared**	**Modified**	**Cleared**	**Modified**	**Cleared**	**Modified**	**Cleared**	**Modified**
Days Cr.-S. Umpqua	9.81	18.55	0.35	0.66	11.01	13.03	2.84	3.36	0.15	1.56	0.02	0.16
Elk Cr.-South Umpqua	21.23	0.00	0.15	0.00	7.43	1.20	0.04	0.01	0.00	0.00	<0.01	0.00
Upper Cow Creek	36.58	0.00	1.56	0.00	37.07	0.00	0.19	0.00	10836	0.00	0.13	0.00
Trail Creek	0.00	0.00	0.00	0.00	41.28	8.99	1.05	0.23	<0.01	0.00	<0.01	0.00
Little Butte Creek	205.26	69.50	0.45	0.15	0.00	0.00	0.00	0.00	7.66	2.56	0.09	0.03
Spencer Creek	0.05	0.02	<0.01	<0.01	71.06	10.05	0.70	0.10	8.63	1.35	0.52	0.08
Total	**272.93**	**1,924.5**	**0.39**	**2.76**	**167.85**	**33.72**	**0.30**	**0.06**	**27.27**	**5.47**	**0.09**	**0.02**

Source: Appendix F.4, table 2-3

The proposed Pacific Connector pipeline route would follow ridgelines and existing rights-of-way, such as powerlines and roads, wherever possible. To the extent possible, route location avoided crossing or modifying Riparian Reserves. In 30.6 miles of Right of Way on NFS lands, approximately 32.74 acres or 0.11 percent of Riparian Reserves on NFS lands in the affected watersheds would be cleared or modified by the Pacific Connector (appendix F.4, table 2-3).

Project impacts on aquatic habitats at stream crossings are generally comparable to construction of a road crossing with a culvert installation. Possible short-term impacts could include sediment transport to waterbodies where construction at stream crossings causes surface erosion, disturbance of banks and stream bottoms, and minor increases in water temperature from removal of effective shade.

Removal of mid and late seral forest vegetation at stream crossings would result in a long-term change in vegetative condition at the site scale. Early seral vegetation removed would recover as early seral vegetation and is less of a change in condition. Use of roads, including standards for reconstruction, would be subject to applicable ACS standards and guidelines. In order to minimize potential adverse impacts on fish, timing of instream work in streams with flowing water would be tied to work windows established by the ODFW. These time periods were established to avoid the vulnerable life stages of potentially affected fish species, including migration, spawning, and rearing.

The ACS is intended to prevent long-term adverse on riparian dependent resources (Forest Service and BLM 1994c, p. 3.4-69). This summary and appendix F.4 show that other than change in vegetative condition, impacts on NFS Riparian Reserves and aquatic habitats would be temporary or minor in scale in any given fifth-field watershed or sixth-field subwatershed. Changes in vegetation at stream crossings are a long-term effect because the 50-foot-wide maintenance corridor for the Pacific Connector pipeline must be kept in low-growing vegetation. This would not prevent attainment of the ACS objectives because the widely dispersed nature of crossings and the small amount of vegetation removed at each site. See appendix F.4 for a complete discussion and analysis of environmental consequences.

Project Effects Related to the ACS in Affected Watersheds on NFS Lands

Umpqua River Basin, Days Creek–South Umpqua River Watershed, HUC 1710030205, Umpqua National Forest

Discussions of watershed analysis recommendations, natural disturbances, range of variability and other elements of the ACS are found in appendix F.4. Table 4.7.3.5-5 (table 2-11 from appendix F.4) compares the Project effects against the objectives of the ACS. The Project does not cross any stream channels in this watershed. It affects approximately 1.71 acres of the Riparian Reserves of which 0.15 acres would be cleared and 1.56 acres would be modified. All affected Riparian Reserves are associated with isolated forested wetland swales on or near the watershed divide between Stouts Creek and Corn Creek that have no apparent surface connection to drainages.

TABLE 4.7.3.5-5

Compliance of the Project with ACS Objectives, Days Creek–South Umpqua River Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are landscape-scale features that would be affected by the Project. The Project ROW would impact 2.2% of the NFS land in the Days Creek–South Umpqua River watershed. Approximately 0.15 acre of Riparian Reserves would be cleared. All of the vegetation cleared would be mid seral. While the cutting of trees where the Project ROW intersects two localized Riparian Reserves would result in a long-term change in vegetation condition, it would be minor in scale and well within the range of natural variability for vegetative change, given the fire history of the Days Creek–South Umpqua River watershed. The application of BMPs and erosion control measures, use of native vegetation, and the anticipated rapid revegetation of disturbed areas would likely further reduce Project impacts. The level of impacts is well within the range of natural variability for disturbance processes described by Everest and Reeves (2007) and Agee (1993) and as documented in the South Umpqua Watershed Assessment (BLM 2001). The NFS lands in the Days Creek–South Umpqua River watershed are approximately 32% LSOG.
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The Project is not expected to affect spatial or temporal connectivity on NFS lands in the Days Creek–South Umpqua River watershed. No streams would be crossed and impacts in Riparian Reserves would be minimal. Any residual levels of disturbance are anticipated to be well within the range of natural variability.
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	The Project would have no discernible impact on streambanks or bottoms in the Days Creek–South Umpqua River watershed because no stream channels would be crossed. The few impacts in Riparian Reserves are associated with near ridge-top intermittent streams or ridge top (wetland) swales that have no apparent surface connectivity to the drainage system. Therefore, there would be little influence on the physical integrity of the aquatic system.

TABLE 4.7.3.5-5 (continued)

Compliance of the Project with ACS Objectives, Days Creek–South Umpqua River Watershed

ACS Objective	Project Impacts
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Sediment impacts are expected to be as described in Appendix F.4, Section 1.4.1. Minor amounts of sediment would be mobilized during construction, but these impacts are expected to be short term and limited to the immediate Project area. Connectivity to aquatic systems is limited since no stream channels would be crossed. With application of the ECRP and BMPs, no long-term impacts associated with sediment transport are anticipated. No impacts on water temperature are expected because the two waterbodies that would be crossed are isolated and not connected to an intermittent or perennial stream and no effective shade would be removed.
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	Areas of unstable soils have been avoided in Project routing. There would be no stream channels crossed in the watershed because the route lies on a ridge top and connections to aquatic systems that would transport sediment do not exist. Sediment fluxes are expected to be minor, short-term, and well within the range of natural variability for the Klamath-Siskiyou Province with implementation of the erosion control measures in ECRP and BMPs as well as the anticipated rapid revegetation that is characteristic of the province. Erosional impacts are, therefore, expected to be consistent with those described in appendix F.4, Section 1.4.1.
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	It is highly unlikely that the Project would affect flows because there is no connectivity between the two isolated wetlands to any drainage system. The Project routing is on a ridge top in the watershed and would not cross any stream channels. The watershed is hydrologically recovered (BLM 2001:143) and the Project would affect less than 0.5% of the watershed (appendix F.4, table 2-6) so changes in peak flows as a result of construction are highly unlikely.
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	Two small forested wetlands would be crossed in or near a ridge top swale in the Stouts Creek subwatershed at MP 102.1 and 102.2. Trench plugs would be installed on each side of these wetlands to block subsurface flows and maintain water table elevations, as required by FERC's Wetland and Waterbody Construction and Mitigation Procedures. By restricting crossings to the dry season (July 1 to Sept. 15), possible impacts on water tables of these wetland areas are expected to be minor and short-term. These features appear to have no surface connectivity with the Stouts Creek drainage network.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	Approximately 0.15 acre or less than 0.01% of Riparian Reserves in the watershed would be cleared by the Project. All affected Riparian Reserves are located at or near ridge tops and contribute little to the thermal regulation, nutrient filtering, bank erosion, and channel stability of the drainage networks in the watershed. Existing herbaceous and brush cover would be maintained in Riparian Reserves to the extent practicable. Replanting with native species would facilitate recovery of vegetation communities. These restoration and off-site mitigation efforts would contribute to the maintenance and restoration and physical functions of the Riparian Reserves in the watershed.
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	Impacts to Riparian Reserves would be minimal. All of the Riparian Reserves are located at or near ridge tops. To maintain riparian habitat, construction BMPs would be implemented. Revegetation would be encouraged by planting of native riparian species. The persistence of riparian-dependent Survey and Manage species would not be threatened by Project construction and operation in the watershed (see appendix F.5).

Source: Appendix F.4, table 2-11

It is highly unlikely that construction and operation of the Project would prevent attainment of ACS objectives due to the relatively small portion of NFS lands affected, the relative lack of intersections with waterbodies, and the small acreage of Riparian Reserve affected in the Days

Creek-South Umpqua River watershed. No Project impacts relevant to the ACS have been identified that are outside of the range of natural variability for disturbance processes in the watershed (appendix F.4, table 2-17). The proposed amendment to the Umatilla National Forest LRMP to waive protection measures for Survey and Manage species would not prevent attainment of ACS objectives because the Project does not threaten the persistence of any riparian-dependent Survey and Manage species. Mitigations associated with the Project are responsive to watershed assessment recommendations and would improve watershed conditions where they are applied (appendix F.4, table 2-10).

Umpqua River Basin, Elk Creek–South Umpqua River Watershed, HUC 1710030204, Umpqua National Forest

Discussions of watershed analysis recommendations, natural disturbances, range of variability and other elements of the ACS are found in appendix F.4. Table 4.7.3.5-6 (table 2-21 in appendix F.4) and this section shows Project effects compared to each of the nine ACS objectives. The Project does not cross any stream channel or clip any riparian reserve on NFS lands.

TABLE 4.7.3.5-6

Compliance of the Project with ACS Objectives, Elk Creek–South Umpqua River Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are landscape-scale features that are affected by the Project. The Project affects (cleared and modified) 0.09% of the NFS land in the Elk Creek-South Umpqua River watershed (Appendix F.4, table 2-12). No Riparian Reserves are crossed or clipped in the Elk Creek watershed since the Project is routed on a ridgetop. The application of BMPs and erosion control measures, use of native vegetation, and the anticipated rapid revegetation of disturbed areas would likely further reduce Project effects. The level of impact is well within the natural range of variability for disturbance processes described by Everest and Reeves (2007) and Agee (1993) and as documented in the South Umpqua Watershed Assessment (Forest Service 1996b).
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The Project is not expected to impact spatial or temporal connectivity on NFS lands in the Elk Creek–South Umpqua River watershed. No streams are crossed, and no riparian reserves are clipped. Aquatic system connectivity would be enhanced by replacement of five culverts within the watershed. Any residual levels of disturbance are anticipated to be well within the range of natural variability (see appendix F.4, table 2-17).
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	The Project would have no discernible impact on streambanks or bottoms in the Elk Creek–South Umpqua River watershed because no stream channels are crossed. Off-site mitigations involving LWD within Riparian Reserves would help restore physical integrity and complexity (appendix F.4, p. 2-47).
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Minor amounts of sediment would be mobilized during construction, but these effects are expected to be short-term and limited to the immediate Project area. Connectivity to aquatic systems is limited since no stream channels are crossed. With application of the ECRP and BMPs, there should be no long-term effects associated with sediment transport and delivery. No impacts to water temperature are expected because no channels are crossed, and no effective shade is removed. Any sediment transport to aquatic systems that may occur would be offset by off-site road drainage enhancement, surface upgrade, and storm-proofing mitigation Projects.

TABLE 4.7.3.5-6 (continued)

Compliance of the Project with ACS Objectives, Elk Creek–South Umpqua River Watershed

ACS Objective	Project Impacts
Maintain and restore the sedimentary erosion, transportation and deposition regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	Areas of unstable soils have been avoided in Project routing. There are no stream channels crossed in the watershed and the route lies on a ridge top; therefore, connections to aquatic systems that would transport sediment do not exist. As a result, sediment fluxes are expected to be minor and short-term and well within the range of variability for the Klamath–Siskiyou Province due to implementation of the erosion control measures in ECRP, BMPs, and the anticipated rapid revegetation that is characteristic of the province. As a result, erosional effects are expected to consistent with those described in Section 1.4.1. Road decommissioning and storm proofing would help reduce sediment effects in the watershed and move the sediment regime closer to the desired condition (appendix F.4 p. 2-47-51).
Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	It is highly unlikely that the Project would impact flows because of the lack of connectivity to aquatic systems. The Project routing is on a ridge top in the watershed and does not cross any stream channels. The watershed is hydrologically recovered, and the Project affects 0.07% of the watershed (appendix F.4, table 2-13). In addition, analysis by FERC showed that the Project was highly unlikely to contribute to increases in peak flows because of the small area affected by the Project as a proportion of the watershed (FERC 2009).
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The Project would not affect floodplains and water table elevations in meadows because these features are not crossed by the Project in the Elk Creek–South Umpqua River watershed.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	No vegetation in Riparian Reserves is removed. Existing herbaceous and brush cover would be maintained in Riparian Reserves to the extent practicable. Replanting with native species would facilitate recovery of vegetation communities. LWD placement within 26 acres of Riparian Reserves would help to enhance physical complexity of the aquatic habitats (appendix F.4, p. 2-47-51). These restoration efforts, along with the limited effects to which they are directed, would maintain and restore biological and physical functions of the Riparian Reserves in the watershed.
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	Existing herbaceous and brush cover would be maintained to the extent practicable. To maintain riparian habitat, construction BMPs would be implemented. LWD placement within 26 acres of Riparian Reserves would help to enhance physical complexity of the aquatic habitats (appendix F.4, p. 2-47-51). Revegetation would be encouraged by planting of native riparian species. The Project would waive application of Management Recommendations for Survey and Manage species in the watershed but would not threaten the persistence of riparian-dependent Survey and Manage species or prevent attainment of the ACS objectives (see appendix F.5).

Source: Appendix F.4, table 2-21

It is highly unlikely that the Project construction and operation would prevent attainment of ACS objectives on NFS land in the Elk Creek–South Umpqua River watershed based on the Project's ridgetop location and the lack of intersection with waterbodies or riparian reserves. Amendments of the Umatilla National Forest LRMP to waive protection measures for Survey and Manage species would not prevent attainment of ACS objectives because the Project does not threaten the persistence of any riparian-dependent species (appendix F.5). No Project effects relevant to the ACS have been identified that are outside of the range of variability for disturbance processes in the watershed (see appendix F.4, table 2-17).

Umpqua River Basin, Upper Cow Creek Fifth Field Watershed, HUC 1710030206, Umpqua National Forest

Discussions of watershed analysis recommendations, natural disturbances, range of variability and other elements of the ACS are found in appendix F.4. Table 4.7.3.5-7 (table 2-35 in appendix F.4) and this section evaluates Project effects against each of the ACS objectives. National Forest System lands where the ACS applies comprise about 51 percent of the Upper Cow Creek watershed (appendix F.4, table 2-22). Timber harvest and removal of LWD from creek channels has reduced structural complexity of the aquatic habitat and its ability to retain sediments. Chronic, fine-grained sediment deposition, primarily related to roads, has negatively affected aquatic habitats. The presence of roads has segregated some stream reaches from upslope habitats that are needed for replenishment of LWD (appendix F.4, p. 2-66-69). A total of 10.83 acres or 0.13 percent of the Riparian Reserves in the (appendix F.4, table 2-25) watershed would be cleared on:

- Four perennial stream channel crossings,
- Two intermittent stream channel crossings,
- One forested wetland crossing,
- One intermittent stream and six forested wetlands where Riparian Reserves are clipped, but the associated waterbodies are not crossed by the Project.

TABLE 4.7.3.5-7

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Upper Cow Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are watershed-scale features that would be affected by the Project. There would be four perennial and two intermittent stream crossings in the South Fork Cow Creek subwatershed. [Note that Hydrofeature N at MP 111.01 is a perennial stream but, because of an upstream diversion, it is dry in the summer. It is counted here as an intermittent stream since that it is its current condition]. One small shrub-dominated wetland is also crossed. Riparian Reserves associated with1 perennial stream and 6 forested wetlands are clipped. The Project ROW is located primarily in early or mid seral forests and largely on or near ridge tops to minimize impacts on aquatic habitats. The Project ROW would affect 73.76 acres or about 0.31% of NFS lands in the Upper Cow Creek watershed and about 10.06 acres or 0.13% of the Riparian Reserves within the watershed. Impacts to aquatic systems are expected to be short-term and minor and limited to the Project scale because of application of BMPs and erosion control measures. LWD cleared in construction of the corridor would be used to stabilize and restore stream crossings. Off-site mitigation measures including road decommissioning and installation of fish-friendly culverts are expected to improve watershed conditions in the Upper Cow Creek watershed (appendix F.4, p. 2-89-90; table 2-33). While there are long-term changes in vegetation in Riparian Reserves from construction clearing of the corridor, these would be minor in scale and well within the range of natural variation given the disturbance history of the Upper Cow Creek watershed (see appendix F.4, p. 2-70-83).

TABLE 4.7.3.5-7 (continued)

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Upper Cow Creek Watershed

ACS Objective	Project Impacts
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The Project is not expected to affect spatial or temporal connectivity in the Upper Cow Creek watershed except during the construction period because the pipeline would be buried in all aquatic habitats crossed, consistent with the requirements of the Wetland and Waterbody Crossing Plan. In the short-term, connectivity would be disrupted during construction. At each crossing, the corridor would be narrowed down to 75 feet wide. Bed and bank disturbances associated with equipment and trenching are small (<15 feet wide). After construction, all disturbed areas would be returned to their approximate original contours to restore preconstruction contours and drainage patterns. The temporary construction ROW would be restored and revegetated with native grasses, forbs, conifers, and shrubs, as outlined in the ECRP. After construction, key habitat components such as LWD and boulders would be restored onsite and the bed and banks would be returned to preconstruction conditions. By implementing these measures, lateral and longitudinal connectivity at the site scale would be maintained, although in the short-term during construction, connectivity may be disrupted. Except for a few days during the construction of the crossing, access to areas necessary for life-histories of aquatic- and riparian-dependent species would not be obstructed. By restricting stream crossing operations to the ODFW in-stream work window, possible impacts to sensitive life stages of aquatic biota would be minimized. Connectivity would be improved by installation of fish-friendly culverts at six sites that currently preclude passage of aquatic organisms (see appendix F.4 table 1-14, p. 2-89-91). The residual levels of disturbance are anticipated to be well within the range of natural variability in the Klamath–Siskiyou Province.
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	Impacts to the beds and banks of aquatic features would be minor and limited to the site of construction because the pipeline would be buried, and the actual area of bank and stream bottom disturbance associated with equipment crossing and trenching is small at each crossing (<15 feet wide). After construction, key habitat components such as LWD and boulders would be restored onsite and the beds and banks would be returned to preconstruction conditions, consistent with the POD requirements. By implementing these measures, the physical integrity of the aquatic system at the site scale would be maintained, although in the short-term (during construction), elements of the aquatic system could be disturbed. This level of disturbance is well within the range of natural variability for the watersheds of the Klamath-Siskiyou Province.
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Mercury from abandoned mercury mines in the South Fork Cow Creek subwatershed is a known issue. Broeker (2010b) and GeoEngineers (2013d) assessed the potential risk of release of mercury from disturbance of affected sediments. Mercury concentration of 0.29 parts per million (ppm)), which is in exceedance of the ODEQ threshold of 0.1 ppm, was detected in soil and stream sediment samples at one site. Special measures including maintenance of 100% effective ground cover have been adopted as recommended by ODEQ. As a result, the presence of inorganic mercury is not anticipated to cause any health risk. Minor amounts of sediment would be mobilized during construction, particularly during the dry open-cut and dam and pump crossing of the East Fork Cow Creek and its perennial tributaries (GeoEngineers 2013b). Water quality impacts from sediment are expected to be short-term and limited to the general area of construction (section appendix F.4 Section 1.4.1.2). No long-term impacts on water quality are expected because of application of the ECRP, including maintenance of effective ground cover (Section 1.3.1 and previous discussion) and BMPs during construction. Approximately 3.1 total acres of effective shading vegetation would be removed at four perennial stream crossings. A site-specific shade analysis conducted by Pacific Connector (NSR 2009, 2014) showed minor temperature increases were possible at the Project scale but no impacts would occur beyond the immediate area of construction; there were no temperature impacts at the stream-network scale. Water quality is expected to remain within the range that supports aquatic biota.

TABLE 4.7.3.5-7 (continued)

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Upper Cow Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	The Upper Cow Creek watershed sediment regime was historically characterized by pulse-type disturbances (Forest Service 1995a, Everest and Reeves 2007). The East Fork Cow Creek, a drainage in the South Fork Cow Creek subwatershed, is characterized in the Cow Creek watershed analysis as being "in balance" for sediment transport and deposition. The Project is not likely to alter these conditions. Eighty percent (3.73 of 5.27 miles) of the Project in the Upper Cow Creek watershed is on ridge tops with little or no aquatic connectivity. Site-specific field reviews by geologists show the Project is unlikely to cause landslides or activate currently stable earth-flow terrains because unstable areas have been avoided (GeoEngineers 2009b; Hanek 2011; Koler 2012). Surface erosion and sediment transport to streams would be minimized because the Project would maintain 100% effective ground cover, effective sediment barriers, and other erosion control measures as needed (see the sediment discussion at the beginning of this section). Sediment generated during construction is expected to be minor and to be limited to the general area of construction using dry dam-and-pump measures that isolate the crossing from flowing water during construction (section 1.3.1). The Project is not expected to alter the balance of sediment transport and storage in the East Fork Cow Creek. The Project is not expected to alter either the pulse-type disturbance or surface erosion sediment regimes of the Upper Cow Creek watershed (appendix F.4, Section 1.4.1.2). A pulse of sediment could be observed following the first seasonal rain, but this is likely to dissipate within a few hundred feet and would be indistinguishable from background levels.
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	Instream flows would be interrupted for a short time during installation of dams during dam and pump crossings. The area of construction that is between upstream and downstream dams would be dewatered during the actual crossing construction. During construction, water would be pumped around the construction site to maintain downstream flows. It is possible that there would be local increases in runoff from canopy removal but, at the watershed scale, flow regimes would not be altered by the Project because of the small scale of the Project relative to the watershed, the relatively high proportion (85%) of the watershed that is hydrologically recovered, and the lack of connectivity of most of the route to any stream network. See the discussion of peak flow processes in appendix F.4, p. 2-70-83 for additional information.
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The Project ROW clips the Riparian Reserve of six forested wetlands and crosses one delineated wetland. Trench plugs would be installed on each side of these wetlands as needed to block subsurface flows and maintain water table elevations, as required by FERC's Wetland and Waterbody Construction and Mitigation Procedures. Regardless, Project construction may have short-term impacts on water tables in these isolated forest wetlands. These site-specific impacts would be minor (i.e., limited to the general area of construction) and are not connected to larger wetland areas; they may also be regulated under Section 404 of the Clean Water Act. By restricting crossings to the dry season (July 1 to Sept. 15), possible impacts on water tables of these wetland areas are expected to be minor and short-term.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	Project impacts on riparian vegetation in the Upper Cow Creek watershed would be minor. In the short term, all vegetation would be removed from the Project ROW. About 4.45 acres of the Riparian Reserves to be cleared in the Project ROW are LSOG (table 2-25). Existing herbaceous and brush cover would be maintained in Riparian Reserves to the extent practicable. Overall, Project construction would affect ~0.13% of the Riparian Reserves in the watershed (table 2-25). Following construction, replanting with native species would facilitate reestablishment of vegetation communities. LWD and boulders from the corridor would be returned to disturbed riparian areas. These restoration efforts, along with the limited impacts to which they are directed, would maintain and restore biological and physical functions of the Riparian Reserves in the watershed.

TABLE 4.7.3.5-7 (continued)

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Upper Cow Creek Watershed

ACS Objective	Project Impacts
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	Project impacts on riparian vegetation in the Upper Cow Creek watershed would be minor (10.06 acres, or 0.13%, of the Riparian Reserves in the watershed) (table 2-25). Existing herbaceous and brush cover within the Project clearing limits would be maintained to the extent practicable. Consistent with the requirements of the POD, LWD and boulders removed from the corridor during construction would be replaced to restore and stabilize channel crossings. Revegetation would be accomplished using native riparian species. The persistence of riparian-dependent Survey and Manage species would not be threatened by Project construction and operation in the watershed. See appendix F.5.

Source: Appendix F.4, table 2-35

Through application of the ECRP BMPs and the FERC Wetland and Waterbody plans, sediment transport would be minimized, and instream flow regimes would be maintained (appendix F.4, section 1.4.1). No known riparian-related Survey and Manage species would be affected by Project construction and operation (see appendix F.5).

The South Fork Cow Creek subwatershed has four perennial stream crossings within one mile. This is the highest number of perennial stream crossings in one subwatershed on NFS lands. Construction of the Project in the Upper Cow Creek watershed has high potential for impacts that could prevent attainment of ACS objectives particularly as related to sediment, water temperature and mobilization of naturally occurring mercury (see appendix F.4, p. 2-70-84). The Project has addressed these issues as follows:

- **Project Routing—**Approximately 80 percent of the route in the Upper Cow Creek watershed is on a ridgetop with little or no connectivity to aquatic habitats or Riparian Reserves. Between MPs 109 and 110 in the South Fork Cow Creek subwatershed, the route has been selected and modified to avoid potentially unstable areas. The Forest Service has participated extensively in routing of the Project and concurs that the location is unlikely to trigger mass wasting or excessive surface erosion.
- **Implementation of Water Quality Best Management Practices—**A site-specific BMP implementation plan based on construction impact and site-response risk has been prepared that is expected to maintain water quality (GeoEngineers 2013b). Within Riparian Reserves for all hydrologic features crossed by the pipeline between MPs 109 and 110, the Project would provide 100 percent post-construction ground cover on all disturbed areas. Wood fiber is the preferred material. In addition, the Project would construct water bars at 50-foot intervals. Other erosion control measures would be used as needed to prevent surface erosion associated with stream crossings or to prevent sediment transport and deposition that may affect riparian systems.
- **Mitigation of Potential Impacts on Stream Temperature—**A temperature analysis on perennial stream crossings showed the Project may have minor temperature impacts (~

0.1°C) at the project scale (NSR 2009, NSR 2014).[153] Although the analysis showed there would be no impact at the next downstream reach below the crossings because of ground water discharge, flow volumes and existing shade, the Project would transplant larger conifers to riparian areas and use logs and slash to provide shade at perennial crossings in the East Fork Cow Creek to mitigate for temperature impacts at the project scale. Temperatures are expected to remain below those specified by the State of Oregon for streams in the Umpqua basin.

- **Mercury--** The Forest Service contracted with a professional consulting geologist with extensive local experience to collect soil and stream sediment samples for analytical testing and reporting of mercury and other naturally-occurring minerals along a 2,000-foot section of the proposed pipeline route between MP 109 and the East Fork Cow Creek (Broeker 2010b; GeoEngineers 2013a). Geochemical analysis of the soil and stream sediment samples have been determined to have very low to nominal concentrations of naturally occurring mercury mineralization. The mercury level at one of the stream sediment sites was 0.29 part per million, which was above the Level II screening level value of 0.1 part per million for invertebrates (ODEQ 1998, cited in GeoEngineers 2013c). In order to prevent this naturally-occurring mercury from mobilizing during and after construction, additional erosion control measures and monitoring would be conducted at these sites. The proposed pipeline construction activities by Pacific Connector within the East Fork Cow Creek subwatershed are not anticipated to disturb and expose soils and bedrock strata that contains more than low amounts of natural occurring mercury mineralization; and any sediment that is generated is not likely to reach the aquatic environment due to implementation of short-term and permanent mitigation measures outlined in Pacific Connector's ECRP and as listed in GeoEngineers (2013a).

There are approximately 7,849.12 acres of Riparian Reserves (NFS lands only) in the Upper Cow Creek watershed (appendix F.4, table 2-22) of which approximately 3,313.66 acres are LSOG. Approximately 10.83 acres of Riparian Reserves or 0.13 percent of the Riparian Reserves on NFS lands in the watershed would be cleared (appendix F.4, table 2-3, 2-24). Of this, approximately 2.81 acres are LSOG (appendix F.4, table 2-25). This is about 0.13 percent of the LSOG in Riparian Reserves on NFS lands in the Upper Cow Creek watershed. Early and mid-seral forest vegetation constitutes the remaining 8.02 acres of the affected Riparian Reserve vegetation. LSOG (2.81 acres) and mid-seral vegetation (4.37 acres) cleared (7.18 acres total) in the corridor would be a change in vegetation condition that is long-term but well within the range of natural variability for the Upper Cow Creek watershed considering its history of disturbance from stand replacement fire and subsequent landslides (appendix F.4, 2-70-83). Federal lands are currently 35.20 percent LSOG and exceed minimum watershed thresholds for LSOG forest after consideration of Pacific Connector Pipeline Project impacts (appendix F.4, p. 2-56).

Several site-specific proposed amendments of the Umatilla National Forest LRMP are required to make provision for the Pacific Connector Project. These proposed amendments are not expected

[153] A temperature increase of this scale is so small that may be outside the confidence limits of the model for precise predictions. In other words, this is possibly "noise" in the metrics, and may not actually occur in the field. Even if the predicted temperature increase does occur, it would quickly dissipate because of downstream shade, hyporheic flows and input from other streams (NSR 2009).

to prevent attainment of the ACS in the Upper Cow Creek watershed (appendix F.4, p. 2-83; table 2-32):

- Proposed amendment UNF-1 would allow removal of effective shade on perennial streams. This amendment would not prevent attainment of ACS objectives because a site-specific temperature assessment (NSR 2009, 2014) showed that any temperature increase resulting from removal of effective shade would be minor and limited to the point of maximum impact at the site of construction.
- Proposed amendment UNF-2 would allow the Pacific Connector corridor to run parallel to an existing stream within the riparian zone. The amendment would not prevent attainment of ACS objectives because an uncut buffer 30 to 60 feet wide remains between the corridor and the East Fork Cow Creek. An estimated 94 percent of the effective shade is maintained adjacent to the East Fork Cow Creek, erosion control measures specified in the ECRP are expected to be effective at controlling surface erosion and LWD would not be removed from the stream. Sources of LWD would remain on both sides of the channel.
- Proposed amendment UNF-3 would allow the Project to exceed detrimental soil conditions within the construction corridor. This would not prevent attainment of ACS objectives because soil decompaction and remediation required in Riparian Reserves is expected to effectively moderate detrimental soil conditions. Implementation of measures in the ECRP is expected to effectively control surface erosion and restore native vegetation (see section 4.3.4 of this EIS).
- Proposed amendment UNF-4 would reallocate approximately 588 acres from the matrix land allocation to the LSR allocation. This would benefit aquatic habitats because this area would be managed for late-successional stand conditions that provide additional aquatic protections.
- Proposed amendment of the Umatilla National Forest LRMP to waive protection measures for Survey and Manage species would not prevent attainment of ACS objectives because the Project does not threaten the persistence of any riparian-dependent species (see appendix F.5).

The routing of the Project through NFS lands, coupled with the relatively small area of NFS land affected by Project construction (73.76 acres or 0.31 percent of the NFS lands in the fifth-field watershed – appendix F.4, table 2-23), makes it highly improbable that Project impacts could affect watershed conditions. Although there are project-level impacts (e.g., short-term sediment and a long-term change in vegetative condition at stream crossings), these would be minor in scale and largely limited to the boundaries of the Project area (appendix F.4, Section 1.4.1.2).

No Project-related impacts that would prevent attainment of ACS objectives have been identified (table 4.7.3.5-7 or appendix F.4, table 2-35). All relevant Project impacts are within the range of natural variability for watersheds in the Western Cascades and Klamath Provinces, although some of these processes have been altered from their natural condition (appendix F.4, p. 2-70-83).

Rogue River Basin, Trail Creek Fifth-Field Watershed HUC 1710030706, Umpqua National Forest

Discussions of watershed analysis recommendations, natural disturbances, range of variability and other elements of the ACS are found in appendix F.4. Table 4.7.3.5-8 (table 2-44 in appendix F.4) compares the Project impacts to the objectives of the ACS for the Trail Creek watershed. The

Project would not affect any Riparian Reserves in the watershed (appendix F.4, table 2-3, 2-38). National Forest System lands where the ACS applies comprise about 12 percent of the Trail Creek watershed (appendix F.4, p. 2-99). Watershed conditions and recommendations are found in the Trail Creek watershed assessment (BLM 1999) and described in detail in appendix F.4. In the Trail Creek watershed, timber harvest and removal of LWD from creek channels has reduced structural complexity of the aquatic habitat and its ability to retain sediments. Chronic, fine-grained sediment, most recently related to roads and timber harvest, has negatively affected aquatic habitats by adding large volumes of sediment. The presence of roads has segregated some stream reaches from upslope habitats that are needed for replenishment of LWD.

TABLE 4.7.3.5-8

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Trail Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are watershed landscape-scale features that would be affected by the Project. No Riparian Reserves are affected in the Trail Creek watershed (table 2-41). On NFS lands subject to the ACS, the Project ROW is located primarily in early or mid seral forests (table 2-41). There are no river or stream crossings on NFS lands, and the Project ROW is located largely on or near ridge tops to minimize impacts on aquatic habitats. No wetlands or streams are crossed or clipped in the watershed. Use of native vegetation and the anticipated rapid revegetation of disturbed areas would likely further reduce Project impacts. Off-site mitigation measures including road stormproofing and decommissioning are expected to improve watershed conditions in the Trail Creek watershed (see appendix F.4, p.2-113-115).
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The Project is not expected to affect spatial or temporal connectivity in the Trail Creek watershed because no wetlands or waterbodies are crossed. No rivers or streams would be crossed on NFS lands.
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	No stream channels are crossed on NFS lands where the ACS applies so the physical integrity of banks and stream bottoms would not be affected.
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	No wetlands or streams are crossed on NFS lands in the Trail Creek watershed. No long-term impacts on water quality are expected because of application of the ECRP, including maintenance of effective ground cover and BMPs during construction (see Section 1.4.1 and previous discussion).

TABLE 4.7.3.5-8 (continued)

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Trail Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	The Trail Creek watershed was historically characterized by pulse-type depositions of coarser sediments from landslides and surface erosion following major disturbances such as fires and high-intensity winter storms (BLM 1999, Everest and Reeves 2007). Chronic erosion and deposition of fine sediments, primarily from roads and to a lesser degree from land use, have replaced these pulse-type disturbances in the watershed. Project construction and operation are not likely to alter sediment erosion and deposition in the watershed nor are they likely to exacerbate these conditions. Proposed mitigation projects would contribute to a reduction of adverse sediment scouring and depositing and restoration of aquatic functions (see appendix F.4, p. 2-113-115).
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	The Project is not likely to affect peak flows in the Trail Creek watershed because of its predominately ridge top location, the relatively small area of the watershed affected (less than 1%), the absence of stream crossings, and the relative lack of connectivity to aquatic systems. The Trail Creek watershed assessment noted that increases in peak flows are a low risk in all the subwatersheds and in the watershed as a whole.
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The Project would not cross any meadows or wetlands in the Trail Creek watershed on NFS lands, so there would be no impact from the Project on water tables or seasonal inundation of these areas
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	The Project would not affect Riparian Reserves in the Trail Creek watershed (table 2-39). Following construction, replanting with native species would facilitate reestablishment of vegetation communities.
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	The Project would not affect any Riparian Reserves in the Trail Creek watershed (table 2-39). Consistent with the requirements of the POD, LWD and boulders removed from the corridor during construction would be replaced to restore and stabilize channel crossings. Revegetation would be accomplished using native riparian species. The Project would waive application of Management Recommendations for Survey and Manage species in the watershed but would not threaten the persistence of riparian-dependent Survey and Manage species or prevent attainment of the ACS objectives (see appendix F.5).

Source: Appendix F.4, table 2-44

Given the ridgetop location of the pipeline corridor on NFS lands, the lack of intersects with waterbodies, and lack of impacts to Riparian Reserves it is highly unlikely that Project construction and operation would prevent attainment of ACS objectives on NFS land in the Trail Creek watershed.

The high clay-content soils in the watershed (BLM 1999:1-4) presents a potential issue with respect to possible compaction and sediment that could be mobilized by overland flow. Subsoil ripping (including the use of hydraulic excavators) is a proven method to reduce soil compaction. Measures in the ECRP including soil remediation with organic materials, rapid revegetation and maintenance of effective ground cover are likely to successfully control surface erosion. The Forest Service may require additional erosion control measures if needed.

Off-site mitigation measures, identified by the Forest Service, would supplement onsite minimization, mitigation, and restoration actions. These proposed offsite mitigation measures are responsive to recommendations in the Trail Creek watershed assessment and would contribute to improving terrestrial and aquatic conditions within the watershed (see appendix F.4, p. 2-113-115).

A site-specific amendment of the Umatilla National Forest LRMP to waive limitation on detrimental soil compaction is proposed to make a provision for the Project. This proposed amendment is minor in scope and is not expected to prevent attainment of ACS objectives because of implementation of the ECRP and the fact that there are no stream intersects on NFS lands in the Trail Creek watershed. The proposed amendment of the Umatilla National Forest LRMP to waive protection measures for Survey and Manage species would not prevent attainment of ACS objectives because species viability would be maintained (see appendix F5).

The relatively small area of NFS land affected by Project construction (50.27 acres or 1.15 percent of NFS lands in the watershed), makes it highly improbable that Project impacts could affect watershed conditions beyond the site scale. Although there are project-level impacts such as short-term surface erosion these would be minor and limited to the boundaries of the Project area (see appendix F.4, section 1.4.1).

No Project-related impacts that would retard or prevent attainment of ACS objectives have been identified (appendix F.4, table 2-44). Impacts, as they relate to relevant ecological processes, are within the range of natural variability for watersheds in the Western Cascade and Klamath-Siskiyou Provinces, although some of these processes have been altered from their natural condition (appendix F.4, p. 2-105-109, table 2-40).

Rogue River Basin, Little Butte Creek Fifth Field Watershed, HUC 1710030708, Rogue-Siskiyou National Forest

Discussions of watershed analysis recommendations, natural disturbances, range of variability are found in appendix F.4. Table 4.7.3.5-9 (table 2-62 in appendix F.4) compares the Project impacts to the objectives of the ACS for the Little Butte Creek watershed. National Forest System lands where the ACS applies comprise approximately 59,900.38 acres or 25.10 percent of the Little Butte Creek watershed (appendix F.4, table 2-45). Riparian Reserves comprise approximately 8,096.50 acres (about 3.39 percent of the entire watershed [appendix F.4, table 2-45]) on NFS lands. Watershed conditions and recommendations are found in the Little Butte Creek watershed assessment (BLM and Forest Service 1997). A total of 10.22 acres or 0.13 percent of the Riparian Reserves in the watershed would be affected of which 7.66 acres are cleared and 2.56 acres (appendix F.4, table 2-47) are modified on:

- One perennial stream channel crossing
- One intermittent stream channel crossing
- One intermittent stream and one wetland where Riparian Reserves are clipped, but the associated waterbodies are not crossed by the Project.

TABLE 4.7.3.5-9

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Little Butte Creek

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are watershed-scale features. The Project would affect about 10.22- acres or about 0.13% of Riparian Reserves on NFS lands in the Little Butte Creek watershed (table 2-47). There is one intermittent and one perennial stream channel crossed in the Little Butte Creek watershed on NFS lands. Impacts to aquatic systems are expected to be short-term and minor and limited to the project scale because of application of BMPs and erosion control measures (see appendix F.4, Section and 1.4.1). Large woody debris cleared in construction of the Project would be used to stabilize and restore stream crossings. Off-site mitigation measures including 57.5 miles of road decommissioning, approximately 1.5 -miles of instream projects, snag creation and coarse woody debris placement are expected to improve watershed conditions in the Little Butte Creek watershed (see appendix F.4, p. 2-149 158, tables 2-57, 2-58, 2-59, 2-60). While there are long-term changes in vegetation in Riparian Reserves from construction clearing of the Project ROW, these would be minor in scale and well within the range of natural variability given the disturbance history of the watershed (see appendix F.4, p. 2-105-109, table 2-40).
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The Project is not expected to affect spatial or temporal connectivity in the Little Butte Creek watershed because the pipeline would be buried in all aquatic habitats crossed, consistent with the requirements of the exhibits specified in the Wetland and Waterbody Crossing Plan. At each crossing, bed and bank disturbances from equipment crossing and trenching are small (<15 -feet -wide). After construction, all disturbed areas would be returned to their approximate preconstruction contours and drainage patterns. The temporary construction ROW would be restored and revegetated with native grasses, forbs, conifers, and shrubs, as outlined in the ECRP. After construction, key habitat components such as LWD and boulders would be restored onsite and the bed and banks would be returned to preconstruction conditions. By implementing these measures, lateral and longitudinal connectivity at the site scale would be maintained, although in the short-term during construction, connectivity may be disrupted. Except for a few days during the construction of the crossings, access to areas necessary for life-histories of aquatic and riparian dependent species would not be obstructed. By restricting stream crossing operations to the ODFW in-stream work window, possible impacts to sensitive life stages of aquatic biota would be minimized. Road decommissioning that occurs within Riparian Reserves (approximately 18-acres) would contribute to restoration of aquatic connectivity. The residual levels of disturbance are anticipated to be well within the range of natural variability in the Klamath-Siskiyou Province and the High Cascades Province. (appendix F.4, p. 2-136-141, table 2-54)
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	Impacts to the bed and banks of aquatic features would be minor and limited to the site of construction because the pipeline would be buried, and the actual area of bank and stream bottom disturbance is small at each crossing (<15-feet -wide). This level of disturbance is comparable to a bank slough (see Section 1.4.1.) or a culvert installation and well within the range of natural variability that for watersheds of the Klamath-Siskiyou Province and the High Cascades Province (see (appendix F.4, p. 2-136-141, table 2-54)). After construction, key habitat components such as LWD and boulders would be restored onsite and the bed and banks would be returned to preconstruction conditions, consistent with the exhibits to the POD. By implementing these measures, the physical integrity of the aquatic system at the site scale would be maintained.

TABLE 4.7.3.5-9 (continued)

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Little Butte Creek

ACS Objective	Project Impacts
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Minor amounts of sediment would be mobilized during construction. These impacts are expected to be short-term and limited to the general area of construction (see appendix F.4, Section 1.4.1). No long-term impacts on water quality are expected because of application of the ECRP that includes maintenance of effective ground cover and BMPs during construction (see appendix F.4, Section 1.4.1.1). Effective shade would be removed at the crossing of the South Fork Little Butte Creek at MP 162.45. A site-specific shade analysis (NSR 2009) found no temperature impacts at the site or at the stream network scale at this crossing.
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	The Little Butte Creek watershed sediment regime was historically characterized by pulse-type depositions of coarser sediments from landslides and surface erosion following major disturbances such as fires and high-intensity winter storms (BLM and Forest Service 1997). The current sediment regime in the watershed has replaced these pulse-type disturbances with more chronic erosion and deposition of fine sediments primarily from urban and agricultural land use, timber harvest and roads. Project construction and operation is not likely to alter this sediment pattern nor is it likely to exacerbate these conditions because of implementation of measures in the ECRP (see Section 1.4.1) including maintenance of effective ground cover, water bars to dissipate overland flows and maintenance of sediment barriers until revegetation is successful. Sediment impacts from construction are expected to be like those described in section 1.4.1.2. A pulse of sediment could be observed following the first seasonal rain, but that this is likely to dissipate within a few hundred feet and would be indistinguishable from background levels. Any sediment impacts are expected to be well within the range of natural variability for the Klamath-Siskiyou Province and the High Cascades Province (see appendix F.4, p. 2-134 140, table 2-54). Proposed mitigation projects including road decommissioning would contribute to reduction of sediments and restoration of aquatic functions at the watershed scale (see appendix F.4, p. 2-148-158, table 2-57).
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	The Project is unlikely to affect peak flows in the Little Butte Creek watershed because of the dispersed nature of impacts, the current hydrologically recovered conditions in the watershed, the relatively small proportion of the watershed affected (0.25%), and the relative lack of connectivity to aquatic systems (see appendix F.4, table 2-54, p. 2-139). Decommissioning roads (57.5 miles) as part of the offsite mitigation plan would contribute substantively the restoration of flow patterns by restoring hydrologic connectivity at stream crossings that are decommissioned (see appendix F.4, p. 2-148-158, table 2-57).
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The Project clips one small wetland on NFS land but does not cross it. Application of the ECRP including maintenance of effective ground cover and BMPs during construction will be applied (see section 1.4.1.1). In addition, decommissioning 57.5 miles of roads, 18- acres of which are in Riparian Reserves (see appendix F.4, p. 2-148-158, table 2-57)) would contribute substantially to restoring floodplain functions where these projects occur.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	The Project impacts on riparian vegetation in the Little Butte Creek watershed would be minor. Approximately 10.22 acres or 0.13% of the Riparian Reserves in the watershed are potentially affected by the Project (table 2-48). Existing herbaceous and brush cover would be maintained in Riparian Reserves to the extent practicable. Following construction, replanting with native species would facilitate reestablishment of vegetation communities. Large woody debris and boulders from the Project ROW would be returned to disturbed riparian areas. Coarse woody debris placement and snag creation on 126- acres in Riparian Reserves, along with revegetation on 18 acres of Riparian Reserves in roads that would be decommissioned would help to reestablish species composition and structural diversity of plant communities in Riparian Reserves (see appendix F.4, p. 2-148-158, table 2-57).

TABLE 4.7.3.5-9 (continued)

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Little Butte Creek

ACS Objective	Project Impacts
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	The Project impacts on riparian vegetation in the Little Butte Creek watershed would be minor. Approximately 10.22 acres or 0.13% of the Riparian Reserves in the watershed are potentially affected by the Project. Following construction, replanting with native species would facilitate reestablishment of vegetation communities. Large woody debris and boulders from the Project ROW would be returned to disturbed riparian areas. Coarse wood placement and snag creation on 126- acres in Riparian Reserves, along with revegetation on 18 acres of Riparian Reserves in roads that would be decommissioned would help to reestablish species composition and structural diversity of plant communities in Riparian Reserves. The Project would waive application of Management Recommendations for Survey and Manage species in the watershed but would not prevent attainment of the ACS objectives because the viability of riparian-dependent Survey and Manage species would not be threatened. (see appendix F.5).

Source: Appendix F.4, table 2-62

The Little Butte Creek watershed is the largest, and in some ways, the most complex watershed crossed by the Project. With 13.75 miles of corridor, and 207.17 acres of clearing on NFS lands, this watershed has the most NFS land area affected of all watersheds crossed by the Project. The watershed is geologically complex with both Klamath-Siskiyou Province and the High Cascades Province landscapes. It is ecologically diverse and important, providing some of the most productive coho salmon streams in the Upper Rogue Basin. Little Butte Creek watershed is a Tier 1 Key Watershed above the confluence of the North and South Forks of Little Butte Creek (appendix F.4, table 1-2), and roughly 88 percent of the NFS lands in the watershed are managed as LSR (appendix F.4, table 1-1). Against this backdrop, compliance with the ACS is an important measure of Project impacts.

Pacific Connector has modified the Project to respond to the ACS objectives and has incorporated measures consistent with the Riparian Reserve Standards and Guidelines into the ECRP and other elements of their plan of development (e.g., Wetlands and Water Body Crossing Plan). The assessment in appendix F.4 demonstrates that short-term impacts associated with the Project would occur to streambanks, and substrates at the site scale. Change in vegetative condition from clearing of forest within the Project ROW is a long-term impact. These impacts, however, are well within the range of natural variability given the disturbance processes that function in the watershed (see appendix F.4, p. 2-134 – 2-141, table 2-54). This is especially apparent when considering the total amount of Riparian Reserves that are located within the Little Butte Creek watershed (8,096.50 acres) and the amount of clearing (10.22 acres) in Riparian Reserves (0.13 percent of the Riparian Reserves in the watershed) (appendix F.4, table 2-47). Also, because of the linear characteristic of the pipeline, the Riparian Reserve crossings would be spread out across the landscape.

Off-site mitigation measures including over 66 miles of road decommissioning (57.5 miles are within Key Watershed), 1.5 miles of LWD instream projects, identified by the Forest Service, would supplement onsite minimization, mitigation, and restoration actions. These proposed offsite mitigation measures are responsive to recommendations in the Little Butte Creek watershed assessment (1997) and the South Cascades Late-Successional Reserve Assessment (1998).

Mitigations measures encompassed with the Project description described in chapter 2 of this EIS are responsive to watershed assessment recommendations and would improve watershed conditions where they are applied (see appendix F.4, p. 2-148-158, table 2-57, 2-58).

To make provisions for the Project, three site-specific amendments of the Rogue River National Forest LRMP related to the ACS are proposed (see appendix F.4, p. 143-148).

- Proposed amendment RRNF-5 would allow the Project to cross the MA-26 Restricted Riparian land allocation at one location on the South Fork of Little Butte Creek a perennial stream. This amendment would not prevent attainment of ACS objectives because a site-specific temperature assessment (NSR 2009) showed there would be no temperature increase from shade removal at this location, effective ground cover and sediment barriers would be maintained and implementation of the ECRP is expected to control surface erosion and reestablish native vegetation.
- Proposed amendment RRNF-6 would allow the Project to exceed detrimental soil conditions within the construction corridor. This would not prevent attainment of ACS objectives because the Project would require soil remediation as needed with biosolids or other organic materials in areas with potential revegetation difficulty, soil decompaction, maintenance of effective ground cover, application of BMPs, and application of offsite mitigations. Therefore, any sediment impacts from detrimental soil conditions are expected to be minor and short term and the methods described above would be expected to effectively moderate detrimental soil conditions. Implementation of measures in the ECRP is expected to effectively control surface erosion and restore native vegetation (see section 4.3.4 in this EIS).
- Proposed amendment of the Rogue River National Forest LRMP to waive protection measures for Survey and Manage species would not prevent attainment of ACS objectives because the persistence of riparian dependent survey and manage species would not be threatened (see appendix F.5).

The Project is otherwise consistent with Standards and Guidelines for activities in Riparian Reserves for the Rogue River National Forest.

The routing of the pipeline through NFS lands, coupled with the relatively small area of NFS land affected by Project construction (0.46 percent of NFS lands in the fifth-field watershed), makes it highly improbable that Project impacts could affect watershed conditions. The relative lack of intersections with aquatic systems serves to further minimize possible impacts. Although there are project-level impacts from short-term sediment and long-term change in vegetative condition at stream crossings, these would be minor in scale (appendix F.4, table 2-62).

No Project-related impacts that would prevent attainment of ACS objectives have been identified (appendix F.4, section 1.4.1, table 2-62). All relevant Project impacts are within the range of natural variability for watersheds in the Klamath-Siskiyou and High Cascades Provinces, although some of these processes have been altered from their natural condition (appendix F.4, p. 2-236).

Klamath River Basin, Spencer Creek Fifth Field Watershed, HUC 180102206, Winema National Forest

Discussions of watershed analysis recommendations, natural disturbances, range of variability etc. are found in appendix F.4. Table 4.7.3.5-10 (table 2-77 in appendix F.4) and this section compares the Project impacts to the objectives of the ACS for the Spencer Creek watershed. National Forest System lands where the ACS applies comprise approximately 41 percent of the Spencer Creek watershed (appendix F.4, table 1-1). Watershed conditions and recommendations are found in the Spencer Creek watershed analysis (BLM et al. 1995). The Project would include approximately 6.05 miles on NFS lands. A total of 9.98 acres of Riparian Reserves or 0.60 percent of the Riparian Reserves in the watershed (appendix F.4, table 2-65) would be affected of which 8.63 acres are cleared and 1.35 acres (appendix F.4, table 2-3 are modified on:

- Four intermittent stream channels and two wetlands crossed by the Project.
- Four intermittent streams and two wetlands where Riparian Reserves are clipped but the associated stream channel or wetland is not crossed.

TABLE 4.7.3.5-10

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Spencer Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are watershed-scale features. The Project would clear about 8.63-acres or about 0.52% of Riparian Reserves on NFS lands in the Spencer Creek watershed (table 2-67). There are four intermittent stream channels crossed in the Spencer Creek Watershed. No perennial streams are crossed. Riparian Reserves associated with two forested wetlands and four intermittent streams are clipped. Impacts to aquatic systems are expected to be short-term or minor and limited to the project scale because of application of BMPs and erosion control measures (see appendix F.4, section 1.4.1.). Clearing of 4.58 -acres of LSOG vegetation in Riparian Reserves is a long-term change in condition, but is minor in scale, and within the range of natural variability given the disturbance processes in Spencer Creek (appendix F.4, p. 2-176-2-181). Spencer Creek watershed remains above the 15% threshold on federal lands for LSOG vegetation established in the NWFP (appendix F.4, p. 1-174). Large woody debris cleared in construction of the Project ROW would be used to stabilize and restore stream crossings. Off-site mitigation measures including 29.2-miles of road decommissioning, one mile of instream projects, fencing and riparian planting projects are expected to improve watershed conditions in the Spencer Creek watershed. While there are long-term changes in vegetation in Riparian Reserves from construction clearing of the Project ROW, these would be minor in scale and well within the range of natural variability given the disturbance history of the watershed (see appendix F.4, p. 2-176-2-181).

TABLE 4.7.3.5-10 (continued)

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Spencer Creek Watershed

ACS Objective	Project Impacts
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The Project is not expected to affect spatial or temporal connectivity in the Spencer Creek watershed because the pipeline would be buried in all aquatic habitats crossed, consistent with the requirements of the exhibits specified in the POD (i.e., Wetland and Waterbody Crossing Plan). Additionally, all the channels crossed in Spencer Creek are intermittent and are likely to be dry at the time of crossing. In the short-term, during construction, connectivity could be disrupted for 1-5 days. At each crossing, bed and bank disturbances are small (<15 feet wide). After construction all disturbed areas would be returned to their approximate preconstruction contours and drainage patterns. The temporary Project ROW would be restored and revegetated with native grasses, forbs, conifers, and shrubs, as outlined in the ECRP. After construction, key habitat components such as LWD and boulders would be restored onsite and the bed and banks would be returned to preconstruction conditions. By implementing these measures, lateral and longitudinal connectivity at the site scale would be maintained, although in the short-term, during construction, connectivity may be disrupted. Except for a few days during the construction of the crossing, access to areas necessary for life-histories of aquatic and riparian dependent species would not be obstructed. By restricting stream crossing operations to the ODFW in-stream work window, possible impacts to sensitive life stages of aquatic biota would be minimized. Road decommissioning that occurs within Riparian Reserves (approximately 9.63- acres) would contribute to restoration of aquatic connectivity (see appendix F.4, p. 2-186-191). The residual levels of disturbance are anticipated to be well within the range of natural variability in the High Cascades Province (see appendix F.4, p. 176-181).
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	Impacts to the stream bed and banks would be minor and limited to the site of construction because the pipeline would be buried, and the actual area of bank and stream bottom disturbance is small at each crossing (<15- feet -wide). This level of disturbance is comparable to a bank failure (see Section 1.4.1) and well within the range of natural variability for watersheds in the High Cascades Province (see Section appendix F.4, p. 176-181). After construction, key habitat components such as LWD and boulders would be restored onsite and the bed and banks would be returned to preconstruction conditions, consistent with the exhibits to the POD (i.e., Wetland and Waterbody Crossing Plan). By implementing these measures, the fluvial integrity of the aquatic system at the site- scale would be maintained. Offsite mitigation measures (see section 2.6.3.6) would substantively improve watershed conditions by decommissioning 29.22 miles of roads (50- acres total of which 12.6- acres are in Riparian Reserves), replanting willows along 0.5 -miles of perennial streams and restoring LWD in 1 mile of Spencer Creek (appendix F.4, p. 2-186-191, 2-73, table 2-74).
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Project stream crossings in the Spencer Creek watershed are expected to occur when intermittent stream channels are dry. Minor amounts of sediment would be generated during construction that may be mobilized during the onset of seasonal precipitation in the fall. These impacts are expected to be short -term and limited to the general area of construction (see section 1.4.1). No long-term impacts on water quality are expected because of application of the ECRP including maintenance of effective ground cover (see section 1.4.1) and BMPs during construction (see section 1.4.1.1) Offsite mitigation measures (see appendix F.4, p. 2-186 – 191, table 2-73) address key issues identified in the watershed assessment and are expected to substantially improve watershed conditions.
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of this sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	The Spencer Creek watershed sediment regime was historically characterized by pulse-type depositions of coarser sediments from streambank erosion following major disturbances such as fires and high-intensity winter storms. More chronic erosion and deposition of fine-grained sediments primarily from roads, and to a lesser degree from land use has replaced these pulse-type disturbances in the current sediment regime in the watershed. The Project construction and operation are not likely to alter this sediment pattern nor is it likely to exacerbate these conditions. Sediment impacts from construction are expected to be like those described in section 1.4.1.2. Proposed mitigation projects including 29.5 miles of road -decommissioning would contribute to reduction of sediments and restoration of aquatic functions at the watershed scale. Any sediment impacts are expected to be well within the range of natural variability given the disturbance history of the Spencer Creek watershed (see appendix F.4, p. 2-176-181).

TABLE 4.7.3.5-10 (continued)

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Spencer Creek Watershed

ACS Objective	Project Impacts
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	The Project is unlikely to affect flow patterns in the Spencer Creek watershed because of the dispersed nature of impacts, high infiltration rates and the relatively small proportion of the watershed affected (0.41%) (appendix F.4, p 2-191, table 2-64). Decommissioning roads (29.5 miles) as part of the offsite mitigation plan would contribute substantively the restoration of flow patterns by restoring hydrologic connectivity at stream crossings that are decommissioned (see appendix F.4, p. 2-186 – 191, table 2-73)).
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The Project crosses two small wetland areas and clips the Riparian Reserve of another two forested wetlands. Trench plugs would be installed on each side of these wetlands as needed to block subsurface flows and maintain shallow, unconfined aquifer water table elevations, as required by FERC's *Procedures*. By restricting crossings to the dry season (July 1 to Sept. 15), possible impacts on shallow ground water tables of these wetland areas are expected to be minor and short-term.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	The Project impacts on riparian vegetation in the Spencer Creek watershed would be minor. Approximately 9.98 or 0.60% of the Riparian Reserves in the watershed are potentially affected by the Project (table 2-65). Existing herbaceous and brush cover would be maintained in Riparian Reserves to the extent practicable. Following construction, replanting with native species would facilitate reestablishment of vegetation communities. Large woody debris and boulders from the Project ROW would be returned to disturbed riparian areas. Revegetation of 12.6 acres of Riparian Reserves in roads that would be decommissioned would help to reestablish species composition and structural diversity of plant communities in Riparian Reserves (appendix F.4, p. 2-186 – 191, table 2-74)).
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	The Project impacts on riparian vegetation in the Spencer Creek watershed would be minor. Approximately 9.98 acres or 0.60% of the Riparian Reserves in the watershed are potentially affected by the Project (appendix F.4, table 2-65). Following construction, replanting with native species would facilitate reestablishment of vegetation communities. Large woody debris and boulders from the Project ROW would be returned to disturbed riparian areas. Revegetation on 12.6 acres of Riparian Reserves in roads that would be decommissioned would help to reestablish species composition and structural diversity of plant communities in Riparian Reserves. The Project would waive application of Management Recommendations for Survey and Manage species in the watershed but would not prevent attainment of the ACS objectives because the viability of riparian-dependent survey and manage species would not be not threatened. (see appendix F.5).

Source: Appendix F.4, table 2-77

The Spencer Creek watershed is the easternmost and driest watershed where the ACS applies that is crossed by the Project in the High Cascades Province. It is also a Tier 1 Key Watershed in the NWFP. Stream densities are much lower than watersheds west of the Cascade crest. Precipitation patterns show a strong declining gradient from 40 inches a year on the crest of the Cascades to less than 12 inches where Spencer Creek flows into the Klamath River. The pumice soils in the watershed have high infiltration rates and rarely exhibit overland flows and mass wasting events that influence riparian and aquatic resources in other watersheds crossed by the Project. By locating the Project adjacent to the Clover Creek Road for much of its length, impacts on wetlands and stream channels have been minimized when compared to the impacts of creating a new corridor.

Pacific Connector has modified the Project to respond to the ACS objectives and has incorporated measures consistent with the Riparian Reserve Standards and Guidelines. The assessment demonstrates that short-term impacts would occur to streambanks, and substrates at the site scale. Change in vegetative condition from clearing the Project ROW is a long-term impact that would occur on 8.63 acres of Riparian Reserves. These impacts, however, are well within the range of natural variability given the disturbance processes that function in the watershed (see appendix F.4, p. 2-176-181, table 2-70). Also, because of the linear characteristic of the Project, the Riparian Reserve crossings would be spread out across the landscape.

Off-site mitigation measures, identified by the Forest Service, would supplement on-site minimization, mitigation, and restoration actions. These proposed off-site mitigation measures are responsive to recommendations in the Spencer Creek Watershed Assessment (BLM et al. 1995) and would improve watershed conditions where they are applied (appendix F.4, p. 2-186-191, table 2-73).

Three site-specific amendments of the Winema National Forest LRMP that have a nexus with the ACS are proposed to make provision for the Project (see appendix F.4, p. 2-183-186).

- Proposed amendments WNF-4 and WNF-5 would allow the Project to exceed detrimental soil conditions within the Project ROW. This would not prevent attainment of ACS objectives because soil decompaction and remediation required in Riparian Reserves is expected to effectively moderate detrimental soil conditions. Implementation of measures in the ECRP is expected to effectively control surface erosion and restore native vegetation (see section 4.3.4 of this EIS).
- Proposed amendment of the Winema National Forest LRMP to waive protection measures for Survey and Manage species would not prevent attainment of ACS objectives because the Project does not threaten the persistence of any riparian-dependent species (see appendix F.5).

The Project is otherwise consistent with Standards and Guidelines for activities in Riparian Reserves for the Winema National Forest.

The routing of the Project through NFS lands, coupled with the relatively small area of NFS land affected (0.41 percent of NFS in the fifth-field watershed), makes it highly improbable that the Project impacts could affect watershed conditions. Although there are project-level impacts (e.g., short-term sediment and long-term a change in vegetative condition at stream crossings), these would be minor in scale (see appendix F.4, table 2-77).

No Project-related impacts that would prevent attainment of ACS objectives have been identified. All relevant impacts are within the range of natural variability given the disturbance patterns and fire history of watersheds in the High Cascades Province (see appendix F.4, p. 2-176-181, table 2-70).

4.7.3.6 Resource Values and Conditions on Federal Lands: The Late Successional Reserve (LSR) System on National Forest System Lands

This section summarizes appendix F.3 (LSR Technical Report), which contains the full text of the independent Forest Service analysis. Reviewers who seek additional information should review the applicable section in appendix F.3. Section numbers that refer to sections in the appendix are so noted.

The LSR Network

The NWFP allocated a network of LSRs to conserve species of concern within the existing configuration of land ownership and the location of remaining LSOG forests within the range of the NSO (see appendix F.3 section 1.2).[154] The reserve network is embedded in a matrix of "working" forests and was designed to maintain LSOG forests in a well-distributed pattern across these federal lands (Moeur et al. 2011).

The LSR network is composed primarily of areas of large (mapped) reserves, but also includes smaller areas of "unmapped" reserves that are composed of sites occupied by marbled murrelets or are known northern spotted owl activity centers (KOAC). As presently configured the Pacific Connector pipeline would not cross any "unmapped reserves." The LSR standards and guidelines are designed to guide management activities occurring within these LSRs to protect and enhance the conditions of the LSOG forest ecosystems contained therein (Forest Service and BLM 1994b). The proposed Pacific Connector pipeline route would cross two mapped LSRs (LSR 223 on the Umpqua National Forest, and LSR 227 on the Rogue River National Forest).

LSR Standards and Guidelines

The standards and guidelines for LSRs are contained in Attachment A (pages C-9 through C-21) of the NWFP ROD. They are designed to protect and enhance conditions of LSOG forest ecosystems that serve as habitat for LSOG species. They are written to apply to specific management actions such as silviculture, range management, mining, new developments, etc., and should be interpreted in that context. The standards and guidelines that apply to new developments such as pipelines are addressed on page C-17 of the NWFP standards and guidelines. The standard on page C-17states:

> *Developments of new facilities that may adversely affect Late-Successional Reserves should not be permitted. New development proposals that address public needs or provide significant public benefits, such as powerlines, pipelines, reservoirs, recreation sites, or other public works projects would be reviewed on a case-by-case basis and may be approved when adverse impacts can be minimized and mitigated. These would be planned to have the least possible adverse impacts on Late-Successional Reserves. Developments would be located to avoid degradation of habitat and adverse impacts on identified late-successional species.*

The LSR standards and guidelines provide the framework upon which the proposed LSR mitigation actions and related plan amendments for the Pacific Connector pipeline are evaluated (see section 1.3.3 of appendix F.3). To meet this direction, the Forest Service has provided input to the applicant regarding project design. First, in routing the proposed project, LSRs have been avoided where possible. Second, where impacts to LSRs are unavoidable, on-site "Design Features" or "Project Requirements" have been developed to minimize the impacts. Third, in order to ensure that the objectives would continue to be achievable in these LSRs, land reallocations are being proposed as part of a compensatory mitigation plan. These proposed land reallocations would take non-LSR (i.e., matrix) lands and designate them as LSRs. The reallocations will require amendments of the LRMPs for the Umpqua National Forest and Rogue River National

[154] Originally the NWFP covered federal lands managed by the LM) and Forest Service within the range of the NSO. However, in August 2016, the BLM issued new Resource Management Plans that replaced the management direction for BLM lands. Therefore, the management direction in the NWFP no longer applies to BLM lands.

Forest. Fourth, off-site compensatory mitigation actions have been proposed to aid in off-setting unavoidable adverse impacts.

Project Impacts on LSRs on NFS Lands

The proposed pipeline would cross three national forests (Rogue River, Umpqua, and Winema) for a total of approximately 31 miles. The proposed project would affect mapped LSRs on the Rogue River and Umpqua National Forests. As presently configured, the proposed Pacific Connector project would not cross any LSRs on the Winema National Forest. Table 4.7.3.6-1 and figure 4.7-5 provide an overview of the number of acres that would be directly affected by the Project within LSRs on each affected unit of the Forest Service. The mapped LSR that would be crossed on the Umpqua National Forest is depicted in figure 4.7-5, and the mapped LSR that would be crossed on the Rogue River National Forest is depicted in figure 4.7-5.

TABLE 4.7.3.6-1

Direct Effects (a/) of the Proposed Project on Mapped LSRs (acres)

Forest	Cleared	Modified	Total Direct Effects
Umpqua National Forest	68	17	84
Rogue River National Forest	206	70	276
Total	**274**	**87**	**359**

a/ Direct effects include Pipeline corridor clearing, TEWAs, and UCSAs
Data source: Forest Service, GIS layers

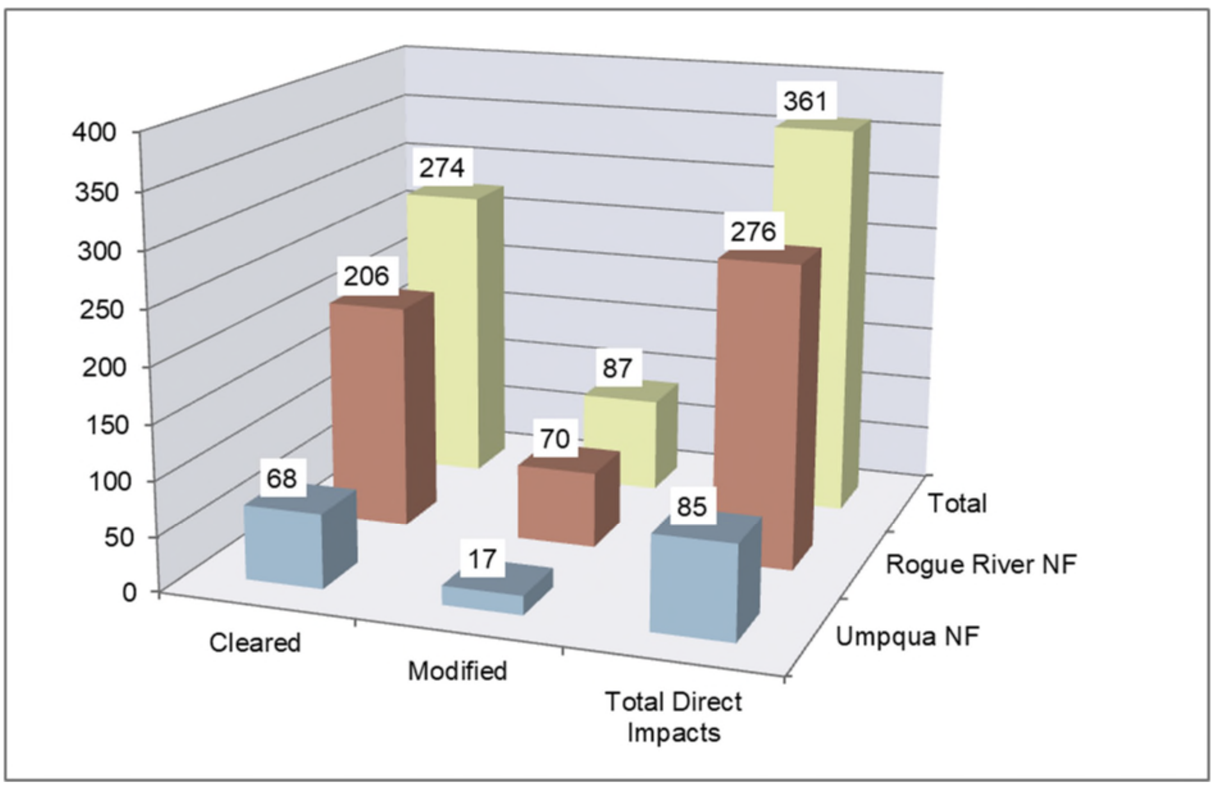


Figure 4.7-5. Direct Effects of the Proposed Project on Mapped LSRs (acres)

Direct effects would occur in the areas that would be cleared (i.e., forest vegetation would be removed) for the pipeline ROW and the TEWAs. Direct effects would also occur on acres that would be "modified" by the pipeline project. These acres include UCSAs that would not be cleared of trees during construction. These areas would be used to store forest slash, stumps, and dead and downed log materials that would be scattered across the ROW after construction, which would be considered temporary habitat modifications.

Indirect effects from construction of the pipeline are also expected within LSRs that have interior forest that the NSO rely on for nesting habitat. The conversion of large tracts of LSOG forest to small, isolated forest patches with large edge areas can create changes in microclimate, vegetation species, and predator-prey dynamics. Such edge effects–the magnitude of changes over distance from the edge to forest interior–would depend on the general orientation to the sun. Two main physical factors affecting and creating an edge microclimate are sun and wind (Forman 1995, Chen et al. 1995, Harper et al. 2005). Together, sun and wind: 1) desiccate leaves by increasing evapotranspiration; 2) influence which plant species survive and thrive along the edge, usually favoring shade-intolerant species; and 3) impact the soil, insects, and other animals along the edge. Compared to the forest interior, areas near edges receive more direct solar radiation during the day, lose more long-wave radiation at night, have lower humidity, and receive less short-wave radiation. However, such effects are dependent on such local conditions as orientation of an edge: the magnitudes of change in humidity with distance from an edge are most extreme with south-facing edges compared to east- and west-facing edges (Chen et al. 1995). These effects would vary along the pipeline route as a function of route orientation and the facing direction of each edge. Because the Pacific Connector pipeline generally trends from northwest to southeast, edge effects would be most pronounced on the southwest-facing edges and weakest along the northeast-facing edges. Fundamental changes in the microclimate (moisture, temperature, solar radiation) of a stand have been recorded greater than 700 feet from the forest edge (Chen et al. 1995).

Using recommendations from the ESA Sub-Task Group and Habitat Quality Subtask Group, indirect effects are considered to extend for 100 meters from the created edge in LSOG forest. In making their recommendation, the sub-task groups considered the study done by Karen A. Harper et al., which looked at edge influence on forest structure in fragmented landscapes (Harper et al. 2005). The study reviewed the effects caused by forest edges on multiple response variables, including: 1) forest processes of tree mortality/damage, recruitment, growth rate, canopy foliage, understory foliage, and seedling mortality, 2) forest structure by canopy trees, canopy cover, snags and logs, understory tree density, herbaceous cover, and shrub cover, and 3) stand composition by species, exotics, individual species, and species diversity. The study found that the mean distance of edge influence on any single response variable did not exceed 300 feet (100 meters). Therefore, indirect effects for the project are estimated to extend for 100 meters beyond the cleared area on each side of the corridor in LSOG forest habitat. There is no corresponding research for edge effects in younger forest stands (less than 80 years old). There is, however, research that indicates indirect effects extend out approximately two times the average tree height (Morrison et al. 2002). Based on this research, an estimate of 30 meters is used in non-LSOG forest habitat. In non-forested areas, no indirect effects are estimated since no new edge would be created. Table 4.7.3.6-2 and figure 4.7-6 provide a summary of the total number of LSR acres that would be directly and indirectly affected on Forest Service lands by the pipeline project.

The construction, operation, and maintenance of the proposed pipeline project would affect LSRs on Forest Service lands in several ways. It would remove and fragment LSOG forest habitat that some vertebrate and invertebrate species depend on. It would directly affect individuals of species listed as threatened under the ESA through removal of suitable nesting, roosting, and foraging habitat for the NSO. The indirect effects discussed above would result in the loss of interior LSOG forest habitat and increased predation (see also section 4.6 of this EIS for additional discussion).

TABLE 4.3.7.6-2

Summary of Total LSR Acres Directly and Indirectly (a/) Affected by the Proposed Project

Forest	Direct Effects	Indirect Effects	Total Effects
Umpqua	84	241	325
Rogue River	276	534	810
Total Forest Service	**360**	**775**	**1,135**

Data source: Forest Service GIS data layers
a/ Direct effects include cleared acres (corridor and TEWAs) and modified acres (UCSAs). Indirect effects include 100 meters on each side of the cleared corridor edge in LSOG, and 30 meters on each side of the cleared corridor edge in non-LSOG.

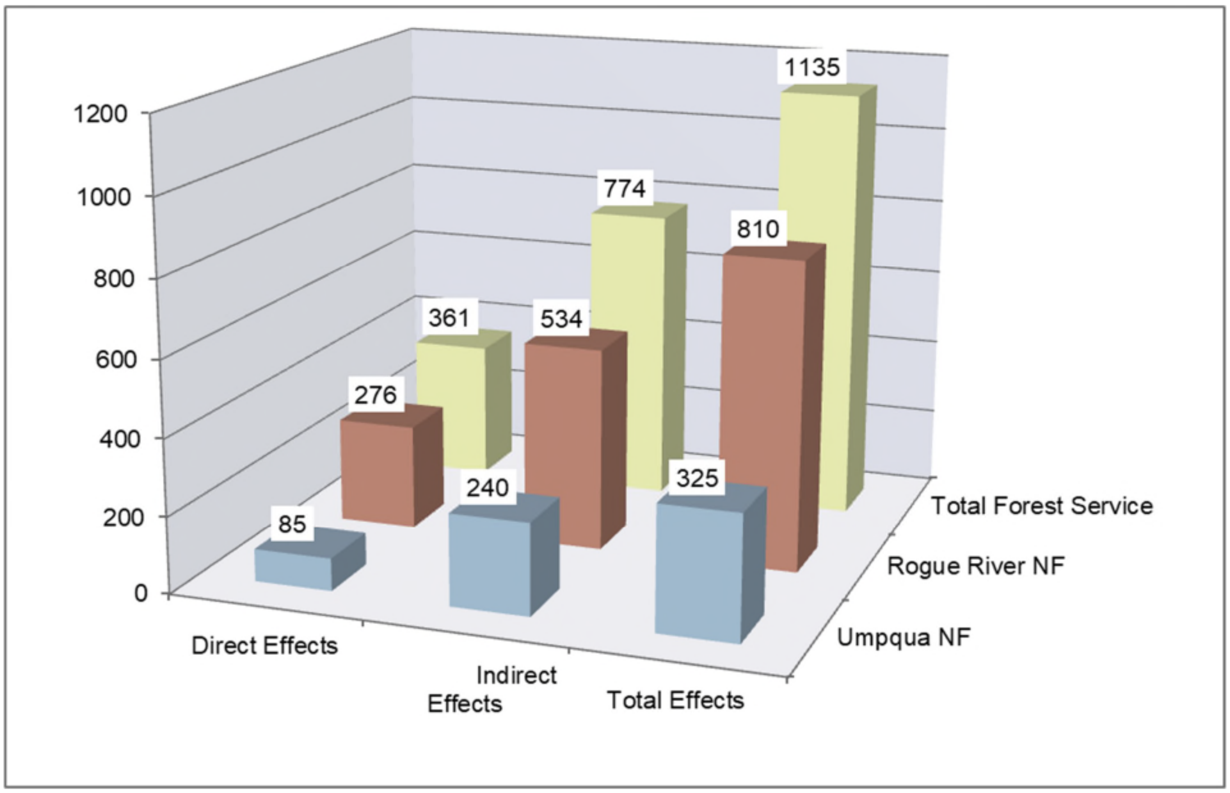


Figure 4.7-6. Summary of Total LSR Acres Directly and Indirectly Affected

The primary mitigation action for the effects of the proposed pipeline on LSRs would add acres to the LSRs. The Forest Service is proposing to accomplish this through reallocation of matrix lands to LSR. Reallocating these acres will require amendments to the Umpqua and Rogue River

National Forest LRMPs.[155] Table 4.7.3.6-3 and figure 4.7-7 display a summary comparison between the LSR acres that would be cleared by the construction of the project and the proposed reallocation of matrix lands to LSR.

TABLE 4.7.3.6-3

Comparison of Total LSR Acres Cleared (a/) by the Project and the Acres of Matrix Reallocated to LSR

	LSR Habitat Affected by Project Construction Clearing			LSR Mitigation
Forest	**LSOG Habitat**	**Non-LSOG Habitat**	**Total LSR Clearing**	**Matrix to LSR Reallocations**
Umpqua National Forest	20	48	68	585
Rogue River National Forest	55	151	206	522
Total	**75**	**199**	**274**	**1,107**

Data source: Forest Service GIS data layers
a/ Clearing includes acres in the project corridor and the TEWAs.

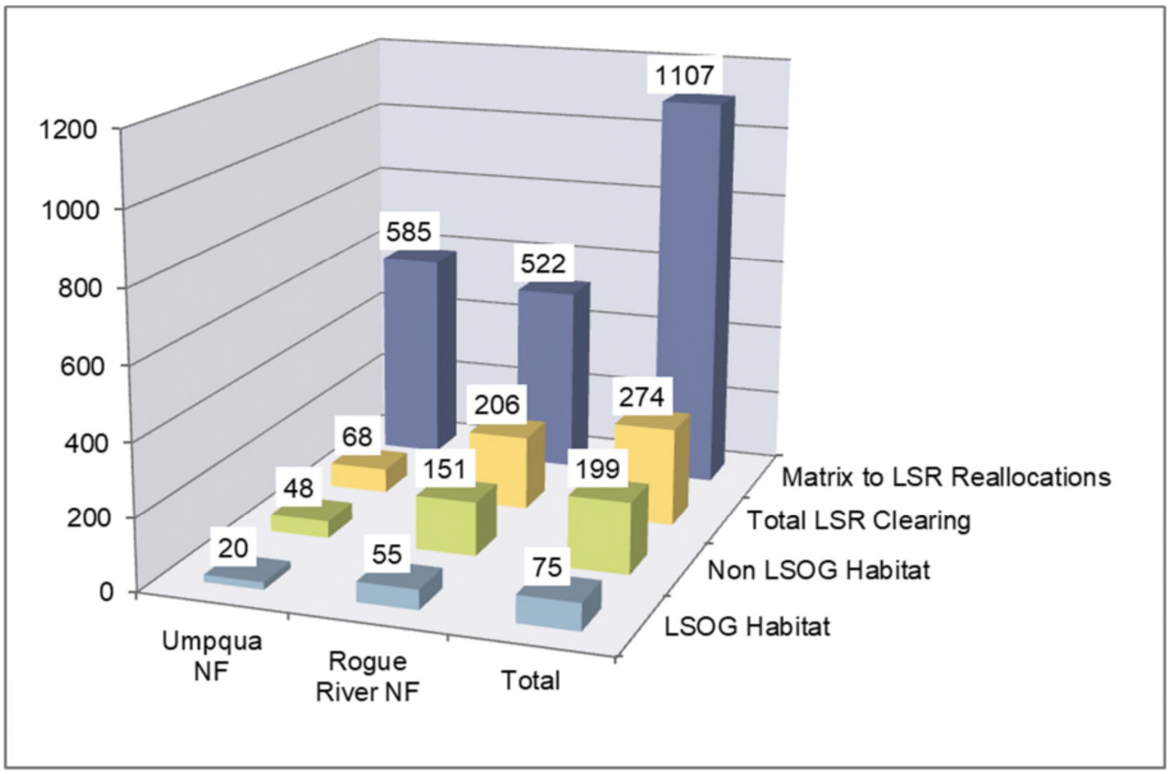


Figure 4.7-7. Comparison of Total LSR Acres Cleared by the Project and Total Acres of Matrix Reallocated to LSR

In addition to the reallocation of matrix lands to LSR, off-site mitigation would also be necessary to ensure that unavoidable adverse impacts are mitigated to meet the requirement that the overall impact would be either neutral or beneficial to the creation and maintenance of late-successional

155 Evaluations of these proposed amendments and how they relate to the planning requirements in the Forest Service planning rule at 36 CFR 219 (2012 Version) is discussed in Section 4.7 of the DEIS and in appendix F.2.

habitat in LSRs (USDA and USDI Memorandum 2001). A Compensatory Mitigation Plan (CMP) on Forest Service lands has been developed by the agency for the project. A portion of the CMP was developed specifically to compensate for the unavoidable adverse impacts of the project on LSRs, to achieve a neutral or beneficial condition within affected LSRs, and to maintain the long-term integrity of the Forest Service land use plans for LSRs. Under the CMP, unavoidable impacts to LSOG forest habitats within LSRs on Forest Service lands would be compensated for by a set of off-site mitigation projects. These projects are discussed in the sections below (see also appendix F.3 sections 2.1 and 2.2, appendix F.2, and section 4.7.3.4 of this EIS).

Umpqua National Forest LSR 223

In the Umpqua National Forest, the construction of the project would directly affect (acres cleared plus acres modified) approximately 85 acres of LSR 223. A map of the proposed project and LSRs in the Umpqua National Forest is displayed in figure 4.7-8.

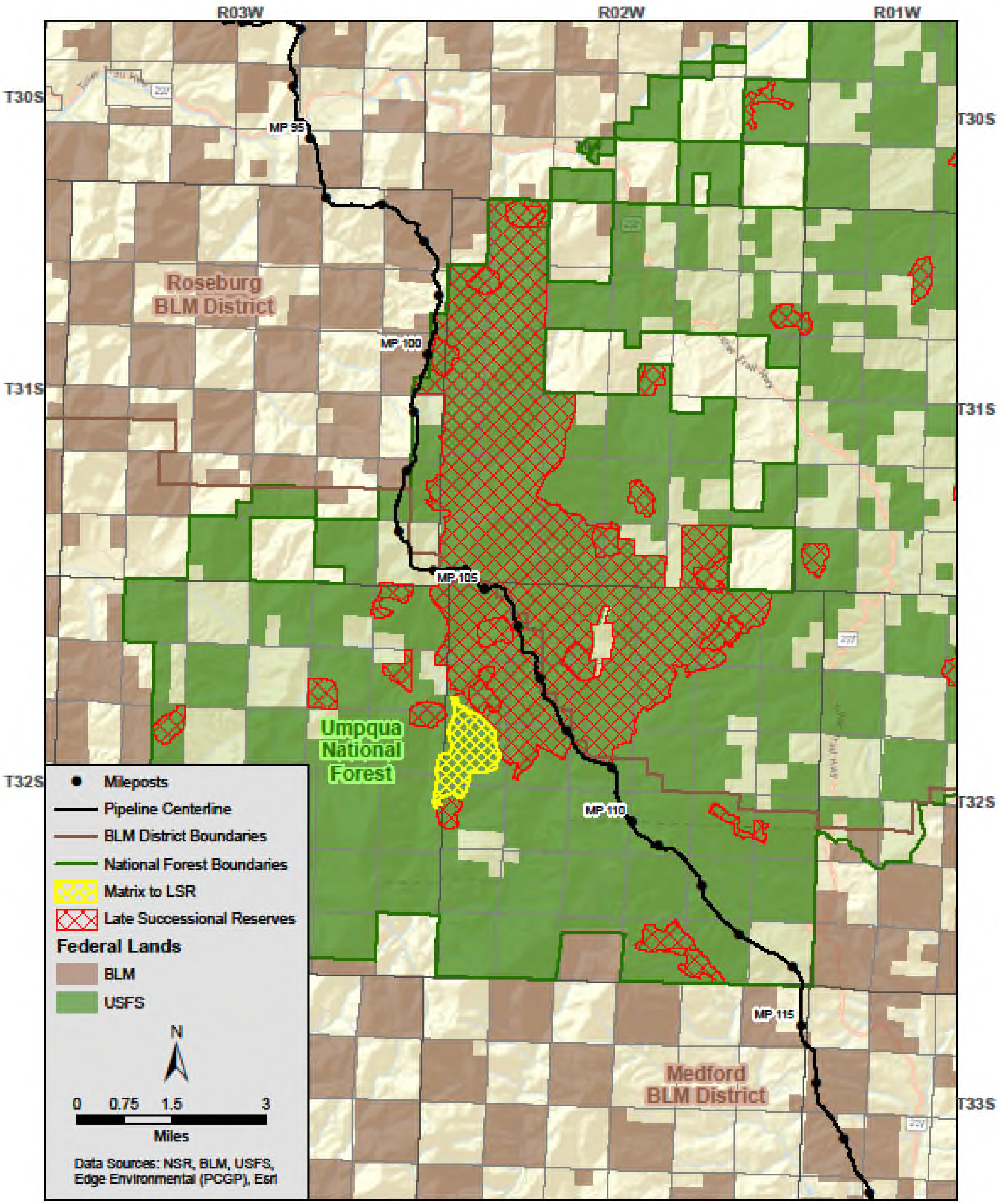


Figure 4.7-8. Map of Proposed Project and LSRs in the Umpqua National Forest

Amendment UNF-4, Reallocation of Matrix Lands to Late Successional Reserves

The Umpqua National Forest LRMP would be amended to change the designation of approximately 585 acres from the matrix land allocation to the LSR land allocation in Sections 7, 18, and 19, T.32 S., R. 2 W., Oregon; and Sections 13 and 24, T. 32 S., R. 3 W., W. M., Oregon (see figure 4.7-8). This change in land allocation is proposed to partially mitigate for the potential adverse impact of the project on LSR 223 in the Umpqua National Forest. This amendment would change future management direction for the lands reallocated from matrix to LSR.

Mitigation Actions

A compensatory mitigation plan has been developed by the Forest Service and submitted to the project applicant to ensure that the goals and objectives of the LRMP related to LSR 223 would be achieved.[156] Mitigation actions include:

- Creation of snags on 190 acres that are below desired snag densities for LSRs.
- Placing coarse woody debris (CWD) on 164 acres in units that are currently below desired levels for CWD.
- Decommissioning 5 miles of roads to reduce fragmentation and develop interior stand habitat over time.
- Thinning approximately 247 acres of overstocked stands to reduce fire risk and accelerate development of LSR characteristics.
- Integrated stand density and fuel break treatments on 898 acres in LSR 233 to restore stand density, species diversity, structural diversity and control the spread and intensity of wildfire within forested stands prone to fire activity.
- Other proposed mitigation actions in LSR 223 include 80 acres of meadow restoration, 301 acres of off-site pine removal, 6 miles of noxious weed treatments, fish passage improvement at two sites, 5 miles of road stormproofing and one water source improvement.

The off-site mitigation actions proposed are consistent with the recommendations in the Late Successional Reserve Assessment (LSRA) for LSR 223. These off-site mitigation actions would accelerate the development of LSOG forest habitat elements to further offset the effects of the project on LSR 223 in the long term. The additional off-site mitigation actions would also increase the effectiveness of the additional LSOG forest habitat added to LSR 223 by improving the quantity, quality, and distribution of high-quality habitat. Figure 4.7-9 displays a map of the proposed mitigation actions.

[156] This mitigation plan has been revised from the previous version based on the changed conditions in LSR 223 as a result of the 2015 Stouts Creek Fire (see Attachment 1 to appendix F.3).

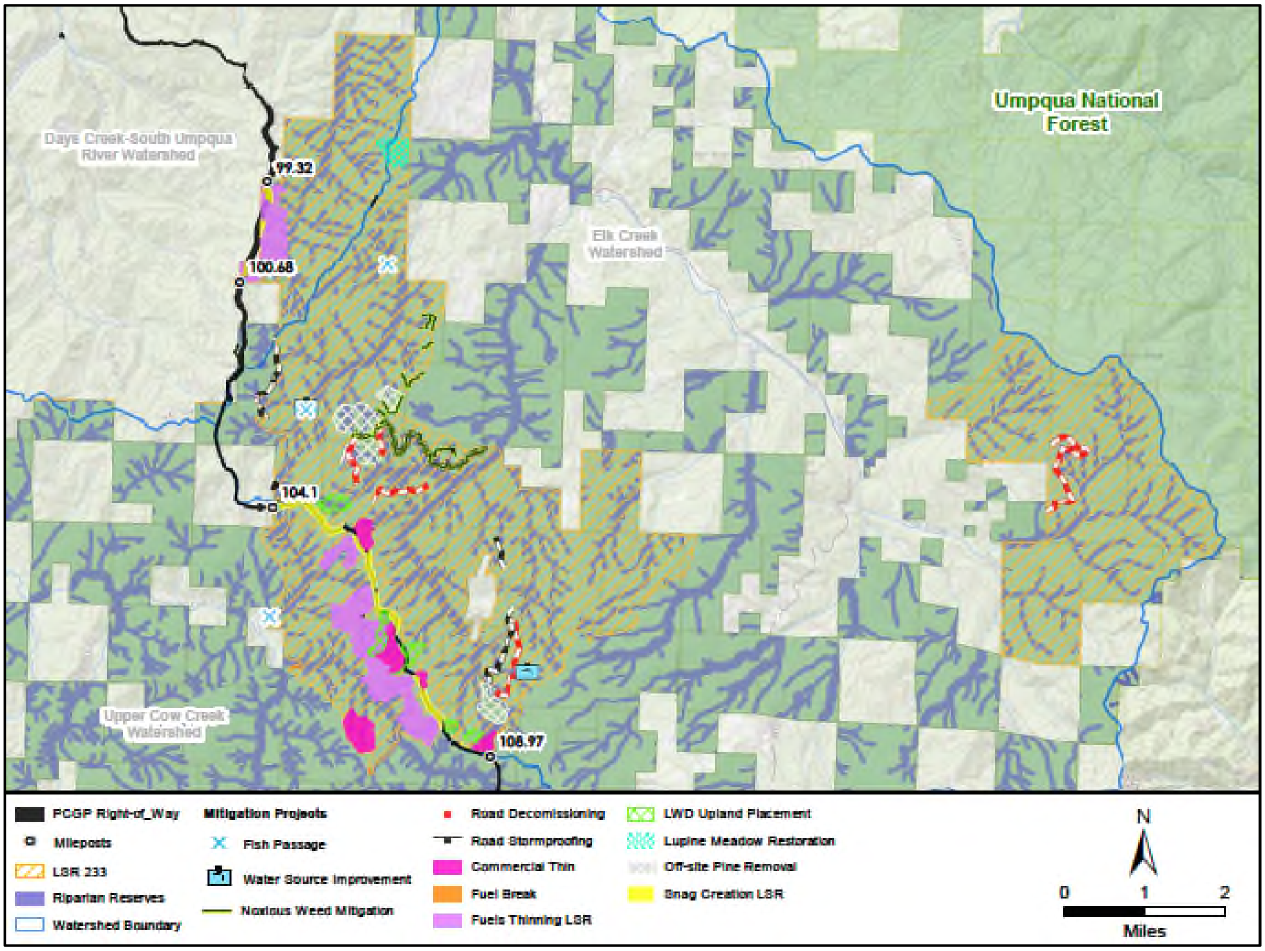


Figure 4.7-9. Proposed Off-Site Mitigation Actions in LSR 223

Assessment of Proposed Amendments and Mitigation Actions Relevant to LSR 223

The Project would clear approximately 68 acres in LSR 223, of which approximately 20 acres are LSOG forest. The area proposed to be reallocated to LSR 223 is approximately 585 acres of matrix lands, of which approximately 296 acres are LSOG forest. This change in land allocation is proposed to partially mitigate for the potential adverse impact of the Project on LSR 223 in the Umpqua National Forest. When acres reallocated from matrix lands to LSR are compared to the acres of LSR that would be cleared by the Project, the proposed amendment would reallocate over eight times more acres to LSR than would be cleared for the Project corridor. A comparison of the total acres affected in LSR 223 and the acres of reallocation are displayed in table 4.7.3.6-4 and figure 4.7-10 below.

TABLE 4.7.3.6-4

Comparison of LSR 223 Acres Affected (a/) by the Project and Acres of Matrix Reallocated to LSR

Umpqua NF LSR 223	Direct Effects: Cleared	Direct Effects: Modified	Indirect Effects	Total Effects	Matrix to LSR Reallocation
LSOG	20	6	166	192	296
Non- LSOG	48	11	74	133	289
Non-Forest	0	0	0	0	0
Total	**68**	**17**	**240**	**325**	**585**

a/ Total effects include cleared acres (corridor and TEWAs), modified acres (UCSAs), and indirect effect acres (100 meters on each side of the cleared corridor edge in LSOG and 30 meters on each side of the cleared corridor edge in non-LSOG).
Data source: USFS GIS Data Layers

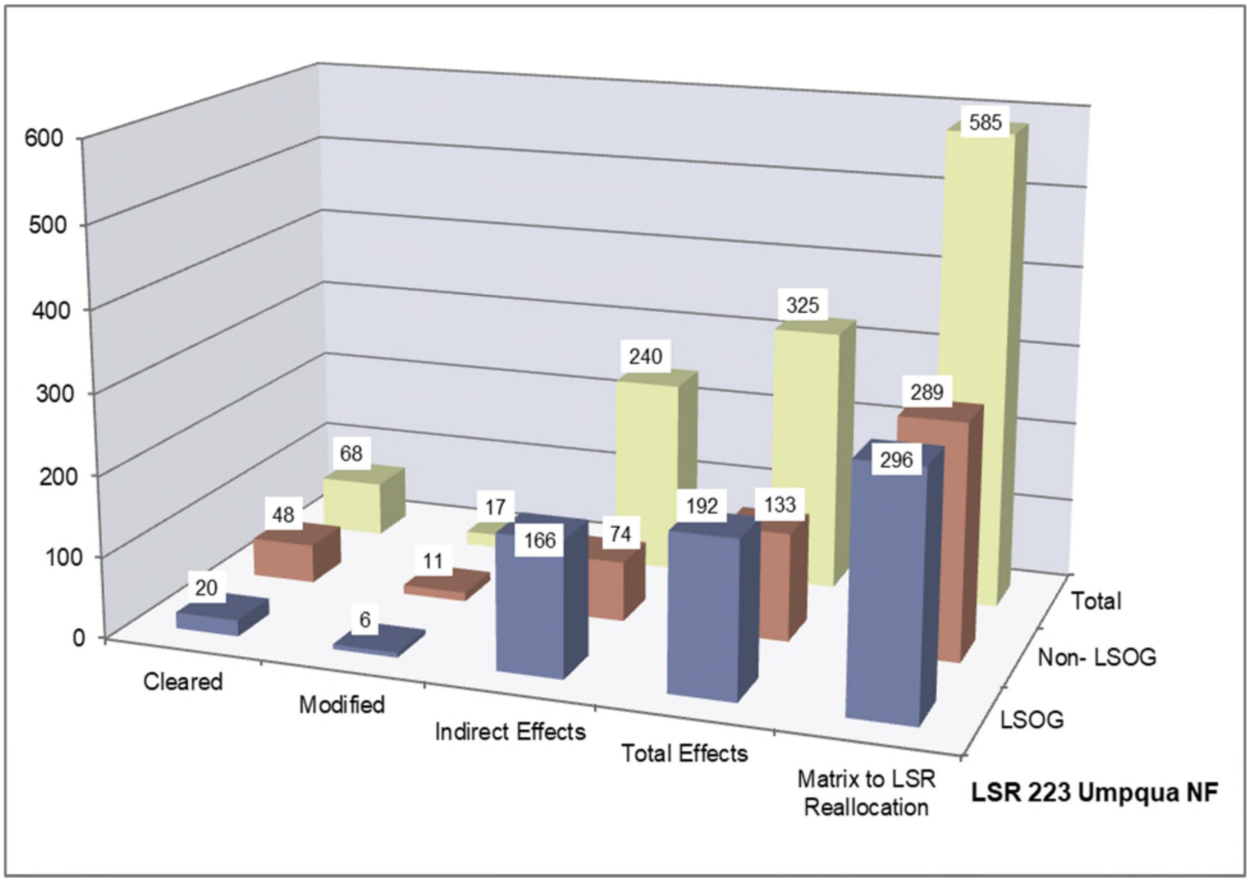


Figure 4.7-10. Comparison of Total LSR 223 Acres Affected by the Project and Acres of Matrix Reallocated to LSR

In addition to the Project impacts on LSR 223 in the Umpqua National Forest there are also potential off-site impacts to LSR 223 from road re-reconstruction that would be necessary to accommodate the trucks that would haul the sections of pipe. These trucks are longer than typical trucks that use forest roads, and some road widening and curve realignment may be necessary to safely allow for this truck traffic. Although this road widening would occur to the extent possible within the existing clearing limits, it is probable that some additional clearing of forest vegetation would be necessary to accommodate the road reconstruction. It is estimated that this would be a maximum of 2.5 acres and would occur along an existing road opening.

Assessment of Functionality of LSR 223 on the Umpqua National Forest and Consistency with LSR Standards and Guidelines

The functionality of LSR 223 relates directly to the goals and objectives for LSRs (see section 1.2 of appendix F.3) and can be measured by the quantity, quality, and distribution of LSOG forest habitat in the LSR and how the proposed project would impact these characteristics.

- Quantity: The overall quantity of LSOG habitat within LSR 223 on the Umpqua National Forest would increase with the proposed LRMP amendment. The project would remove approximately 20 acres of LSOG habitat but the reallocation would add 296 acres of LSOG habitat, for a net increase of 276 acres.
- Quality: The area proposed for reallocation to LSR 223 contains some large blocks of LSOG habitat and it would also be located immediately adjacent to two KOACs, providing further consolidation of LSOG habitat and increased protection of NSO habitat. With the reallocation of matrix to LSR and the consolidating of larger blocks of LSOG habitat, the quality of the LSOG habitat within LSR 223 would be slightly improved. There is also the benefit of the 289 acres of younger (less than 80 years old) stands in the reallocated acres being managed for future LSOG habitat, which would provide the potential for larger blocks of LSOG habitat.
- Distribution: The distribution of LSOG habitat within LSR 223 would remain largely unchanged with the proposed project and the reallocation of matrix to LSR LRMP amendment. To the extent there are minor changes, they would be beneficial due to the location of the proposed reallocation. The reallocation would occur on the southwest edge of the LSR, providing for some additional connectivity with the nearest LSRs to the south and west.
- The off-site mitigation actions would improve the quantity, quality, and distribution of LSOG habitat in LSR 223 by accelerating the development of constituent elements of late-successional habitat, reducing the risk of stand-replacement fire and reducing fragmentation through road decommissioning and stand-density management.

The project design features, the reallocations of matrix to LSR, and the off-site mitigation actions for LSR 223 in the Umpqua National Forest have been designed with the goal of making the overall impact of the Pacific Connector pipeline project either neutral or beneficial to the creation and maintenance of late-successional habitat. These actions combined would maintain or improve the functionality of LSR 223.

Rogue River National Forest LSR 227

The proposed project would cross approximately 13.7 miles of the Rogue River National Forest and, if constructed, would directly affect (corridor plus TEWAs and UCSAs) approximately 276 acres of LSR 227. The proposed project and LSR 227 in the Rogue River National Forest are displayed on figure 4.7-11.

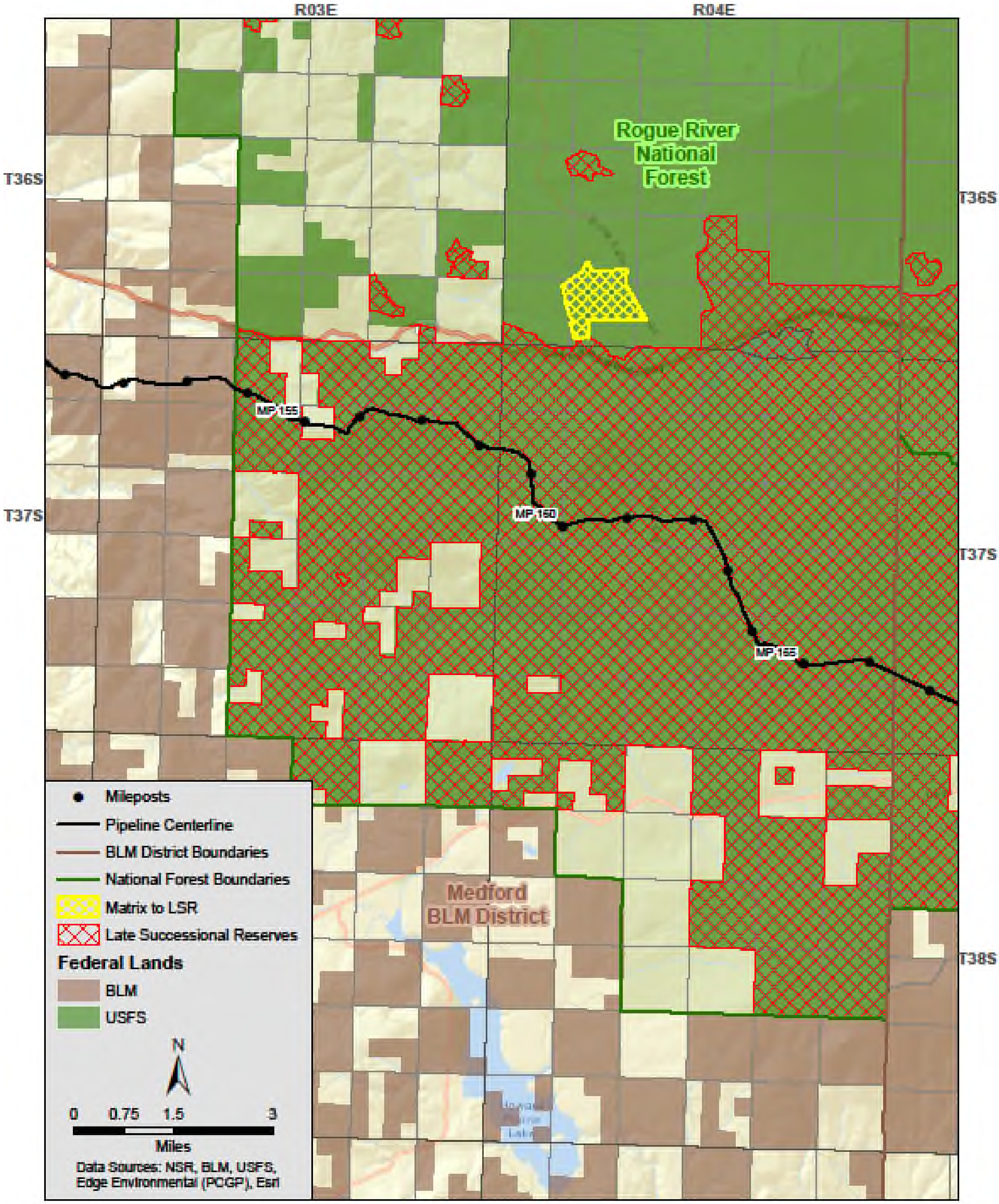


Figure 4.7-11. Map of Proposed Project and LSR in the Rogue River National Forest

Amendment RRNF-7, Reallocation of Matrix Lands to Late Successional Reserves

The Rogue River National Forest LRMP would be amended to change the designation of approximately 522 acres from the matrix land allocation to the LSR land allocation in Section 32, T.36 S., R. 4 E., W. M., Oregon (see figure 4.7-11). This change in land allocation is proposed to partially mitigate for the potential adverse impact of the project on LSR 227 in the Rogue River National Forest. The amendment would change future management direction for the lands reallocated from matrix to LSR.

Mitigation Actions

A compensatory mitigation plan has been developed by the Forest Service and submitted to the project applicant to ensure that the goals and objectives of the LRMP related to LSR 227 would be achieved (see appendix F.3 section 2.2). The lands in the Rogue River National Forest that would be affected by the proposed project are all within LSR 227. The primary objectives for the off-site mitigation actions are to accelerate the development of LSOG forest habitat in LSR 227. Mitigation actions include:

- Creation of snags on 622 acres that are below desired snag densities for LSRs.
- Placing CWD on 511 acres in units that are currently below desired levels for CWD.
- Decommissioning 57 miles of roads to reduce fragmentation and develop interior stand habitat over time.
- Thinning approximately 618 acres of overstocked stands to reduce fire risk and accelerate development of LSR characteristics.
- Other proposed mitigation actions in LSR 227 include placing large woody debris in approximately 1.4 miles of streams to improve fish habitat.

The off-site mitigation actions proposed are consistent with the recommendations in the LSRA for LSR 227. These off-site mitigation actions would accelerate the development of LSOG forest habitat elements to further offset the effects of the project on LSR 227 in the long term. The additional off-site mitigation actions would also increase the effectiveness of the additional LSOG forest habitat added to LSR 227 by improving the quantity, quality, and distribution of high-quality habitat. The proposed mitigation actions are displayed in figure 4.7-12.

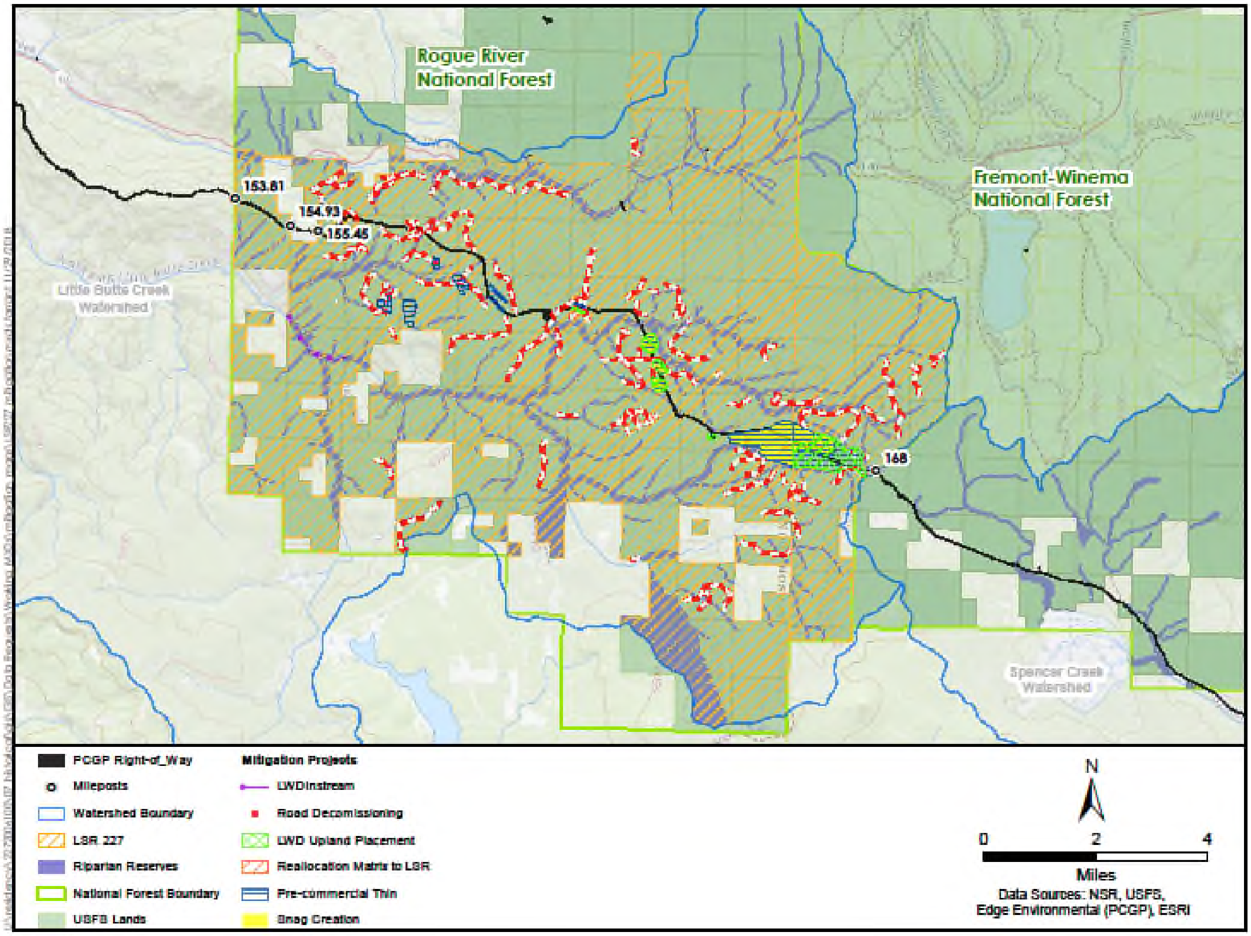


Figure 4.7-12. Proposed Off-Site Mitigation Actions in the Rogue River National Forest

Assessment of Proposed Amendments and Mitigation Actions Relevant to LSR 227

In the Rogue River National Forest, the proposed project would lie entirely within LSR 227. If constructed, the portion of the project on the Rogue River National Forest would be about 13.7 miles long and would clear approximately 206 acres of forest vegetation in LSR 227, of which approximately 55 acres are LSOG forest. The matrix area proposed for reallocation to LSR is approximately 522 acres, of which approximately 237 acres are LSOG forest (see figure 4.7-13). This change in land allocation is proposed to partially mitigate for the potential adverse impact of the project on LSR 227 in the Rogue River National Forest. When acres reallocated from matrix to LSR are compared to the acres of LSR that would be cleared by the project, the proposed amendment would reallocate about 2-1/2 more acres to LSR than would be cleared in the project corridor. When comparing acres of LSOG habitat, the proposed amendment would reallocate over 4 times more acres of LSOG habitat than would be cleared by the project. A comparison of the total acres affected in LSR 227 and the acres that would be reallocated are displayed in table 4.7.3.6-5 and figure 4.7-13 below.

TABLE 4.7.3.6-5

Comparison of Total LSR Acres Affected a/ by the Project and Acres of Matrix Reallocated to LSR

Rogue River National Forest LSR 227	Direct Effects: Cleared	Direct Effects: Modified	Indirect Effects	Total Effects	Matrix to LSR Reallocation
LSOG	55	21	350	426	237
Non- LSOG	142	49	184	375	284
Non-Forest	9	0	0	9	1
Total	**206**	**70**	**534**	**810**	**522**

a/ Total effects include cleared acres (corridor and TEWAs), modified acres (UCSAs), and indirect effect acres (100 meters on each side of the cleared corridor edge in LSOG and 30 meters on each side of the cleared corridor edge in non-LSOG).
Data source: USFS GIS Data Layers

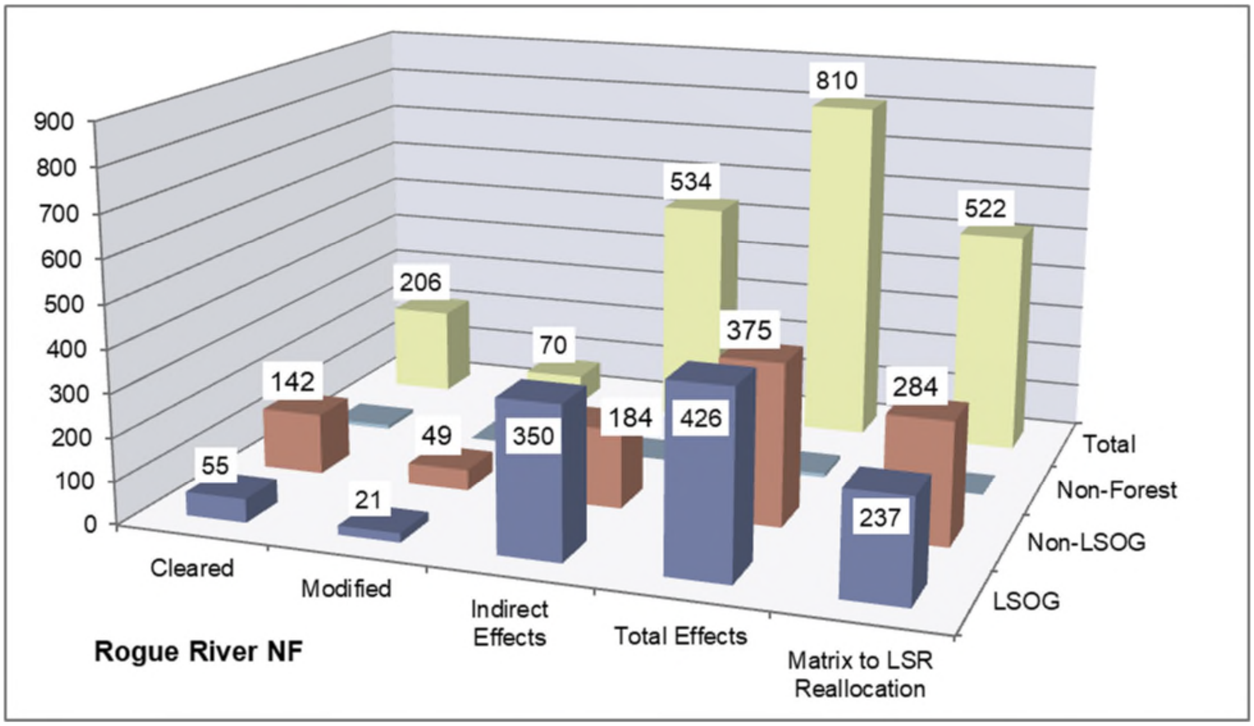


Figure 4.7-13. Comparison of Total LSR Acres Affected by the Project and Acres of Matrix Reallocated to LSR

In addition to the impacts of the pipeline corridor, there are also potential off-site impacts to LSR 227 from road reconstruction that would be necessary to accommodate the trucks that would haul the sections of pipe. These trucks are longer than typical trucks that use forest roads, and some road widening and curve realignment may be necessary to safely allow for this truck traffic. Although this road widening would occur to the extent possible within the existing clearing limits, it is probable that some additional clearing of forest vegetation would be necessary to accommodate the road reconstruction. It is estimated that this would be a maximum of four acres and would occur along an existing road opening.

Assessment of Functionality of LSR 227 on the Rogue River National Forest and Consistency with LSR Standards and Guidelines

The functionality of LSR 227 relates directly to the goals and objectives for LSRs (see section 1.2 of appendix F.3) and can be measured by the quantity, quality, and distribution of LSOG forest habitat in the LSR and how the proposed project would impact these characteristics.

- Quantity: The overall quantity of LSOG habitat within LSR 227 on the Rogue River National Forest would increase with the proposed LRMP amendment. The project would remove approximately 55 acres of LSOG habitat but the reallocation would add 237 acres of LSOG habitat for a net increase of 182 acres.

- Quality: The area proposed for reallocation to LSR 227 contains some large blocks of LSOG habitat. With the reallocation of matrix to LSR and the consolidating of larger blocks of LSOG habitat, the quality of the LSOG habitat within LSR 227 would be slightly improved. There is also the benefit of the 284 acres of younger (less than 80 years old) stands in the reallocated acres being managed for future LSOG habitat that would provide the potential for larger blocks of LSOG habitat.

- Distribution: The distribution of LSOG habitat within LSR 227 would remain largely unchanged with the proposed project and the reallocation of matrix to LSR LRMP amendment. To the extent there are minor changes, they would be beneficial due to the location of the proposed reallocation. The reallocation would occur on the north end of the LSR, providing for some additional connectivity with the nearest LSRs to the north.

- The off-site mitigation would improve the quantity, quality, and distribution of LSOG habitat in LSR 227 by accelerating the development of constituent elements of late-successional habitat, reducing the risk of stand-replacing fire, and reducing fragmentation through road decommissioning and stand-density management.

The Project design features, the reallocation of matrix to LSR, and the off-site mitigation actions for LSR 227 in the Rogue River National Forest have been designed with the goal that the overall impact of the Pacific Connector pipeline project would be either neutral or beneficial to the creation and maintenance of late-successional habitat. These actions combined would maintain or improve the functionality of LSR 227.

4.7.4 Conclusion

Constructing and operating the Project would have both temporary and permanent effects on land use. Some land uses would be permanently converted to industrial use, others (such as affected orchards, vineyards, and forests) would no longer being permitted directly over the pipeline, Other land uses would be converted to more natural conditions than they are currently (as part of the proposed Project-related mitigation sites). Based on the proposed mitigation and minimization measures the Project would not significantly affect land use.

4.8 RECREATION AND VISUAL RESOURCES

4.8.1 Recreation and Public Use Areas

4.8.1.1 Jordan Cove LNG Project

Parks and Other Recreational Use Areas

Land on the North Spit is managed and owned by several public agencies, including the COE, BLM, Forest Service, State of Oregon, and the Port, as well as private entities such as Roseburg Forest Products, D.B. Western, and Southport. The COE manages 245 acres on the Spit, including the North Jetty at the mouth of Coos Bay.

The Jordan Cove LNG Project would be located on the North Spit of Coos Bay, on private land. No recreational activities would be allowed within the facility boundaries. Parks and recreational areas in the general vicinity of the Project site are shown on figure 4.8-1 and discussed in the following sections.

<u>BLM Coos Bay/North Spit Shorelands</u>

The North Spit of Coos Bay is a strip of land between the Pacific Ocean and the waters of Coos Bay. This peninsula area contains both industrial and semi-wild areas. The BLM administers 1,864 acres on the Spit, with 709 acres classified as an Area of Critical Environmental Concern (ACEC) and the remainder designated as Recreation Management Areas (RMAs). BLM (2016a) designated four RMAs within the Coos Bay/North Spit area as part of the Northwestern and Coastal Oregon Record of Decision and Approved Resource Management Plan. The four RMAs are: Bastendorff Beach (a 53-acre Special Recreation Management Area [SRMA]), Coos Head (an approximately 11-acre SRMA), North Spit Boat Ramp (a 5-acre SRMA), and the North Spit Trail System (a 1,505-acre Extensive Recreation Management Area [ERMA]).[157] These SRMA and ERMA areas provide non-motorized and motorized recreation opportunities along the Pacific Coast and in the greater Coos Bay area for use by the local community and regional visitors.

The closest of these RMAs to the Jordan Cove LNG Project is the North Spit Trail System, which is approximately 300 feet from the Trans-Pacific Parkway. The BLM boat launch facility and courtesy dock, which provides access to the Coos Bay estuary and is also part of the SRMA, is approximately 0.16 mile southwest of the LNG terminal site. These four areas include designated roads and trails for OHV use. These roads are also available to hikers and equestrians. The BLM estimated that in a typical year about 2,460 OHVs and approximately 6,150 people traveled on the sand road to the North Jetty. According to the BLM, about 13,100 vehicles visited the boat dock in a single year, and about 420 boats were launched (BLM 2006b). Cross country areas in the Bastendorff Beach, Coos Head, and North Spit Trail System RMAs are available for non-motorized use only.

[157] SRMAs are defined by the BLM as administrative units where recreation opportunities and setting characteristics are recognized for their unique value, importance, and/or distinctiveness, especially as compared to other recreation areas. ERMAs are administrative units that require specific management consideration to address recreation use, demand, and/or related investments (BLM 2016a).

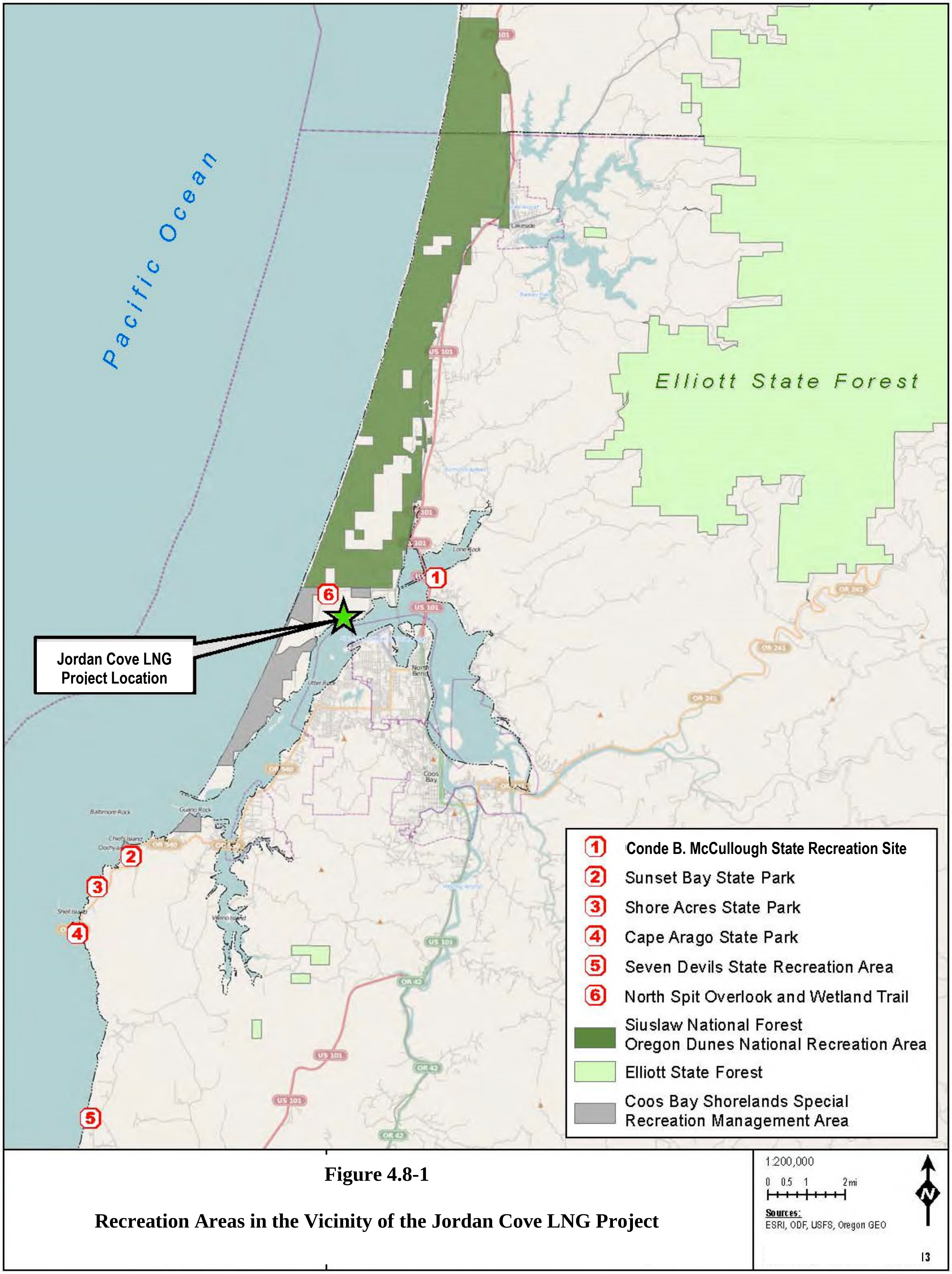


Figure 4.8-1

Recreation Areas in the Vicinity of the Jordan Cove LNG Project

Oregon Dunes National Recreation Area

The Forest Service manages the ODNRA within the Siuslaw National Forest at the north end of the Spit. The ODNRA extends approximately 45 miles along the Oregon Coast from Coos Bay north to Florence. The southern boundary of the ODNRA is about 100 feet north of the Jordan Cove LNG terminal site, across the Trans-Pacific Parkway. The Horsfall Campground is located about 0.5 mile northeast of the LNG terminal site.

The ODNRA contains the largest expanse of coastal sand dunes in North America, as well as a coastal forest and over 30 lakes and ponds. Recreational opportunities at the ODNRA include OHV use, hiking, camping, horseback riding, angling, canoeing, sailing, waterskiing, and swimming. There are approximately 34 miles of designated OHV routes open to all classes of OHVs, and roughly 135 miles of unofficial user-developed routes that are technically closed (Forest Service 2012b). The ODNRA south of Horsfall Road is closed to OHV travel, except along the beach. Day use and overnight camping facilities within the ODNRA are visited by approximately 1.0 to 1.5 million people each year (Forest Service 2009, 2012c). The Forest Service identified 1.6 million visits to the Siuslaw National Forest, including the ODNRA, in 2011, with 23.6 percent of visitors engaging in OHV use, including 18.2 percent of visitors who identified OHV use as their main activity and spent an average of 6.6 hours participating in OHV use per visit (Forest Service 2012c).

National Wildlife Refuges

Two NWRs are located near the North Bank upland wildlife habitat mitigation site (North Bank mitigation site). The 889-acre Bandon Marsh NWR is located adjacent to the North Bank mitigation site, near the mouth of the Coquille River. The lower Coquille River estuary provides important habitat for juvenile and adult anadromous fish species, including coho and Chinook salmon, steelhead, and cutthroat trout (FWS 2018c). The Oregon Islands NWR includes 1,853 rocks, reefs, and islands and extends from Tillamook, Oregon to the Oregon/California border. The refuge also protects two headlands: Coquille Point and Crook Point. Coquille Point, located approximately 5 miles from the North Bank mitigation site, provides a buffer zone between mainland development and the islands, and provides opportunities to watch seabirds and harbor seals, as well as a paved trail and interpretive panels (FWS 2018d).

State of Oregon

Pacific Ocean Beaches

The OPRD controls the Pacific Ocean beaches below the high tide mark on the west side of the Spit, while the ODSL possesses the beach land below mean low tide, including submerged lands (BLM 2005). A survey conducted on behalf of the OPRD found that the 15-mile stretch of beach along the ocean from Ten Mile Creek to the mouth of Coos Bay was visited by an average of 38 people on a weekday, and 60 people on a weekend day (Shelby and Tokarczyk 2002). The main activities of beach visitors in this area include OHV use (54 percent), relaxing (21 percent), walking (16 percent), and recreational activities with dogs (4 percent). Surfing is also a recreational activity in the ocean along the North Spit.

Oregon State Parks and Recreation Areas

Four state parks and two state recreation areas are located within 15 miles of the Project. The closest of these is the Conde B. McCullough State Recreation Site, located approximately 2.4 miles northeast across Highway 101 from the Jordan Cove LNG Project. Located along the southern shore of Haynes Inlet, this narrow shoreline recreation site is largely forested, with a small parking lot near a boat ramp at its eastern end. Only day-use recreation is permitted. The remaining five sites—the William M. Tugman, Sunset Bay, Shore Acres, and Cape Arago State Parks, and the Seven Devils State Recreation Site—are all located more than 8 miles from the Jordan Cove LNG Project. In addition, two state parks are located near the North Bank mitigation site. Bullards Beach State Park is located approximately 0.75 mile west of the North Bank mitigation site. Park facilities include campsites, a horse camp, a hiker/biker camp, and a boat ramp, and also provides access to the historic Coquille River Lighthouse (Oregon State Parks 2018). Face Rock State Scenic Viewpoint is located about 0.2 mile from the North Bank mitigation site. Amenities include picnic tables, restrooms, a viewing scope, and a stairway and trail to the beach.

Oregon State Forests

Elliott State Forest, located in the Coast Range approximately 7.8 miles to the northeast, is the closest state forest to the Jordan Cove LNG Project. Elliott State Forest is a contiguous block of land about 18 miles long (north to south), and about 16 miles wide (west to east) that encompasses approximately 93,000 acres, primarily in Coos and Douglas Counties. Although Elliott State Forest is managed primarily for timber production, recreation uses on the forest include dispersed camping, fishing, OHV use on forest roads and designated trails, horseback riding, hunting, and low amounts of hiking and mountain biking.

<u>North Spit Overlook</u>

The North Spit Overlook and nature trail are located about 0.5 mile west of the Jordan Cove LNG Project, on the north side of the Trans-Pacific Parkway. These facilities are maintained by Weyerhaeuser, a forest products company, to provide the public an opportunity to observe wildlife and birds in the vicinity of its former wastewater lagoon on the North Spit. Typically open to the public for nature studies, birding, walking, and photography, the gate providing access to the overlook and trails has been closed in recent years.

<u>Coos Bay Estuary</u>

Coos Bay estuary spreads nearly 20 square miles, offering many recreational opportunities including boating, fishing, clamming, and crabbing. The Coos Regional Trails Partnership (2004), a loose consortium of federal land management agencies and local economic development entities, developed a brochure that maps Coos Bay's water trails where canoeists and kayakers can enjoy the sloughs, bay islands, and rivers draining into the bay. The water trails closest to the LNG terminal site are approximately one mile northeast in North Slough and Haynes Inlet east of the Central Oregon and Pacific Railroad Bridge that crosses Coos Bay. A separate water trail is identified for Coos Bay east of the Highway 101 bridge. The section of Coos Bay south of the LNG terminal site is not identified as part of the water trail system (Coos Regional Trails Partnership 2004).

<u>Oregon Coast Trail</u>

The Oregon Coast Trail passes within 0.5 mile of the Jordan Cove LNG Project and the meteorological station site, where the trail follows Horsfall Beach Road and joins the Trans-Pacific Parkway. The Oregon Coastal Trail is a 360-mile-long hiking trail that extends south from the Columbia River to the California border. The trail was created by the Oregon Recreation Trails Advisory Council and is managed by the OPRD as part of the state park system. The trail crosses beaches, follows roads, passes through forests, and hugs coastal headlands. The majority of the trail is on the beach, but approximately 1.25 miles north of the Jordan Cove LNG Project, the trail leaves the beach at Horsfall Beach Access Road and becomes an inland trail. After heading east along Horsfall Beach Access Road, the inland trail turns east along the Trans-Pacific Parkway, and then south on U.S. Highway 101 heading into the city of North Bend. The inland trail continues through North Bend on city streets and then continues south to Charleston and then out to Sunset Bay State Park.

Oregon Coast Bike Route

The Oregon Coast Bike Route is a 370-mile-long signed bicycle route that primarily follows U.S. 101 as a shoulder bikeway and passes near the terminal, following U.S. Highway 101 through the Trans-Pacific Parkway/U.S. 101 intersection. In several areas, the route departs from the main highway and follows county roads and city streets. This occurs in North Bend, where bicyclists follow the North Bend Bypass and avoid heavy commercial and truck traffic on U.S. 101 through North Bend and Coos Bay. The bypass passes south of Pony Slough on Virginia Avenue and then turns south on Broadway Street, approximately 1.7 miles south of the Jordan Cove LNG Project. At Newmark Avenue (Cape Arago Highway), the bypass turns west and continues to South Empire Boulevard, where it continues south to Charleston, crossing the South Slough Bridge. Leaving Charleston, the bypass turns south on Seven Devils Road. In Bandon, near the North Bank mitigation site, the route runs along Riverside Drive, Ocean Drive, and Beach Loop Road through historic Old Town.

City of North Bend Parks

There are eight existing parks, one planned park, and a boat ramp in the city of North Bend. Three of these parks and the boat ramp are within 3 miles of the Jordan Cove LNG Project. Simpson Park, located approximately 1.9 miles to the southeast, is mostly forested land for day-use, low intensity recreation. Ferry Road Park, located approximately 1.9 miles to the southeast, across U.S. Highway 101 from Simpson Park and the terminal, is a developed recreation site, with a baseball diamond, a pavilion available for rent from the North Bend Parks Department, and restrooms. Winsor Park, also located approximately 1.9 miles to the southeast, on the east side of U.S. 101, is mostly forested, with an open field for recreational activities. All three parks are located close to the APCO laydown site. The California Street Boat Ramp is located approximately 2.5 miles southeast of the Jordan Cove LNG Project.

City of Coos Bay Parks

Parks operated by the City of Coos Bay Parks Department include John Topits Park, Hollering Place Wayside, Mingus Park, and a series of neighborhood pocket parks. Hollering Place Wayside and Ed Lund Park, one of the neighborhood pocket parks, are the closest of these facilities to the Jordan Cove LNG Project; both are located about 2 miles to the south. Hollering Place Wayside was the location of a pre-European village and also the site of the first European settlement in what would become Coos County. Today, the location offers water views and a place for a picnic. Ed Lund Park includes a children's play area, a large lawn, horseshoe pits, picnic tables and benches, and is the site of many community activities, including the annual Empire Clamboree.

City of Bandon Parks

Three city parks (i.e., Bandon City Park, Kronenberg County Park, and Weber’s Pier) are located approximately 3 miles southwest of the North Bank mitigation site. In addition, private recreation facilities in the vicinity of the North Bank mitigation site include three golf courses north of Bullards Beach State Park, a youth center, and an RV park.

Impacts on Parks and Other Recreational Use Areas

Increased Demand from Construction Workers

The temporary influx of non-local construction workers could potentially increase demand for recreational activities at the parks and other recreational use areas located near the Jordan Cove LNG Project. An estimated average of 802 non-local workers are expected to be employed over the 53-month-long construction phase, with the number of non-local workers expected to peak at 1,568 workers during month 30. Assuming that a portion of the workforce temporarily relocating to the area would be accompanied by family members, temporary increases in population would range from the equivalent of 3.4 percent to 6.6 percent of the combined populations of Coos Bay and North Bend in 2016 (section 4.9). A share of these workers and family members may seek recreational opportunities near the Jordan Cove LNG Project. Demand would primarily be limited to periods when workers are not employed, primarily weekend days, and would be temporary and short term. Given the large amount of public lands in the region and the relatively low levels of current use, this potential short-term increase in demand is not expected to result in significant effects on parks and other recreational areas.

Noise

Construction and operation of the Jordan Cove LNG Project could result in increases in the ambient sound environment for people recreating in the immediate vicinity, including users of the North Spit Overlook, coastal beaches, BLM RMAs, and ODNRA. Noise modeling (discussed in more detail in section 4.12 of this EIS) indicates that expected Project construction noise levels at the closest noise sensitive area (REC 1, which is located about 0.7 mile from the LNG terminal and is representative of the closest areas of federally managed lands on the North Spit) would temporarily result in noise levels increasing from ambient levels of approximately 55 A-weighted decibels (dBA)to 57 dBA.

OHVs that are allowed on the beach and dune trails contribute to the ambient noise levels on the North Spit. The noise limit for OHVs in the ODNRA is 93 dBA at 20 inches from the exhaust outlet (Forest Service 2013). For OHV riders and other people in close proximity, OHV sound levels would exceed the predicted Project's construction and operational noise levels. Distance, topography, coastal winds, and vegetation would help to minimize Project construction and operational noise in the portions of the ODNRA where OHVs are not allowed (between the Trans-Pacific Parkway and Horsfall Beach Access Road).

Recreation Access and Driving for Pleasure:

There may be some conflicts between recreational drivers on the Trans-Pacific Parkway and construction traffic traveling to and from the Jordan Cove LNG Project. Recreational drivers in this context could include recreationists using the Trans-Pacific Parkway to access recreation sites, including the ODNRA, as well as people recreating by driving for pleasure.

Traffic counts conducted in support of the Traffic Impact Analysis prepared on behalf of Jordan Cove (David Evans & Associates, Inc. [DEA] 2017b) counted a total of 232 vehicles passing through the intersection of the Trans-Pacific Parkway and Horsfall Beach Road from 4:30 p.m. to 6:30 p.m. on a Friday afternoon in August 2015. DEA (2017b) estimates that the number of vehicles traveling to and from the Jordan Cove LNG Project would peak in 2021, with 945 workers driving to the site in two staggered shifts each day, and 140 long haul truck trips each day to and from U.S. 101 via the Trans-Pacific Parkway to the site/north laydown yard, and 2 long haul trips each day to and from U.S. 101 via Ferry Road to the south laydown yard. DEA (2017b) assumed that the truck trips would occur throughout the day. Although the number of construction workers employed on-site would be higher in 2022, the number of passenger vehicles traveling to and from the terminal site would decrease with the addition of the temporary workforce housing facility on South Dunes, and external park and ride lots. The addition of construction-related traffic could cause potential delays at key intersections as discussed in section 4.10 during peak hours. Mitigation measures, also discussed in section 4.10, are expected to reduce potential effects, and recreationists could avoid delays by traveling outside of peak commuting hours. Mitigation would likely include staggered work shifts, construction of a dedicated eastbound left-turn lane at the intersection of U.S. 101 at the Trans-Pacific Parkway, and implementation of a temporary signal at the intersection for the duration of construction activities (see section 4.10).

Hunting

Hunting activities are managed by the ODFW. Big game, waterfowl, and fur-bearing animals are hunted in the public areas of the North Spit and within the Siuslaw National Forest during hunting seasons. The influx of Jordan Cove workers to the area could add to the number of people who would hunt on public lands in the region during hunting seasons. However, this potential increase would be temporary and short term. The total construction period would be about 53 months and most construction jobs would last for less than two years. As noted with respect to overall project-related demand for recreation, workers temporarily relocating to the area would have limited time available to hunt, primarily weekend days.

Clamming and Crabbing in Coos Bay

Recreational clamming and crabbing activities occur in Coos Bay near the Jordan Cove LNG Project. Coos Bay was the third most productive clamming estuary in Oregon as of 2008 and an annual average of 15,000 crabbing trips took place between 2008 and 2011 (Ainsworth and Vance 2009; Ainsworth et al. 2012). Sites for clamming include the mud flats on the bay side of the North Spit, the northern reaches of South Slough, in Haynes Inlet and the eastern side of the bay north of the McCullough Bridge. Crabbing takes place from the docks in Charleston and Empire, from boats, and on the bay side of the North Spit.

Dredging in the bay to create the access channel for the Jordan Cove LNG Project could potentially affect recreational clamming and crabbing. Potential effects related to dredging are assessed in section 4.3.2.1 of this EIS, which concludes that dredging of the access channel would only have temporary effects on bay water quality, and increased sedimentation from dredging would be limited in extent. The limited time and extent of dredging siltation is not expected to result in long-term or population wide effects on clams and crabs near the Jordan Cove LNG Project. Further, as mitigation for wetland effects, Jordan Cove would create new eelgrass beds in Coos Bay that could serve as nursery habitat for crabs and Jordan Cove would also create new wetlands at Kentuck Slough.

Wakes from LNG carriers in the Federal Navigation Channel are not expected to cause major shoreline erosion beyond natural waves. Further, due to the relatively low transit speed and the required minimum underkeel clearance distance, propeller wash from LNG carriers is not expected to greatly disturb the channel bottom or affect clam and crab harvest in Coos Bay (see section 4.3.2.1).

Recreational clamming and crabbing that takes place outside the navigation channel would not be directly affected by LNG carrier traffic transiting the waterway to and from the LNG terminal. Effects would be similar to those presently experienced during the passage of other deep-draft ships. However, if crabbing or clamming activities were to occur within the established security zones, those activities may be required to cease, with attending vessels required to temporarily move out of the security zone while the LNG carrier in transit moves by. The requirement for any commercial or recreational boat operating within the security zone near the channel, but not impeding the safe navigation of the LNG carrier in the channel, to move and vacate the security zone area would be up to the Coast Guard on-scene commander and decided on a case-by-case basis. The Coast Guard has informed Jordan Cove that the degree of security zone enforcement would be based on the threat level in effect at the time and the specific perceived threat of any vessel in the security zone. Crab pots outside of the navigation channel should not be affected by LNG carrier traffic in the waterway. Passive equipment, such as crab pots, would be permitted to remain within the security zone while an LNG carrier is present.

Boating and Fishing

Data collected by the Oregon State Marine Board (OSMB) identified approximately 105,000 boat-use days in Coos County in 2013 (Lesser et al. 2014). The data did not identify the share of these trips that originated in Coos Bay, but information collected as part of a similar survey in 2007 indicated that recreational boaters took a total of 31,552 boat trips in Coos Bay for a total of 35,950 activity days. Fishing accounted for 91 percent of these days, sailing for 8 percent, and recreational cruising for 1 percent (OSMB 2008). Sixty-eight percent of the boating activities in Coos Bay in 2007 originated from the Charleston Marina and the Empire ramp, 19 percent at the California Street boat ramp, and 4 percent at the North Spit ramps. Charleston Marina, the Empire ramp, and North Spit ramp are located approximately 7.3 miles, 3.3 miles, and 2.1 miles southwest of the Jordan Cove LNG Project; the California Street boat ramp is about 2.5 miles southeast.

Popular fish species caught by recreational anglers out of Coos Bay include Coho and Chinook salmon. Other recreational catch species include various species of perch, rockfish, flatfish, sturgeon, Pacific herring, and California halibut. Much of the recreational angling for salmon in Coos Bay occurs in late summer and fall. Bank angler access on the North Spit is limited. Boat angling occurs throughout the bay, but angling is limited in some areas at times by exposure to winds.

Jordan Cove proposes to construct the slip and LNG carrier berth structures while the slip is kept isolated from Coos Bay by an earthen berm. The excavation and dredging of the slip would occur in isolation from the bay, with no restrictions placed on recreational boating in the construction site area. Recreational boating would, however, be discouraged around the construction area during the final phase in the slip construction, which would involve removing the earthen berm and connecting the excavated/dredged slip area to the bay. Recreational boating would also be discouraged during excavation of the access channel. Construction would also involve dredging within Coos Bay and would include the excavation of the four submerged areas adjacent to the existing Federal Navigation Channel as part of the Navigation Reliability Improvements. Excavation and dredging activities are expected to occur during the in-water work period from October through February 15. Excavation of the berm and the four submerged areas as part of the

Navigation Reliability Improvements would occur during a single in-water work period. Dredging of the access channel is expected to occur over two in-water work periods.

The Coast Guard and OSMB would provide Notice to Mariners to avoid the affected areas during the construction period. In addition, Jordan Cove would post signs on the shoreline, at the boat ramps and marinas, and on buoys or fixed navigation aids in the bay to notify boaters of the planned construction activity and the duration of the activity. All floating and submerged dredging equipment operating in the bay would be clearly marked with day signals and light signals at night in accordance with the U.S. Inland Rules of the Road. If the signage and notices are not sufficient to prevent recreational boaters from avoiding the construction areas, some form of physical barrier, such as a continuous string of highly visible soft material floats, could be extended across the mouth of the slip or around the construction area. Construction safety inspectors would also be responsible for warning any recreational boaters who enter the construction area.

Potential effects on recreational boaters during construction of the slip, access channel, and the four Navigation Reliability Improvement areas would be temporary and affect a limited area. Coos Bay is extensive (20 square miles or 12,800 acres) and recreational boating opportunities would continue to be available in other portions of the bay during construction, with existing boat ramps remaining open during construction. The construction dredging areas are limited in size and boaters could avoid these areas by moving to the south and east side of the bay.

During construction of the Project, Jordan Cove would have large pieces of equipment brought in via water transport, using the existing Federal Navigation Channel. Jordan Cove anticipates that the terminal would receive approximately 70 water deliveries over a 2-year period. Deliveries would be via a mix of ocean-going vessels and barges. In addition, during construction of the access channel about two barges per day would transport dredged materials from Ingram Yard to the Kentuck project site. The addition of these vessels is not expected to have adverse effects on other bay users, including recreational boaters.

During operation of the Project, recreational boaters would have to avoid LNG carriers in transit within the waterway. Jordan Cove anticipates that up to 120 LNG carriers would visit the LNG terminal each year. Recreational boaters using the bay at the same time that an LNG carrier is in transit within the waterway may encounter delays due to the moving security zone requirements around an LNG carrier, as specified in Jordan Cove's Waterway Suitability Assessment (WSA) and the Coast Guard's Waterway Suitability Report (WSR) and LOR. Jordan Cove estimated that it may take an LNG carrier up to 90 minutes to transit the waterway from the buoy to the terminal at speeds between 4 and 10 knots. Pilots guiding commercial ships in the Federal Navigation Channel currently encounter approximately six recreational boats during the transit into and out of the Port. These numbers are typically lower in winter and on weekdays than during the summer and on weekends. The Coast Guard and OSMB would continue to remind boaters of their obligation not to impede deep draft ships, regardless of the cargo. LNG carriers may take up to 30 minutes to pass resulting in limited potential delays to recreational boaters.

Other Public and Special Use Areas:

The LNG terminal would be approximately 0.9 mile from the Southwest Oregon Regional Airport. Potential effects of the LNG terminal on the airport are addressed in section 4.10.

4.8.1.2 Pacific Connector Pipeline Project

Parks and Recreational Areas or Facilities on Non-Federal Lands

The pipeline route does not cross any non-federal park lands or developed recreational facilities, and construction and operation of the pipeline should not adversely affect park users. However, construction-related activities would temporarily increase traffic on local roads used to access parks, and park users may be able to hear construction noise while workers and equipment move through the area to install the pipeline. In addition, the pipeline route would cross a water trail (i.e., the Haynes Inlet Water Trail) as discussed below. The following sections discuss parks and recreational areas or facilities in the vicinity of the pipeline project.

<u>Oregon State Lands</u>

Oregon Coast Trail

The Oregon Coast Trail is discussed above in section 4.8.1.1. The pipeline route would be within one-quarter mile of the trail where it follows Horsfall Beach road and joins the Trans-Pacific Parkway. Recreational users of the Oregon Coast Trail would be exposed to pipeline construction traffic along the Trans-Pacific Parkway, which is the only access road to the North Spit area and the Jordan Cove Meter Station. Pacific Connector proposes to reduce effects on local traffic by following the measures outlined in its *Transportation Management Plan* (see section 4.10.2). Pipeline construction activities and related traffic could be visible and audible to hikers on the Oregon Coast Trail where it joins with the Trans-Pacific Parkway, but these effects would be temporary, lasting only the duration of pipeline installation in this area. Further, this area is adjacent to a large-scale industrial facility (Roseburg Forest Products), a railroad, and a road. As a result, pipeline construction is not expected to significantly affect trail use or trail user experience.

Coos Bay Estuary

Coos Bay is used for recreational boating, canoeing, kayaking, angling, clamming, and crabbing. As noted above, the Coos Regional Trails Partnership, a consortium of land management agencies and economic development groups, have mapped Coos Bay's water trails for kayakers and other paddlers (Coos Regional Trails Partnership 2004). Portions of one water trail – the Coos Bay Trail – would be crossed by the pipeline alignment. The Coos Bay Trail begins at the California Avenue Boat Ramp, near the south end of the McCullough Bridge (i.e. U.S. Highway 101). The trail heads south through Coos Bay, along the western banks. The pipeline would cross this water trail using trenchless HDD crossing methods at about MP 1.50, with the proposed HDD continuing up into Kentuck Inlet to approximately MP 3.0, where it would end in uplands.

Potential effects on boaters using these areas during or after construction would be limited due to the use of HDD as boating in the vicinity of the HDD path would be allowed to continue during the drilling. HDD operations and pipe stringing would occur in uplands for both the Jordan Cove to North Point HDD, and for the HDD crossing from North Point to Kentuck Inlet. The HDD pipe string would be staged in uplands north of Jordan Cove for the Jordan Cove to North Point HDD, and the pipe string for the North Point to Kentuck Inlet crossing would be staged east of Kentuck Inlet and pulled to the west underneath the bay.

Klamath Wildlife Area

The Klamath Wildlife Area is managed by ODFW to provide habitat for wintering and nesting waterfowl, upland game birds, and a variety of other wildlife. Bald eagles, white pelicans, and ospreys are among the bird species that are present in this area during certain times of the year. The Miller Island Unit, along the Klamath River south of West Klamath, also serves as a recreation spot for fishing, hunting, and boating (ODFW 2017i). The pipeline right-of-way passes within 0.1 mile along the north side of the Miller Island Unit near MP 199.15, but is separated from the Unit by the Klamath River and other industrial areas. Construction in this area would be limited to the ODFW-recommended work period of July 1 through January 31 to avoid affecting wildlife populations supported by the area.

State Parks

There are no Oregon State Parks within 1 mile of the pipeline. Some USGS maps show Camas Mountain State Park near MP 51.7 in Douglas County. However, OPRD records do not show that there is, or historically has been, a state park or any state land ownership at this location (Teal 2006).

County Lands

There are nine county parks located near the pipeline route. Five of these parks are located in Coos County and include three parks accessed by the Coos Bay Wagon Road: Middle Creek Park, Ham Bunch-Cherry Creek Park, and Frona County Park. Middle Creek Park lies approximately 0.5 mile west of the pipeline alignment at about MP 27.5. Middle Creek is an unimproved, day use park. Ham Bunch-Cherry Creek Park, with about eight primitive campsites and fishing on Cherry Creek, is located about 1 mile northwest of the pipeline alignment at MP 28.5. Frona County Park, which offers a primitive group campground and fishing area along the East Fork of the Coquille River, is less than 0.5 mile northwest of the pipeline alignment at MP 29.9 (Coos Bay Net 2006; Coos County Park and Recreation 2006).

The other two parks in Coos County are Rock Prairie County Park and Laverne County Park. Rock Prairie County Park is an unimproved, day use park, located approximately 1.5 miles southwest of the pipeline, near MP 23.26. Laverne County Park is a 350-acre park located approximately 2.5 miles southeast of MP 22. Located on the North Fork Coquille River, Laverne County Park includes 76 campsites (46 RV sites and 30 tent sites), as well as a picnic area, large group area, softball field, playground, and other amenities. Construction is not anticipated to affect park use or associated recreational opportunities.

There are three county parks near the pipeline route in Douglas County: Ben Irving Reservoir, North Myrtle Park, and the Carl C. Hill Wayside. Ben Irving Reservoir, located about 1.5 miles south of the pipeline alignment near the town of Tenmile and State Highway 42 (near MP 55.8), is a large man-made water body used for fishing, boating, and other water related recreation. The day use park has a picnic site and boat launch. The reservoir could be a source of water for pipeline hydrostatic testing (see section 4.3). Project water use would be allowed by the reservoir owner and is not expected to significantly draw down the reservoir or affect boating or other day-use activities. North Myrtle Park is located approximately 1.5 miles north of MP 79 on County Road 15 (North Myrtle Road). This park is a day use park, with a ball field and picnic area. The pipeline would cross the access road to this park. Near Milo, the Carl C. Hill Wayside provides a picnic area and fishing along the South Umpqua River. This day use area is approximately 0.7 mile southwest of the pipeline alignment at MP 94.7, where the pipeline route crosses the South Umpqua River.

In Jackson County, Rogue Elk Country Park provides camping, hiking, and picnicking opportunities. This park is located west on State Highway (SH) 62 (Crater Lake Highway), approximately 2 miles west of the town of Trail. The park, at its closest point, is approximately 0.64 mile from the pipeline. No construction traffic or other related indirect effects are anticipated for park visitors because construction access to the pipeline would be via other roadways.

Although construction-related activities would temporarily increase traffic on local roads used to access the above parks, the five relatively remote county parks (Middle Creek, Ham Bunch-Cherry Creek, Frona, Ben Irving Reservoir, North Myrtle, and Rogue Elk Country) would not be directly affected by construction and operation. The Carl C. Hill Wayside picnic area may experience increased construction traffic and noise due to its proximity to SH 227 and the presence of a large pipe laydown and staging yard. Park visitors would also be able to hear construction activities upriver. The proposed diverted open cut of the South Umpqua River is, however, scheduled to coincide with the low water season of late summer/early fall to minimize effects on boaters and anglers in the area.

Other Non-Federal Public Recreation Areas

Keno Recreation Area

Pacific Power's Keno Recreation Area consists of a developed campground, boat launch, and picnic area along the Keno Reservoir of the Klamath River. Fishing and water sports are common activities at this recreation site near the town of Keno. The pipeline alignment passes less than 0.5 mile north of the reservoir where it would be adjacent to an existing powerline corridor. Recreation and access to the Keno Recreation Area would not be affected by construction and operation activities. While the Keno Reservoir could be a source of water for pipeline hydrostatic testing, this potential use is not expected to significantly draw down the reservoir or affect boating or other day-use activities. Hydrostatic testing is more fully discussed in section 4.3.2.

OHV Controls and Limited Access to the Right-of-Way

Comments received during public scoping expressed concern with the potential for an increase in OHV use where the pipeline right-of-way could create new access points. There was also concern about the effectiveness of control methods proposed by Pacific Connector. The pipeline right-of-way could increase unauthorized OHV, snowmobile, and dispersed motorized access and associated resource access. Pacific Connector's *Recreation Management Plan*[158] describes measures to be employed on both public and private lands to control unauthorized OHV use. Pacific Connector's plan indicates that they would assess the need for OHV control measures primarily where the pipeline right-of-way would intersect roads, OHV trails, or other trails. Various natural and constructed control measures would be installed at appropriate locations in coordination with the appropriate land management agencies or landowner. Potential locations identified by Pacific Connector include the PCT area, the Camel Hump and Obenchain Road areas, Dead Indian Memorial Highway, Forest Road 700, and Clover Creek Road. OHV control measures could include:

- dirt or rock berms, sometimes coupled with erosion control devices;

[158] Appendix S to Pacific Connector's POD filed with the FERC in January 2018.

- strategically placed non-merchantable logs, slash, or tree stumps;
- large rocks or boulders partly buried along the right-of-way;
- signs;
- fencing and locked gates; and
- vegetative screening to disguise the existence of the right-of-way.

Where necessary, OHV control structures would extend out beyond the right-of-way to prevent "drive-around" and would be built at an appropriate height to prevent passage.

Pacific Connector would coordinate with landowners during construction and restoration to finalize site-specific OHV control measures. In addition, following construction, the effectiveness of the site-specific measures would be assessed on a periodic basis, generally in conjunction with revegetation monitoring and in response to identified problems. Pacific Connector would be responsible for monitoring and managing unauthorized OHV use during the full life of the pipeline project and would implement additional measures as necessary.

Federal Parks, Recreation Areas, and Other National Designations

As discussed throughout this EIS, portions of the Pacific Connector pipeline route would cross through parts of three National Forests (Umpqua, Rogue River-Siskiyou, and Fremont-Winema) and four BLM Districts (Coos Bay, Roseburg, Medford, and Lakeview). The proposed route for the Pacific Connector pipeline would not cross any national parks, national monuments, national landmarks, wilderness areas, wildlife preserves, wild and scenic river segments, or reservoirs. The route would, however, cross several federally designated scenic byways, rivers on the national inventory, and national trails, as discussed below. The route would also cross two ERMAs, also discussed below.

<u>National Parks and Monuments</u>

The closest national park to the Pacific Connector pipeline is Crater Lake National Park, located approximately 26 miles northeast of MP 132. The Cascade-Siskiyou National Monument is the closest monument to the pipeline at approximately 10 miles southwest of MP 175. Because of their distance from the pipeline route, no national parks or monuments would be directly affected by the Pacific Connector Pipeline Project. However, indirect effects may include air quality effects on Class I areas (see section 4.12.1), and construction traffic on roads leading to the parks and monuments.

<u>National Scenic Byways</u>

Three National Scenic Byways would be crossed by the Pacific Connector pipeline: the Pacific Coast Scenic Byway (U.S. Highway 101); the Rogue-Umpqua Scenic Byway (State Highway 62); and the Volcanic Legacy Scenic Byway (U.S. Highway 97). Generally, installation of a pipeline across a road may have direct effects through a temporary halt to traffic, and removal of vegetation which may affect visual quality. However, in the case of these three National Scenic Byways, as discussed below, the highways would remain open during pipeline construction and no vegetation would be removed in the vicinity of the crossings.

Following Highway 101 south from Astoria to Brookings, many locations along the Pacific Coast Scenic Byway offer views of the Oregon coast. The pipeline would be installed by conventional construction methods underneath U.S. Highway 101 (at Conde B. McCullough Memorial Bridge) between approximately MPs 1.22 and 1.23 because the highway is elevated at this location. Pipeline construction activities would be staged within existing construction storage yards on both the west and east sides of the highway and would be visible on either side from the highway. There would be no surface disturbance to the highway. Construction access to the staging areas would be via surface streets at Pittum Loop and Chappell Parkway. Temporary short-term traffic interruptions may occur at the intersection of Highway 1 and Ferry Road (approximately 0.23 mile south of construction), when supplies, crews, and heavy equipment traffic are required. Potential effects would be temporary, and once completed, the pipeline would be undetectable to those traveling on U.S. Highway 101, but the right-of-way may be visible in the existing construction storage yard and an old lumber storage yard to the west of Highway 101. Given the current land use of these areas, the right-of-way feature would not be expected to be especially noticeable to those travelling the Pacific Coast Scenic Byway.

Following State Routes 138, 62, and 234, the Rogue-Umpqua Scenic Byway forms a semi-circle route through the Umpqua and Rogue National Forests between the cities of Roseburg and Gold Hill. The pipeline would cross the Rogue-Umpqua Scenic Byway approximately 0.2 mile south of the town of Trail (MP 122.6) on State Highway 62. An HDD would be used to cross under State Highway 62 and the adjacent Rogue River, from MP 122.24 to 122.67; therefore, the pipeline is not expected to affect the Rogue-Umpqua Scenic Byway. A temporary extra work area would be located immediately adjacent to the Scenic Byway, in between the highway and the Rogue River. Temporary short-term traffic interruptions may occur at the intersection of State Highway 62 when supplies, crews, and heavy equipment traffic would be required to service the HDD operations. Pacific Connector would implement traffic control measures while the HDD activities are occurring to ensure safety for the public and construction personnel. The pipeline would not be visible to travelers along the Rogue-Umpqua Scenic Byway following the completion of construction.

The Volcanic Legacy Scenic Byway provides a touring route of south-central Oregon and northeastern California. The Oregon portion of the Volcanic Legacy Scenic Byway begins on U.S. Highway 97, north of Crater Lake, circles Crater Lake, and then continues south on State Routes 62 and 140 through Klamath Falls and into California. The Pacific Connector pipeline would cross the Volcanic Legacy Scenic Byway just south of Klamath Falls (MP 199.6) near where it crosses the Klamath River. Pacific Connector proposes to use an HDD to cross under Highway 97 and the Klamath River between MPs 199 and 200. Effects would be temporary, as travelers on Highway 97 may be able to briefly glimpse pipeline construction activities off in the distance. The HDD under Highway 97 and the Klamath River would be completed within a two-month period. The Pacific Connector Pipeline Project would have no direct effects on the Volcanic Legacy Scenic Byway, and the highway would be kept open to traffic during construction. Following installation, the pipeline would not be visible to travelers using the Volcanic Legacy Scenic Byway and is, therefore, not expected to affect the scenic qualities of this byway.

National Wild and Scenic Rivers and Nationwide Rivers Inventory

Wild and Scenic Rivers

The Rogue River, which the pipeline would cross near the community of Trail, is a designated Wild and Scenic River[159] from the Crater Lake National Park boundary downstream to Prospect, approximately 20 miles north of the pipeline crossing. In addition, an 84-mile section of the Rogue River is designated as Wild and Scenic starting about 7 miles west of the city of Grants Pass and proceeding west toward the town of Gold Beach (NPS 2005). Neither of the designated Wild and Scenic River segments would be crossed or otherwise affected by the pipeline.

Indirect effects could occur if the pipeline crossing were to cause sedimentation that could run downstream and affect water quality of the federally designated Wild and Scenic River portion of the Rogue River. However, the pipeline would cross the Rogue River using an HDD, which would avoid direct effects on this river. Also, while this segment of the Rogue River was found eligible for Wild and Scenic designation by the BLM Medford District (BLM 1995f), its river-related values are only protected on BLM-managed lands (approximately one mile from the pipeline crossing). The pipeline would not cross any protected segments of the Rogue River on BLM-managed lands. The values for which the river was found eligible are not expected to be affected by the pipeline construction and operation.

National Wildlife Refuges, Natural Landmarks, and Wilderness Areas

Sky Lakes Wilderness and Mountain Lakes Wilderness

There are several federally designated Wilderness Areas in the Umpqua, Rogue River, and Fremont-Winema National Forests, but none of them would be crossed by the Pacific Connector pipeline. The pipeline does, however, pass in the general vicinity of two Wilderness Areas: the Sky Lakes Wilderness (113,590 acres), which is located in both the Fremont-Winema and Rogue River National Forests; and the Mountain Lakes Wilderness (23,071 acres), in the Fremont-Winema National Forest. The pipeline would pass approximately 3.7 miles south of the Sky Lakes Wilderness and 1.3 miles south of the Mountain Lakes Wilderness. These wildernesses would not be affected by pipeline construction or operation because of these distances and the intervening forested landscapes.

Round Top Butte National Natural Landmark

Between MPs 134.7 and 137.1 the Pacific Connector pipeline route would pass in close proximity to the east side of the Round Top Butte National Natural Landmark (NNL), which was designated an NNL on June 15, 2011. Geologically, the NNL includes a basaltic butte and volcanic plains. Biologically, the NNL encompasses a unique mixture of grasslands, ponderosa pine, white oak, and buck brush vegetation. The NNL is administered as two parcels: 747 acres managed by the BLM as a Research Natural Area (RNA), and a private preserve managed by The Nature Conservancy.

At its closest point, the pipeline would be about 0.25 mile away from the BLM boundary to the NNL. Where the pipeline would be closest to the NNL boundary, near MP 135.6, it would be located on private land through previously harvested and thinned forest. The pipeline route does

[159] Wild and scenic rivers are designated for preservation under the Wild and Scenic Rivers Act of 1968 (Public Law 90-542), which was enacted by the U.S. Congress to preserve certain rivers with outstanding natural, cultural, and/or recreational values in a free-flowing condition for the enjoyment of present and future generations.

not cross the NNL and would have no direct effects on it. Pacific Connector would minimize the spread of weeds by following its ECRP and its *Integrated Pest Management Plan*.

Klamath Basin National Wildlife Refuges

The Klamath Basin hosts a complex of six NWRs in the Klamath Falls region of Southern Oregon and Northern California. These refuges, managed by the FWS, consist of a variety of habitats including freshwater marshes, lakes, meadows, coniferous forests, sagebrush and juniper grasslands, agricultural lands, and rocky cliffs and slopes. These habitats support diverse and abundant populations of resident and migratory wildlife, with 433 species having been observed on or near the refuges. Each year the refuges serve as a migratory stopover for about 75 percent of the Pacific Flyway waterfowl, with peak fall concentrations of more than 1 million birds. The Pacific Flyway is one of four major migratory routes (Pacific, Central, Mississippi, and Atlantic flyways) used by migratory birds in North America.

The pipeline would pass approximately 3.5 miles north of the Bear Valley NWR, and approximately 3.7 miles north of the Lower Klamath NWR. Between MPs 196 and 199, the pipeline wraps around on the north side of the Klamath River. On the south side of the river, the FWS owns two small 80-acre "out parcels," which are surrounded by State of Oregon lands managed by the ODFW. The two parcels are approximately 0.8 mile to 1.2 miles south of the pipeline. Some USGS topographic maps show old Lower Klamath Refuge boundaries on lands that were withdrawn from consideration in the 1920s (Coles 2006). Pacific Connector confirmed with the FWS in June 2006 that the pipeline would not affect any lands within the Klamath Basin Refuge boundaries.

Construction and operation of the Pacific Connector Pipeline Project should have no direct effects on the Wilderness Areas, Natural Landmarks, and NWRs discussed above because the pipeline would not cross any of these areas.

<u>Inventoried Roadless Areas</u>

The pipeline route and related facilities would not be located in any Inventoried Roadless Areas (IRAs). The nearest IRA is the Brown Mountain IRA, located on the Rogue River National Forest approximately 0.6 mile north of the pipeline route at MP 162.0. On the Fremont-Winema National Forest, the West Boundary IRA is about 2.2 miles northeast of MP 172.25. Construction and operation of the Pacific Connector Pipeline Project would have no direct effects on these IRAs.

<u>National Recreational Areas and Trails</u>

BLM Coos Bay/North Spit RMAs and Forest Service ODNRA

The Pacific Connector pipeline would have no direct effects on the Coos Bay/North Spit RMAs or the ODNRA because it does not cross those areas. From MP 0.00, the pipeline would be installed using an HDD underneath Coos Bay to the southeast, away from the RMAs and ODNRA. During the HDD process, supplies, equipment and crews would need to access the LNG terminal area and the north end of the HDD area. There would be increased traffic volumes on the Trans-Pacific Parkway, which provides access to the North Spit. Travelers may experience increased traffic congestion and short delays, but these effects would be temporary and short term, and access or use of the RMA or ODNRA areas would not be precluded. The *Transportation Management*

Plan prepared by Pacific Connector[160] addresses the potential indirect effects that construction-related traffic may have on recreational users who drive on Highway 101, the Trans-Pacific Parkway, and Horsfall Beach Road to reach the RMAs and ODNRA. This is further discussed in section 4.10.

Recreational users of the Coos Bay/North Spit RMAs and the ODNRA may also be exposed to noise from pipeline construction, as well as from construction of Pacific Connector's Jordan Cove Meter Station. Potential noise effects would be temporary and short-term, and mitigated in part by distance, topography, vegetation, and ambient noise levels from other sources, including non-project related traffic on the Trans-Pacific Parkway, OHVs, and other industries on the North Spit. Noise is more fully discussed in section 4.12.2.

Pacific Crest National Scenic Trail

The Pacific Crest Trail (PCT) is a 2,650-mile-long hiking and equestrian trail stretching from the Canadian border in Washington to the Mexican border in California. With the passage of the National Trails System Act of 1968, as amended, Congress designated the PCT as one of the first scenic trails in the nation (Forest Service 1982). Thousands of hikers, horse riders, cross-country skiers, and snowshoers use the trail each year. Approximately 430 miles of the PCT runs through the Cascade Mountain Range in Oregon. The pipeline route crosses the PCT at approximately MP 167.8.

Trail users can access the trail in several locations near the pipeline route area, including a registered trailhead on the Dead Indian Memorial Highway (County Road 533). This trailhead is about 1.3 miles west of where the pipeline would cross Dead Indian Memorial Highway. The trail can also be accessed using Forest Road 700 or using the Brown Mountain trail accessed by Forest Road 3705.

Installation of the pipeline would affect PCT users for a short duration of time. Pacific Connector proposes to construct the portion of the pipeline across the trail as a "tie-in" to reduce the period when trail users are inconvenienced. Pacific Connector has indicated that it expects that construction of the trail tie-in would be completed within 48 hours or less to minimize effects and the need for trail detours. Pacific Connector has also identified site-specific mitigation measures to reduce potential effects on the PCT in its *Recreation Management Plan.* These measures include the following:

- Provide advance notice of construction to the Forest Service and PCT Association;
- Notify the Forest Service District Ranger 48 hours in advance if any anticipated delays for PCT users would exceed 1 hour;
- Provide at least 7 days advance notice if the PCT needs to be detoured;
- Obtain Forest Service approval and install detailed detour route signs (if needed);
- Plan, if practicable, for PCT disruption outside of the trail's busiest hiking season (mid-July to early August);
- Establish a roughed-in trailhead within 24 hours of crossing completion, with temporary directional signs posted at each end of the crossing;
- Restore the trail to full design standards within 2 weeks of completing the trail crossing (weather permitting);

[160] Appendix Y to Pacific Connector's POD filed with the FERC in January 2018.

- Install standard Nordic ski trail markers as needed post-construction;
- Revegetate the right-of-way using native trees, shrubs, and plants;
- Use a combination of rocks, logs, slash, and gates to deter motorized vehicles and OHVs from gaining access to the PCT, in such a manner as not to adversely affect the area's visual resource qualities, to the extent practicable.

Pacific Connector intends to use a "dog-leg" segment to avoid a perpendicular crossing of the trail and thereby reduce the visibility of the pipeline corridor to trail users (see section 4.8.2.3 for an assessment of visual resources on federal lands). To further reduce potential effects on the PCT and its users, Pacific Connector has "necked down" the construction right-of-way width from the standard 95 feet to 75 feet for approximately 300 feet on either side of the trail.

South Brown Mountain Shelter

The South Brown Mountain Shelter is a small, fully enclosed log cabin about 200 yards off the PCT in Section 32, T.37S, R.5E. The shelter, located in the Rogue River-Siskiyou National Forest near its boundary with the Fremont-Winema National Forest, is used year-round by hikers, cross-country skiers, snowmobilers, and others. The cabin contains a wood stove, primitive storage facilities, and counter spaces. Potable well water is available using a hand pump that is operational from mid-May to late October.

The South Brown Mountain Shelter is approximately 600 feet north of the pipeline route near MP 167.7; and would not be directly affected by construction or operation of the pipeline. Temporary noise from pipeline construction may be audible at the shelter, but visitors would not be able to see the pipeline or related construction activities because of the existing vegetation screening that is located between the shelter and the right-of-way. Distance, topography, and vegetation would reduce pipeline construction noise at the shelter. The effects from pipeline construction noise would be temporary and should not adversely affect users of the shelter.

Brown Mountain Trail

The Brown Mountain Trail is a path for non-motorized users on the Fremont-Winema and Rogue River-Siskiyou National Forests. The trail is linked by two short sections of forest roads and circles Brown Mountain. One access point is near the pipeline at a trailhead on Forest Road 3705, near South Fork Little Butte Creek about a mile north of MP 165.0. In addition to summer recreational activities, cross-country skiing and snowmobiling are popular winter sports along the Brown Mountain multi-use trail system between about MPs 160 and 170. The Brown Mountain Trail and access on Forest Road 3705 are not expected to be affected by pipeline construction or operation.

Other Extensive Recreation Management Areas

Blue Ridge Trail System ERMA.

The Blue Ridge Trail System ERMA is located within the Coos Bay District. Designated for hiking, biking, equestrian, and motorcycle trails, this 1,405-acre ERMA currently supports approximately 12 miles of trails, which connect with a larger network of logging roads that can also be utilized. Timber harvest and management operations occur in this area, with road closures occurring intermittently for logging operations. The pipeline would cross this ERMA from MP 19.92 to MP 22.11 (approximately 2.19 miles) and cross three of the Blue Ridge trails. In addition, Pacific Connector would utilize several existing roads in this ERMA for construction access.

Similar to when logging activities occur in the area, these trail segments would need to be closed during pipeline construction. Construction would also result in increased traffic volumes on existing roads and other users may experience traffic congestion and delays, with access to some trails temporarily affected. Potential construction traffic-related impacts on recreational users are discussed in Pacific Connector's *Transportation Management Plan*. Recreational users may also be exposed to noise during pipeline construction. Potential noise effects would be temporary and short-term, and partially mitigated in some locations by distance, topography, vegetation, and ambient noise levels from other sources, including OHVs. Noise is more fully discussed in section 4.12.2. After construction is complete, Pacific Connector would restore trail segments affected during construction.

In addition, Pacific Connector is proposing to use an existing communications tower located on the top of Blue Ridge, within the ERMA. Pacific Connector would use the tower during operations and Pacific Connector staff and contractors may need to access this existing location intermittently to maintain communications equipment. Impacts to other users are expected to be limited.

Buck Berry Rock ERMA

The Buck Berry Rock ERMA is located within the Medford District. Designated for non-motorized trail systems in a remote setting, this ERMA encompasses 6,504 acres, located north of the community of Trail. This ERMA is approximately 0.5 mile from the pipeline at its closest point, near MP 121 and separated from the proposed route by private lands and SH 227. Construction is not anticipated to have any impacts on this ERMA.

Green Top Mountain ERMA

The Green Top Mountain ERMA consists of 5,316 acres located within the Medford District. Designated for non-motorized trail systems, this ERMA is not located in proximity to any larger communities. This ERMA is approximately 0.3 mile from the Pipeline at its closest point, near MP 138.5. Construction is not anticipated to have any impacts on this ERMA.

Surveyor Mountain ERMA

The Surveyor Mountain ERMA consists of 17,376 acres located within the Lakeview District. This ERMA is a short distance from Klamath Falls and frequented by big game hunters, OHV users, and snowmobilers. From MPs 172 to 178, the pipeline is within one mile of the ERMA, and between MPs 176.1 and 177, the pipeline crosses the ERMA. In this area, the proposed pipeline right-of-way is co-located immediately adjacent to Clover Creek Road (County Road 603), and no new impacts are expected.

Stukel Mountain ERMA

The Stukel Mountain ERMA consists of 9,622 acres located within the Lakeview District. Located close to Klamath Falls, this ERMA attracts OHV users, hikers, and mountain bikers. The Pipeline is approximately 0.4 mile from the ERMA, near MP 212.5, and separated from the ERMA by private lands. Pipeline construction is not expected to have any impacts on this ERMA. Pacific Connector's proposed Stukel Mountain Communication Site is located at an existing communication tower complex on BLM-managed lands within the ERMA. Construction activities at or adjacent to the existing complex would be temporary and short-term lasting a few months with a small crew requiring limited equipment. Communication-related construction and operation activities would be similar to existing activities and operations at the complex with limited impacts on recreation users.

Bryant Mountain ERMA

The Bryant Mountain ERMA consists of 9,093 acres located within the Lakeview District. The Bryant Mountain ERMA has potential for an OHV trail system. The site is close to Klamath Falls and is mostly a contiguous block of BLM land. The Pipeline is approximately 0.4 mile from the ERMA, near MP 228, and separated from the ERMA by private lands. Construction is not anticipated to have any impacts on this ERMA.

Federal Recreational Lakes and Reservoirs

Fish Lake

Fish Lake is located on the Rogue River National Forest near the crest of the Cascades about 2.5 miles away from the pipeline route at about MP 161. The Fish Lake Recreation Area includes Forest Service campgrounds, picnic areas, and a boat ramp, as well as a privately-operated resort with cabins, a trailer park, additional camp sites, food service, and a marina. During the summer the lake supports water related activities, including fishing and boating. During the winter, ice-fishing, cross-country skiing, and snowmobiling are popular in the area. Pacific Connector has identified Fish Lake as a potential source for water that would be used for hydrostatic testing of the pipeline. Water would be potentially withdrawn from two places: one location at the lower end of the lake near the dam; and the other at the upper end of the lake in the vicinity of the Fish Lake Campground and boat ramp. No roads or recreational facilities would be closed because of the hydrostatic test water withdrawals from the lake; however, water trucks would use Forest Service Roads 2800700, 2800706, and 2800800. Use of these roads is addressed in Pacific Connector's *Transportation Management Plan*. Pacific Connector has indicated that after it has selected a construction contractor for the pipeline, it would submit a water withdrawal plan to the Forest Service that would outline measures to minimize effects on recreational users and encumbrances at the lake.

John C. Boyle Reservoir

The John C. Boyle Reservoir is operated by PacifiCorp as part of a FERC-licensed hydropower project. Boat launches and the Topsy Recreation site, operated by the BLM, provide camping, picnicking, fishing, boating and swimming for visitors to this section of the Klamath River approximately 8 miles south of MP 184.31. Recreation and access to the reservoir and recreation site would not be directly affected by construction activities, although construction could cause some temporary delays on Keno Access Road (also known as State Highway 66). Pacific Connector has identified the reservoir as a potential source of water for hydrostatic testing. Use of the reservoir for this purpose would not be expected to significantly or noticeably draw down the reservoir or affect recreational activities. The John C. Boyle Dam is one of four dams on the Klamath River that is planned to be removed as part of the Klamath Economic Restoration Act.

ACECs

North Spit ACEC

The North Spit ACEC is located about 3.5 miles southwest of the Jordan Cove Meter Station, where the pipeline would terminate. The North Spit ACEC would not be directly affected by construction or operation of the Pacific Connector Pipeline Project. Indirect effects could occur as a result of the increased traffic on the Trans-Pacific Parkway that would occur during construction. These potential increases have the potential to cause traffic congestion and short delays but are not expected to preclude access to or use of the ACEC.

Upper Rock Creek ACEC

The BLM's Coos Bay District designated 364 acres in Section 5, T.29S., R.9W., Douglas County, Oregon as the Upper Rock Creek ACEC. The purpose of this ACEC is to maintain, protect, and restore the area's natural systems and botanical values, which include western red cedar and western hemlock, and skunk cabbage, as well as sedge-dominated wetlands. The area also supports the Oregon Natural Heritage Program Coast Range Ecological Cell 108 and provides habitat for marbled murrelet and northern spotted owl. At its closest point, the construction right-of-way is approximately 115 feet south of this ACEC at MP 43.2 and would not directly conflict with the management of the ACEC. Pacific Connector proposes to use North Rock Creek Road, a paved public road located approximately 50 feet from the ACEC, for construction access in this area. Potential effects on wildlife are assessed in section 4.5.1.

4.8.1.3 Environmental Consequences on Federal Lands

Forest Service Potential Wilderness Evaluation

Wilderness Areas, Inventoried Roadless Areas (IRA), and Potential Wilderness Areas (PWA) are discussed together here because they share a set of terminology and interrelated history. A wide range of terms and references have been used by respondents, the courts, and the Forest Service when referring to these topics such as roadless, unroaded, uninventoried roadless, undeveloped areas, and roadless expanse. The terms and definitions as stated below are used in this site-specific analysis. They are based on current law, regulation, agency policy, and the LRMPs, as amended, for the Umpqua, Rogue River, and Winema National Forests.

<u>Wilderness</u>

A Wilderness Area is designated by congressional action under the Wilderness Act of 1964 and other wilderness acts. The Wilderness Act of 1964, Section 2(c) defines wilderness, in part, as:

> *[A]n area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements of human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; …*

Two Wilderness Areas are in proximity to the pipeline alignment: Sky Lakes Wilderness (113,590 acres) is in both the Winema and Rogue River National Forests and its southern tip is approximately 3.7 miles north of the pipeline alignment at MP 162, and Mountain Lakes Wilderness (23,071 acres), in the Winema National Forest, is approximately 1.3 miles north of MP 172.

No Project activities would occur within or adjacent to a wilderness area. There would be no effects on designated wilderness or wilderness characteristics because the closest wilderness (Mountain Lakes) is over a mile away. Because of this distance, project activities would typically not be seen or heard by anyone recreating in the wilderness. The exceptions could be short duration views of smoke during burning activities. Smoke management mitigation measures would minimize the risk of smoke drifting into the wilderness.

Inventoried Roadless Areas

IRAs were identified in the 2001 Roadless Area Conservation Rule in a set of inventoried roadless area maps, contained in Forest Service Roadless Area Conservation Final Environmental Impact Statement, volume 2, dated November 2000, which are held at the National headquarters office of the Forest Service, or any subsequent update or revision of those maps (36 CFR 294.11). These areas were set aside through administrative rulemaking and have provisions, within the context of multiple use management, for the protection of inventoried roadless areas.

The nearest IRA is the Brown Mountain IRA, located on the Rogue River National Forest approximately 0.6 mile north of MP 162. On the Winema National Forest, the West Boundary IRA is about 2.2 miles northeast of MP 172. No activities associated with the Pacific Connector Pipeline Project would occur within or adjacent to an IRA; therefore, there would be no project-related effects on IRAs.

Potential Wilderness Areas

This is not an official inventory. Official inventories of potential wilderness areas are completed during forest planning. This analysis considers PWAs only for purposes of assessing potential effects of the Pacific Connector pipeline activities on wilderness characteristics. PWAs are not a land designation decision (e.g., does not change current land management allocations), they do not imply or impart any particular level of management direction or protection, they are not an evaluation of potential wilderness (Forest Service Handbook [FSH] 1909.12, Chapter 72), and they are not preliminary administrative recommendations for wilderness designation (FSH 1909.12, Chapter 73). The inventory of PWAs does not change the administrative boundary of any IRA or any congressionally designated wilderness. The original designated management area (*e.g.*, Matrix) would remain the land designation even if areas in the project planning area meet the handbook criteria for PWAs. PWAs are evaluated (regarding making recommendations to Congress for inclusion in the National Wilderness Preservation System) during the development or revision of land management plans, in other words at the forest planning level and not at the project planning level.

PWAs qualify for placement on the inventory if they meet the following criteria (FSH 1909.12, Chapter 71):

1. The area contains 5,000 acres or more.
2. Areas contain less than 5,000 acres, but can meet one or more of the following criteria:
    a. Area can be preserved due to physical terrain and natural conditions.
    b. Areas are self-contained ecosystems, such as an island, that can be effectively managed as a separate unit of the National Wilderness Preservation System.
    c. Areas are contiguous to existing wilderness, primitive areas, Administration endorsed wilderness, or potential wilderness in other Federal ownership, regardless of their size.
3. Areas do not contain forest roads (36 CFR 212.1) or other permanently authorized roads, except as permitted in areas east of the 100th meridian.

Areas may meet either criteria 1 and 3, or criteria 2 and 3. If the criteria in section 71.1 of the FSH are met, criteria in section 71.11 of the FSH (criteria for including improvements) must also be met. This analysis used the following project-specific criteria to delineate areas characterized as undeveloped and roadless, yet included improvements:

- Roads (as defined in 36 CFR 212.1) were excluded per FSH 1909.12, section 71.1. Mapped areas were at least 300 feet from NFS roads. This distance was selected because tree harvest is commonly permitted within 300 feet of open forest roads for personal-use firewood. In addition, danger tree removal occurs at various distances from open forest roads depending on tree height, topographic slope, and other factors.

- Timber harvest areas where logging, as evidenced by stumps, and prior skid trails or roads are substantially unrecognizable, or areas where clearcuts have regenerated to the degree that canopy closure is similar to surrounding uncut areas per FSH 1909.12, section 71.11.

No undeveloped areas greater than 5,000 acres would be crossed by the Pacific Connector pipeline route. All of the undeveloped areas crossed by the pipeline are less than 5,000 acres in size, are not contiguous to existing Wilderness or IRAs, and do not meet the PWA criteria for areas less than 5,000 acres. As a result, the Project would not affect any PWAs.

<u>Other Undeveloped Areas</u>

Other undeveloped areas refer to those areas that do not meet inventory criteria as PWAs, and are not an IRA or designated Wilderness area. There are no forest-wide or management area standards and guidelines specific to other undeveloped areas in the Umpqua, Rogue River, and Winema National Forest LRMPs. All lands, including undeveloped areas, are managed consistent with forest-wide standards and guidelines and by designated LRMP management area allocations. Other undeveloped areas are identified because they may contain special resource values that warrant an evaluation differently than other parts of the project area.

There are approximately 3,747 acres of other undeveloped lands not meeting PWA criteria that would be crossed by the pipeline on NFS lands. Approximately 1,792 acres of these areas are within the Umpqua National Forest[161], and approximately 1,955 acres are within the Rogue River National Forest (see appendix F8 for maps and additional information). The portion of the pipeline route within the Winema National Forest is on or adjacent to existing roads and would not impact "other undeveloped areas." Other undeveloped areas may have intrinsic ecological and social values because they do not contain roads (or the roads are no longer system roads) or evidence of past timber harvest. These values can include intrinsic physical and biological resources (e.g., soil, water, wildlife, recreation, fisheries, etc.), and intrinsic social values (e.g., apparent naturalness, solitude, remoteness).

Human influences have had limited impact to long-term ecological processes within these other undeveloped areas. Disturbances by insects and fire have likely been the factors with the most potential to have affected the area. Opportunities for primitive recreation include camping, hiking, hunting, wildlife watching, and photography. Opportunities for a feeling of solitude, the spirit of adventure and awareness, serenity, and self-reliance are limited by the size and shape of the areas,

[161] This area burned in the 2015 Stouts Creek Fire and as a result there are additional alterations in this area from fire suppression efforts. In addition to the changed vegetation conditions the surrounding landscape has also changed as a result of salvage logging on industrial forest lands immediately to the west of this area.

as well as by distance to roads and topographic screening. The size of the area necessary to feel a sense of solitude varies by individual; however, areas that are long and narrow offer less opportunity for solitude due to less distance from noise at their midpoint. Nearby sounds of roads, timber harvest, and other management activities can often be heard and the activities sometimes seen from within these undeveloped areas because they are all within approximately 1 mile or less of the nearest road from their midpoints.

The Pacific Connector Pipeline Project would directly impact approximately 8 acres of other undeveloped areas on the Umpqua National Forest and approximately 22 acres on the Rogue River National Forest. These impacts include the areas cleared by the right-of-way construction, the TEWAs, and the acres used as UCSAs.

For these other undeveloped areas within the pipeline project area where construction and operation would occur the impacts to soil; water quality; air quality; forage; plant and animal communities; habitat for threatened, endangered, and sensitive species; developed recreation; noxious weeds; and cultural resources are essentially the same as disclosed above for recreation and in other sections of chapter 4 of this EIS and are not reiterated here.

The Pacific Connector Pipeline Project would impact the apparent naturalness and solitude within these areas. Pipeline construction would alter the apparent naturalness on approximately 30 acres of these areas. The increase in the number of visible stumps, and the linear nature of the pipeline corridor clearing would be the most apparent visual change resulting from implementation. The linear nature of the cleared corridor would likely adversely affect the visual recreational experience of anyone using these areas for dispersed recreation. This impact would be long term due to a portion of the right-of-way being maintained as a low vegetation area for the life of the pipeline project. Although the pipeline construction and operation would adversely affect visual resources in these areas, they would not be inconsistent with the standards and guidelines for visual quality in the respective LRMPs.

Activities associated with the construction of the pipeline in and adjacent to these other undeveloped areas would reduce the sense of solitude and remoteness during construction activities. Other sights and sounds of ongoing and previously approved activities in areas adjacent to these other undeveloped areas would continue to have short-term effects on opportunities for solitude and remoteness. Overall, there would be little change to the current availability of solitude or primitive recreation within these areas because only a very small portion (approximately 0.8 percent) would be affected by the Pacific Connector Pipeline Project.

BLM Lands with Wilderness Character

In the fall of 2012, the BLM updated its inventory of lands with wilderness character. These updates were part of the Analysis of the Management Situation process associated with the new RMPs for western Oregon that were approved in August of 2016. The inventory covered BLM lands in the Salem, Eugene, Roseburg, Coos Bay, and Medford Districts, as well as the Klamath Falls Resource Area of the Lakeview District. The results of this most recent inventory were compared to the proposed route, and no areas of overlap were discovered. The proposed pipeline would not impact BLM land with wilderness character.

4.8.1.4 Conclusions

Constructing and operating the Jordan Cove LNG Project would not have direct adverse effects on nearby recreational areas, including the ODNRA and BLM RMAs, but may have indirect effects. As described in the preceding sections, temporary indirect impacts during construction would include construction-related noise and short-term delays to recreationists using the Trans-Pacific Parkway to access recreation sites, including the ODNRA. Indirect impacts during operation include short-term delays for recreational boaters required to avoid LNG carriers in transit within the waterway. Constructing and operating the Pacific Connector Pipeline Project would result in impacts on recreation resources as described in the preceding sections. Based on the proposed construction, mitigation, and operation procedures the Project would not significantly affect recreation resources or areas.

4.8.2 Visual Resources

Procedures for describing the existing visual condition of the landscape and assessing the visual effects of the Project are similar to and generally consistent with methodologies developed by the BLM (1986), Forest Service (1973, 1995b), the FHWA (2015), and the COE (Smardon et al. 1988). This section documents the visual assessment conducted for the Jordan Cove LNG Project and the Pacific Connector pipeline, based primarily on the potential visibility of the Project facilities and their expected visual effects on the landscape.

4.8.2.1 Jordan Cove LNG Project

The Jordan Cove LNG Project would be located almost entirely on privately owned, mostly open, industrial-zoned land on the bay side of the North Spit of Coos Bay. Ingram Yard is generally bordered to the north by the Coos Bay Rail Link and the Trans-Pacific Parkway; to the west are open lands of Henderson Marsh, which is owned by the Port; to the east is the existing industrial Roseburg Forest Products wood chip facility; and to the south are the open waters of the Coos Bay estuary. About 3,000 feet northwest of the LNG terminal is the beach and Pacific Ocean. Topography on the westernmost portion of Ingram Yard is relatively flat where fill material has been covered by brush and grasses. Forested sand dune ridges reaching elevations that exceed 100 feet AMSL cover the eastern portion of Ingram Yard.

North of the access and utility corridor is the Coos Bay Rail Link and the Trans-Pacific Parkway, beyond which are federal lands managed by the BLM and Forest Service. Those federal lands contain forested sand dunes. South of the corridor is the existing industrial Roseburg Forest Products facility.

The South Dunes area is relatively flat open lands that were formerly the location of the Menasha-Weyerhaeuser mill complex and a fish hatchery. Most of the buildings of those facilities have been removed, and what remains is a mixture of roads, railroad tracks, parking lots, grasslands, dunes, and wetlands. The South Dunes area is surrounded on the south and east by the open waters of the Coos Bay estuary, including geographic Jordan Cove on the south and Hayes Inlet on the east. To the west is the Roseburg Forest Products facility. To the north is the ODNRA.

The Roseburg Forest Products facility is mostly paved, with roads and railroad tracks, and includes a dock for mooring ships, a 190-foot-tall loading tower, wood chip piles, two large buildings, two water towers, and several small outbuildings.

Beyond 0.5 mile from the Jordan Cove LNG Project, the existing landscape on the North Spit is characterized by a mix of industrial land uses and open space. Industrial facilities on the north side of Coos Bay on the North Spit include the Southport Forest Products lumber mill, approximately 1 mile southwest of the Jordan Cove LNG Project. The International Marine Contractors and the D.B. Western manufacturing plant facilities are also located on the North Spit approximately 2 miles southwest of the Jordan Cove LNG Project (specifically the terminal site). Undeveloped land separates the Project from these facilities. Most of the rest of the North Spit southwest from the Project consists of the open lands and dunes of the BLM RMAs.

Southward, across Coos Bay from the Jordan Cove LNG Project, are the cities of North Bend and Coos Bay. The smaller community of Glasgow is located on the east side of Haynes Inlet and north side of the Coos Bay estuary, about 4,000 feet northeast of South Dunes. The Kentuck project site proposed for wetland mitigation (see section 4.4) is located approximately 1.5 miles southeast of Glasgow and inland from Kentuck Inlet on Upper Coos Bay. The closest residential developments to the terminal site are approximately 1 mile south, on the opposite side of the bay. The Southwest Oregon Regional Airport is directly across Coos Bay, about 1 mile south of the terminal site.

Once constructed, the largest aboveground structures within the Jordan Cove terminal would be the two LNG storage tanks, which would each be approximately 267 feet wide and 180 feet tall. Dredge materials from the Navigation Reliability Improvement Project would be deposited at the APCO site located on the south side of the Bay, between the Coos Bay Railroad Bridge and the Oregon Coast Highway (also known as U.S. Highway 101).

Viewpoint Selection

A visual assessment was conducted to determine the potential effects on visual resources associated with the Jordan Cove LNG Project. Representative viewing points (also referred to as key observation points [KOPs]) were identified within the terminal viewshed (i.e., the area from which facilities at the terminal would be potentially visible). Generally, visual details become apparent to the viewer when they are seen in the foreground, at a distance of one-half mile or less, but may affect viewers when they are present in the middleground (up to 4 miles from the viewer) depending on the extent of landscape modification noticeable and other visual factors. It is anticipated, however, that views of the Project would be partially or fully screened by existing vegetation, topography, or infrastructure for much of the Project viewshed, and from most areas beyond 2 miles away. Therefore, the visual assessment applies to a viewshed for the Jordan Cove LNG Project that extends to a distance of approximately 2 miles from the LNG terminal in all directions, which was defined using aerial and ground photography, local planning documents, computer modeling, and field reconnaissance. Site visits to document existing visual conditions in the terminal area and to identify potentially affected sensitive viewing locations were conducted in April 2006, May 2013, and August 2017.

Representative viewpoints for use in the assessment were selected based on potential visibility of the proposed Jordan Cove LNG Project site from various distances, the sensitivity of viewing locations, and input from land management agencies (primarily the BLM and Forest Service). The viewpoints consist of locations with concentrations of viewers, such as major roadways or housing developments; visually sensitive land uses, such as parks and recreation areas; culturally sensitive locations, such as historic sites; and places designated as having scenic importance, such as highways and overlooks. Figure 4.8-2 indicates the locations of the 11 viewpoints used for visual assessment of the Jordan Cove LNG Project, and the location of the most prominent features there. The viewpoints are identified as follows:

- Viewpoint-1 North Spit Overlook and Wetland Trailhead
- Viewpoint-2 Trans-Pacific Parkway at Jordan Cove Project Site Entrance
- Viewpoint-3 Horsfall Beach Campground and Day Use Area
- Viewpoint-4 U.S. Highway 101 and Trans Pacific Parkway Intersection
- Viewpoint-5 U.S. Highway 101 on the north side of McCullough Bridge
- Viewpoint-6 U.S. Highway 101 at the southern end of McCullough Bridge
- Viewpoint-7 North Bend, intersection of Meade Avenue and Florida Avenue
- Viewpoint-8 North Bend, intersection of Meade Avenue and Vermont Avenue
- Viewpoint-9 North Bend, Open Space near Washington Avenue
- Viewpoint-10 North Bend, Bike Trail south of the Airport
- Viewpoint-11 BLM North Spit Boat Launch Area

Figure 4.8-2

Key Observation Point Locations for the Jordan Cove LNG Project

Visual Simulations

Computer-generated visual simulations were prepared for 9 of the 11 viewpoints. Visual simulations were not prepared for Viewpoint 4 and Viewpoint 7 because the LNG terminal would be, at most, minimally visible from those locations. Figures K-1 through K-11 in appendix K show the existing conditions (or "before" view) for each viewpoint, and a visual simulation (or "after" view) illustrating the expected appearance of built portions of the Project. The visual impact assessment was based on evaluation of the landscape changes that would result from completed construction and during the operation phase of the proposed facilities.

The visual simulations are the result of an objective analytical and computer modeling process and are accurate within the constraints of available site data, such as site topography, the proposed LNG terminal design, and photography obtained in the field. Existing GIS, a digital elevation model, engineering data, and digital aerial photographs provided the basis for developing three-dimensional digital models of the LNG storage tanks using a real-world coordinate system.

Viewpoint Analyses

The visual assessment for the Jordan Cove LNG Project is based on evaluation of the expected visual effects at the individual representative viewpoints. Because the LNG storage tanks would be the most visible feature of the LNG export terminal, the evaluation for each viewpoint focused on the visibility of the storage tanks.

Viewpoint-1 North Spit Overlook and Wetland Trailhead**—**Viewpoint-1 represents views to the southeast experienced by recreational visitors from the North Spit Overlook and Wetland Trailhead, which are located on private land on the northwest side of the Trans-Pacific Highway approximately 0.4 mile west of the LNG terminal site boundary. As shown in the simulation in figure K-1 in appendix K, there would be an unobstructed view of the LNG terminal from this location. Once the forested sand dune is removed, the LNG storage tanks, ground flares, and surrounding concrete perimeter walls would dominate the view.

Viewpoint-2 Trans-Pacific Parkway at Jordan Cove Project Site Entranc**e—**Viewpoint-2 represents views to the southwest for travelers along the Trans Pacific Parkway to the north of the terminal site. The viewpoint is located approximately 0.25 mile northeast of the northern boundary of the LNG terminal site, and approximately 0.5 mile northeast of the LNG storage tanks. As shown in figure K-2 in appendix K, with the forested sand dune removed, parkway travelers at this location would have an unobstructed view of the ground flares, gas processing area and concrete perimeter walls, and a partially screened view of the LNG storage tanks. Similar conditions would occur at other locations along the Trans-Pacific Parkway where views to the south were not obscured by vegetation.

Viewpoint-3 Horsfall Beach Campground and Day Use Area**—**Viewpoint-3 represents views to the south-southeast experienced by visitors to the sand dune public overlook above the Horsfall Beach Campground/Parking/Staging Area in the ODNRA. The Oregon Coast Trail also passes through this location as it transitions from the beach to Horsfall Beach Road. The viewpoint is located approximately 1.25 mile north of the LNG terminal site boundary, and approximately 1.6 miles northwest of the LNG storage tanks. The simulation indicates that views of the proposed facilities would be partially obstructed, and that the domes of the LNG storage tanks, the ground flares, and the surrounding concrete perimeter walls would be partially visible above the existing tree line (figure K-3 in appendix K). Because of their light color, viewers would be most likely to notice the tops of the LNG storage tanks. Along the Oregon Coast Trail, the LNG terminal would likely be partially visible from 0.5 mile to the east of the intersection of Horsfall Beach Road and the Trans-Pacific Parkway.

***Viewpoint-4 U.S. Highway 101 and Trans-Pacific Parkway Intersection*—**Viewpoint-4 represents views to the west for travelers along U.S. 101 approximately 2.2 miles east of the LNG terminal site boundary, near the intersection with the Trans-Pacific Parkway and less than 0.5 mile east of the Conde B. McCullough State Recreation Site (figure K-4 in appendix K). The Oregon Coast Trail is also located along the Trans-Pacific Parkway and U.S. Highway 101 south of the Trans-Pacific Parkway Intersection in this area. Looking southwest, the Trans-Pacific Parkway can be seen in the middleground and the 190-foot-high loading tower at the Roseburg Forest Products chip export facility is barely visible above the trees beyond. The LNG terminal site, which would be obstructed by intervening landform and vegetation, would be located behind and to the right of the loading tower. Figure K-4 is an existing view from this viewpoint. A simulation was not completed because the proposed facilities would be obscured by topography and vegetation from this viewpoint. The Trans-Pacific Parkway/U.S. 101 widening would be visible in the foreground. The LNG terminal would likely be partially visible from the Conde B. McCullough State Recreation Site, located 2.4 miles to the northeast of the LNG terminal, but would be mostly obscured by vegetation and intervening topography. The LNG terminal would be visible along U.S. Highway 101 South in this area, but would be partially obscured by vegetation and intervening topography.

***Viewpoint-5 U.S. Highway 101 on the north side of McCullough Bridg*e—**Viewpoint-5 represents views to the west as seen by travelers along U.S. 101 on the north side of McCullough Bridge, and is located approximately 2 miles east of the LNG terminal site boundary. The Oregon Coast Trail is also located along this section of U.S. Highway 101.

In the existing view, the forested sand dune located on the LNG terminal site is visible behind the Coos Bay Rail Link Bridge and the Roseburg Forest Products facility (figure K-5 in appendix K). The simulation shows that the forested sand dune would be removed, and that the LNG tanks and concrete perimeter wall would be visible above the treeline. Views of the LNG terminal facilities would be partially obscured by the existing Roseburg Forest Products facilities.

***Viewpoint-6 U.S. Highway 101 at the Southern end of McCullough Bridge*—**Viewpoint-6 represents views to the northwest from the south side of McCullough Bridge, approximately 2 miles southeast of the LNG terminal site boundary and approximately 0.1 to 0.3 mile east of the APCO Dredge Disposal Site. Simpson Park, owned by the City of North Bend Parks, is located adjacent to the viewpoint location to the south. As shown in the simulation (figure K-6 in appendix K), the LNG storage tanks would be visible in the background above the APCO Site dredge material deposits, which are visible in the foreground. APCO Site 1 (approximately 0.1 mile west of the viewpoint location) would be approximately 36 feet tall, and APCO Site 2 (approximately 0.3 mile west of the viewpoint location) would be 48 feet tall. Initially, the dredge deposit areas would appear as an exposed sand dune. After vegetation is established, ground cover on the dredge deposit areas would appear visually similar to the surrounding landscape.

***Viewpoint-7 North Bend, intersection of Meade Avenue and Florida Avenue*—**Viewpoint-7 represents views to the northwest from urbanized areas within North Bend, approximately 2 miles southeast of the LNG terminal site boundary. The Roseburg Forest Products facility is visible between and over the residential buildings and vegetation, across Pony Slough and Coos Bay (figure K-7 in appendix K). The forested sand dune that currently exists on the LNG terminal site is visible as a dark green line of vegetation behind the Roseburg Forest Products facility in the background. The view of the proposed facilities from this viewpoint was not simulated, because visibility of the facilities would be limited by the vegetation, residences, and other development. The LNG storage tanks would mostly be obstructed by intervening landforms, vegetation, and the existing Roseburg Forest Products facility.

***Viewpoint-8 North Bend, intersection of Meade Avenue and Vermont Avenue*—**Viewpoint-8 represents views to the northwest from an urbanized area within North Bend that is higher in elevation compared to Viewpoint-7. The viewpoint is located approximately 2.25 miles southeast of the LNG terminal site boundary. In the existing view, Pony Slough, the Southwest Oregon Regional Airport, the Coos Bay Rail Link, and Coos Bay are visible between the viewpoint location and the proposed terminal location. The forested sand dune that currently exists on the LNG terminal site is visible as the dark green line of vegetation in the distance (figure K-8 in appendix K). As shown in the simulation, the forested sand dune would be removed and the LNG storage tanks, marine slip, concrete perimeter walls, and LNG vessel (when in port) would be visible from this viewpoint.

***Viewpoint-9 North Bend, Open Space Near Washington Avenue*—**Viewpoint-9 represents views to the north from an open space in an urbanized area within the western part of North Bend. A single-family development is proposed (but not approved) for this location along Washington Avenue, which is located just south and uphill from the Church of Jesus Christ of Latter-day Saints, approximately 1.4 miles from the LNG terminal site boundary. As shown in figure K-9 in appendix K, the LNG storage tanks, marine slip, and concrete perimeter walls would be visible above the tree line.

***Viewpoint-10 North Bend, Bike Trail South of the Airport*—**Viewpoint-10 represents views from Airport Lane and a bike trail that is located south and uphill from of the North Bend Waste Water Treatment Plant and the Southwest Oregon Regional Airport, near the intersection of Colorado Avenue and Arthur Street. The viewpoint is located approximately 1 mile south of the LNG terminal site boundary. In the existing view, treatment plant and airport structures are present in the foreground and the Roseburg Forest Products facility is visible in the middleground, as is the forested dune on the LNG terminal site (figure K-10 in appendix K). The simulation shows that the LNG storage tanks, marine slip and associated sheet pile walls, and LNG vessel (when in port) would be visible and prominent from this viewpoint.

***Viewpoint-11 BLM North Spit Boat Launch Area*—**Viewpoint-11 (figure K-11 in appendix K) represents views to the northeast from the interpretive overlook at the BLM North Spit Boat Launch parking lot, and is approximately 0.75 mile southwest of the LNG terminal site boundary. The topography at this site is flat with low-growing vegetation, allowing views of the existing forested sand dune located on the LNG terminal site to the left of the Roseburg Forest Products facility. The simulation shows that the LNG storage tanks, marine slip, concrete perimeter walls, and the LNG carrier (when in port) would be visible in the near middleground.

Visual Impacts

Short-Term Visual Impacts

Construction of the Jordan Cove LNG Project would be noticeable to recreational users on Coos Bay, in portions of the ODNRA, in portions of the North Spit Overlook, and at the boat launch and other locations within the BLM Coos Bay/North Spit RMA. Some residences in both the cities of

North Bend and Coos Bay would also have views across the bay to the terminal, although for other residences such views would be obstructed by terrain, vegetation, or intervening development. Construction activities would also be noticeable to motorists using the Trans-Pacific Parkway and the Pacific Coast Scenic Byway (U.S. Highway 101). Visual effects from construction activities near the terminal site would include dust plumes, exposed surfaces resulting from clearing and grading, and the presence of construction equipment and personnel activity on the LNG terminal site. Wetland restoration activity at the Kentuck project site might be evident to motorists using local roads and rural residences in the immediate vicinity of the site. These visual effects from construction activity would be temporary and limited to the construction period.

Short-term visual effects during construction of the LNG terminal would include the presence of the workforce housing facility within the South Dunes that would include pre-fabricated housing units and basic utility structures, which would visually resemble a small, dense residential community. The workforce housing facility would be dismantled and all structural elements removed from the site following completion of construction activities, and therefore visual effects resulting from the housing facility would be short term.

Long-Term Visual Effects

Based on the visual simulations, the Jordan Cove LNG Project would be visible to the public and would alter the existing visual character and scenic quality of the site. In addition to installation of the LNG tanks and related facilities, another permanent effect includes the removal of portions of a forested dune located on the eastern portion of the terminal site. This dune is a noticeable topographic feature of the existing landscape, and its removal was incorporated in the simulations whenever applicable.

Based on the visual changes indicated by the simulations for the set of representative viewpoints, the Jordan Cove LNG Project would have a moderate to high visual effect on residential communities in Coos Bay and North Bend to the south of the site. This effect would occur because of proposed landform modifications, including removal of the forested sand dune on the LNG terminal site, and the visibility of proposed industrial facilities on a previously undeveloped site. Moderate visual impacts are anticipated for viewers from hillside residences that would have views of the LNG terminal site that are not screened by topography, vegetation, or intervening development. These viewers would see the proposed development in the context of existing residential, commercial, transportation, and industrial uses in North Bend and Coos Bay that would be visible in foreground to middleground distances. Residences located along the shoreline of Coos Bay south of the regional airport (along Maxwell Road, Seagate Avenue, and Fenwick Street, for example) with unobstructed views of the site would experience a stronger visual effects and reduced scenic quality than would hillside residences, because the proposed facilities would primarily be viewed in the context of a shoreline landscape that currently has sparser development and higher scenic quality than the interior urban areas. Lights associated with the LNG terminal site are not anticipated to create a substantial new source of light or glare that would adversely affect daytime views. Nighttime views in the area include lights associated with the airport, the industrial facilities on the North Spit, and other urban uses. The addition of lights associated with the Jordan Cove LNG Project would be a low to moderate incremental impact when viewed in context of the extent and intensity of current lighting in the area.

The Jordan Cove LNG Project would be visible to recreational users on Coos Bay, in portions of the ODNRA, from the North Spit Overlook, and in portions of the BLM Coos Bay/North Spit

RMAs, including the BLM boat launch. Recreational users with views of the Jordan Cove terminal would notice moderate visual contrast in most locations, but high contrast when the Project is viewed in the foreground (within approximately 0.5 mile of the proposed facilities). The reduction of scenic quality in these areas where the Project creates a high contrast in the foreground would reduce the recreation experience from those viewpoints for some viewers who are sensitive to those changes. When viewed from greater distances, the reduction of scenic quality would generally be less pronounced because the Project would be viewed in the context of the surrounding landscape, which is characterized by other industrial, residential, and commercial developments.

The Project would be noticeable to motorists using the Trans-Pacific Parkway and the Pacific Coast Scenic Byway (also known as U.S. Highway 101). Visual effects on travelers on these roadways would be low to moderate. Intervening landforms and vegetation obstructs views toward the LNG terminal site from many locations along U.S. 101 and the Trans-Pacific Parkway. Travelers on these roadways would potentially experience low to moderate visual effects, because these viewers tend to have lower sensitivity and a shorter duration of view, and because the facilities would be viewed in the context of the surrounding landscape.

Wetland restoration would alter the long-term appearance of the 140-acre Kentuck project site. The site is the location of the former Kentuck Golf and Country Club, an 18-hole golf course that opened for play in the mid-1960s and closed in 2009. Aerial imagery indicates the site is no longer actively maintained and has a vegetative cover of grasses and other low-growing species, with trees and shrubs in some areas around the southern periphery and some visible evidence of remnant golf course features. The Kentuck project site is similar in character to adjacent open pasture areas located in the flat valley bottom land along Kentuck Slough, which is a narrow, linear waterway parallel to Kentuck Lane. Over time, most of the open, grassy area of the site would take on the appearance of freshwater and estuarine wetlands, including some areas of open water. The long-term visual effect of the proposed mitigation action would be to create a more natural-appearing landscape at the Kentuck site, and the change would be relatively subtle. Because the Kentuck project site is in a narrow tributary valley, this visual change would only be evident within the immediate local area, primarily including segments of East Bay Road and Kentuck Lane and a small number of rural residences located in the valley. The long-term landscape change at the Kentuck site is likely to be perceived as a minor, positive visual effect.

A related visual element of the LNG terminal would be the introduction of LNG carriers to the viewshed of the Coos Bay area communities. Traveling between 4 and 10 knots per hour, an LNG carrier would cross through the field of view for shoreline viewers in a few minutes. While LNG carriers are very large vessels, they are relatively close in size to cargo ships that currently transit the bay for the purpose of transporting wood products, which average around 600 feet in length. Because ships of this scale are already a regular occurrence in the waterway, the presence of LNG carriers would not be a new type of visual feature on the waterway.

Proposed Mitigation Measures

Jordan Cove has proposed several measures that would mitigate long-term visual effects of the Project. Jordan Cove has taken measures to minimize impacts on wetlands and estuaries in the siting of the Project, thereby retaining some of the visual characteristics of the site. The LNG terminal location was selected to avoid disturbance of Jordan Lake, which would help to minimize visual effects by preserving an existing, distinctive waterbody in the landscape. However, the size and location of the proposed LNG terminal and associated facilities would cause visual effects from many viewpoints that cannot be effectively mitigated.

The exterior of the LNG storage tanks would be constructed of untreated concrete of a light grey color for cryogenic purposes. While a darker color would help reduce the visibility of the tanks from a distance, such treatment is not generally considered feasible, as dark colors absorb heat, which would increase the temperature of the tank exterior and become problematic for LNG storage control. Jordan Cove evaluated various tank profiles and locations to minimize visual effects, and concluded that the proposed size, profile, and location would be the optimum considering other environmental factors, safety, and reliability. The final landscape design for the site would include provisions to contour and stabilize landforms not affected by construction and to provide some level of screening around the facilities. The use of native plants for restoration and stabilization of the landforms would also be incorporated into the final planting design to the extent practical. Building facades would incorporate the architectural design of existing buildings in the area. The final lighting plan would include hooded or cut-off lighting to minimize light spillage onto adjacent areas. Only lighting required for operation and maintenance, site safety and security, and to meet FAA requirements would be used on the LNG storage tanks and, whenever possible, the light would be localized to minimize off-site effects.

4.8.2.2 Pacific Connector Pipeline

Visual resources along the pipeline alignment vary greatly. The natural landscape features include sandy treed dunes, expansive bay views and temperate rain forest in the Coos Bay area, and rolling steep conifer-forested hillsides in the Coast and Cascade ranges and foothills. Open oak savanna, pasturelands, and rolling hills are common in the viewsheds near Roseburg and east of Medford, with views transitioning to dramatic conifer mountain and volcanic landscapes in the Cascade Mountains. Croplands, pasturelands, rolling sagebrush rangeland, and pine-juniper forests punctuated by westerly views of the Cascades compose a unique scenic landscape in the Klamath Basin at the eastern end of the pipeline.

Culturally modified landscapes include farm and rangelands, small towns, and forest management activities including clearcut timber harvesting. Forested viewsheds are characterized by various aged forest stands that are in various stages of harvest, regeneration, or mature forests. Several viewsheds along the western portion of the pipeline route have very low scenic integrity, including hillsides altered by clearcuts and traversed by logging roads. A few forested areas also include existing utility corridors. Where the pipeline crosses NFS lands within the Umpqua, Rogue River-Siskiyou, and Fremont-Winema National Forests, the forested viewsheds are characterized as ranging from low to high scenic integrity, varying with stages of forest maturity and harvest regeneration. Other forest landscapes and views have been modified by recent wildfires, such as the Stouts Creek Fire in the Umpqua National Forest in 2015.

On BLM and NFS lands, visual resources are managed according to visual resource management guidelines. Most of the pipeline alignment would pass through viewsheds which allow moderate change, as evidenced by active timber management activities. These are areas where alterations of the existing landscape would not significantly alter the existing characteristics of the viewshed. In a few locations, the pipeline would cross federally managed public lands that are designated as having high visual resource sensitivity under the agencies' visual management system. These areas are discussed in detail later in this section.

KOP Selection

A visual assessment was conducted to determine the potential effects on visual resources associated with the pipeline. Representative viewpoint points (also referred to as KOPs) were identified within the viewshed for the pipeline, defined as the area from which the pipeline would be potentially visible. The pipeline viewshed extends to a distance of 5 miles on either side of the pipeline. This distance was defined using aerial and ground photography, local planning documents, computer modeling, and field reconnaissance. Site visits were conducted in April 2006 and updated in May 2013 to document visual conditions along the pipeline route and to identify potentially affected sensitive viewing locations along the proposed route. Based on these site visits, it is anticipated that views of much of the pipeline from within the 5-mile viewshed would be partially or fully screened by existing trees, landforms, or intervening development. Figures 4.8-3 to 4.8-5 show the proposed route as it moves through the various BLM VRM classifications and Forest Service visual quality objective (VQO) classes[162] as well as the KOP locations along the route.[163]

A supplemental visual impact assessment was conducted to determine the potential effects on visual resources associated with the pipeline as it crosses the PCT. The viewshed for the PCT at this crossing is quite limited because of the old-growth forest, dense brush and understory trees, and the pedestrian scale of the characteristic landscape. A detailed visual analysis was undertaken for the PCT crossing site. Several site visits were conducted in the spring of 2015 to document existing visual conditions of the PCT at the pipeline crossing. The Forest Service determined that two new KOPs would be required to accurately simulate the expected future visual conditions as seen from the PCT. Forest Service personnel and the visual analysts established two new KOPs in this pedestrian landscape.

For this supplemental analysis, the new KOPs are numbered sequentially as KOP-P8 and KOP-P9, as shown on figure 4.8-5 (MP 155 to 228). The VQO for the affected landscape along the PCT is Foreground Partial Retention, indicating that human activities should remain visually subordinate to the characteristic landscape. Activities may repeat form, line, color, and texture common to the characteristic landscape, but changes in their qualities of size, amount, intensity, direction, pattern, etc. should remain visually subordinate to the characteristic landscape.

A supplemental visual impact assessment was also conducted for the crossing of the Coos Bay Wagon Road corridor in 2013, to support an analysis of the Modified Blue Ridge Route Alternative, which has been incorporated into the Proposed Route. As a result, KOP-P10 was added to the visual resource analysis, as shown on figure 4.8-3.

As a result of the original and supplemental visual assessments, the complete list of KOPs for the Pacific Connector Pipeline Project is summarized as follows:

- **KOP-P1 ODNRA**, west of MP 0, Horsfall Beach Campground and Day Use Area

[162] The VRM system has four management classes, with objectives ranging from preserving the existing landscape character (Class I) to providing for management activities that require major modification of the existing landscape character (Class IV). The VQO system has five classes, ranging from Preservation (where most management activities are prohibited) to Maximum Modification (where management activities may dominate the landscape). See Section 4.8.2.3 for additional discussion.

[163] The VRM class boundaries shown on figure 4.8-4 are incorrect near KOP-P2. They are based on GIS data which is being corrected at the time of publication. The VRM class near the Trail Post Office KOP is VRM-II.

- **KOP-P10 Coos Bay Wagon Road**, MP 24.37, Sumner-Fairview Road northwest of Fairview
- **KOP-P2 Trail Post Office**, MP 123.0, Town of Trail adjacent to Highway 62
- **KOP-P3 Highway 140**, MP 145.6 near Little Butte Creek
- **KOP-P4 Big Elk Road** (Forest Road 37), MP 161.4, west of Lake of the Woods
- **KOP-P5 Clover Creek Road**, MP 172.2, north of Buck Lake
- **KOP-P6 Clover Creek Road**, MP 176.8, east of Buck Lake and west of Aspen Lake
- **KOP-P7 Clover Creek Road**, MP 170.1, northwest of Buck lake
- **KOP-P8 Pacific Crest Trail**, MP 167.8, south of Brown Mountain
- **KOP-P9 Pacific Crest Trail**, MP 167.8, south of Brown Mountain

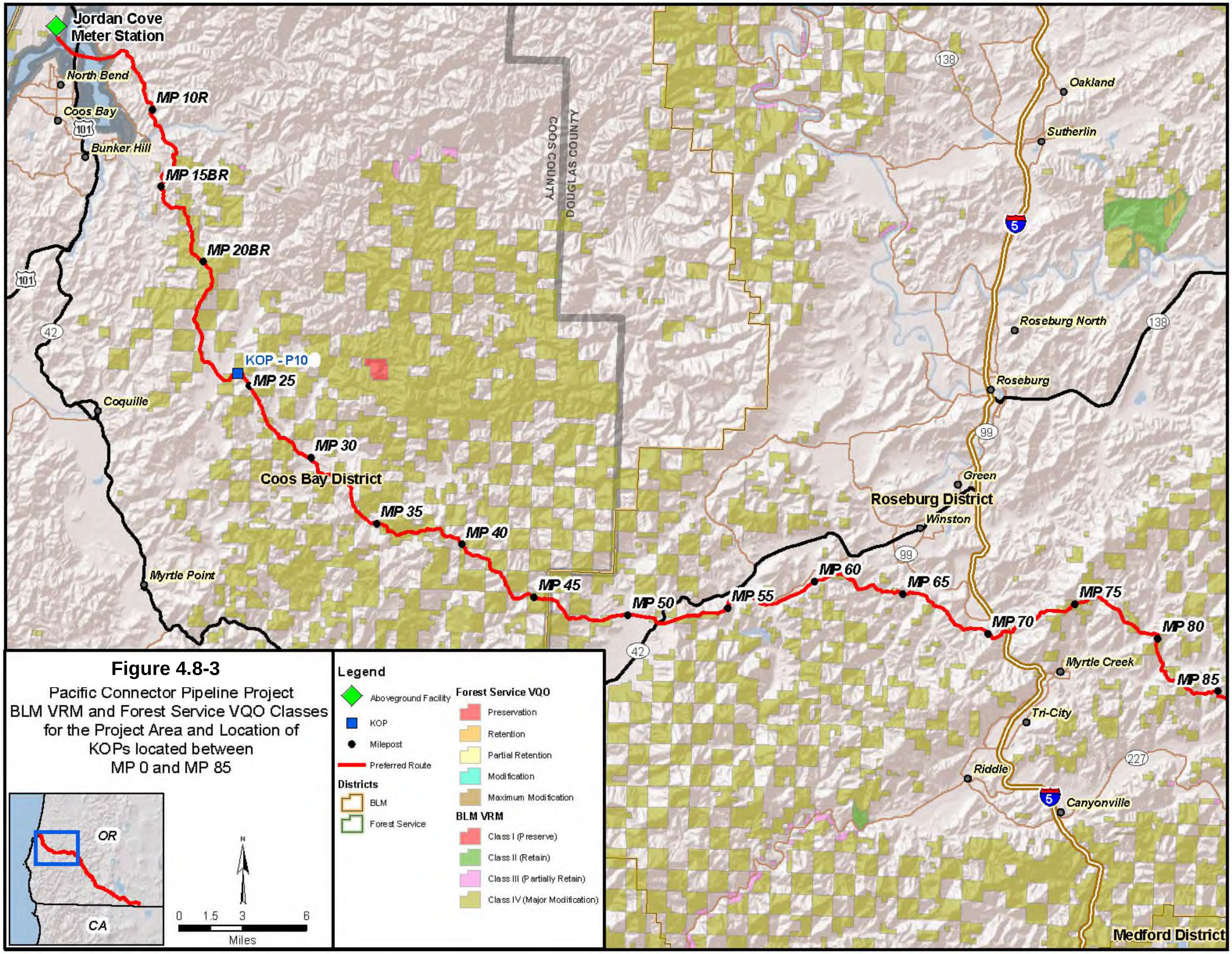
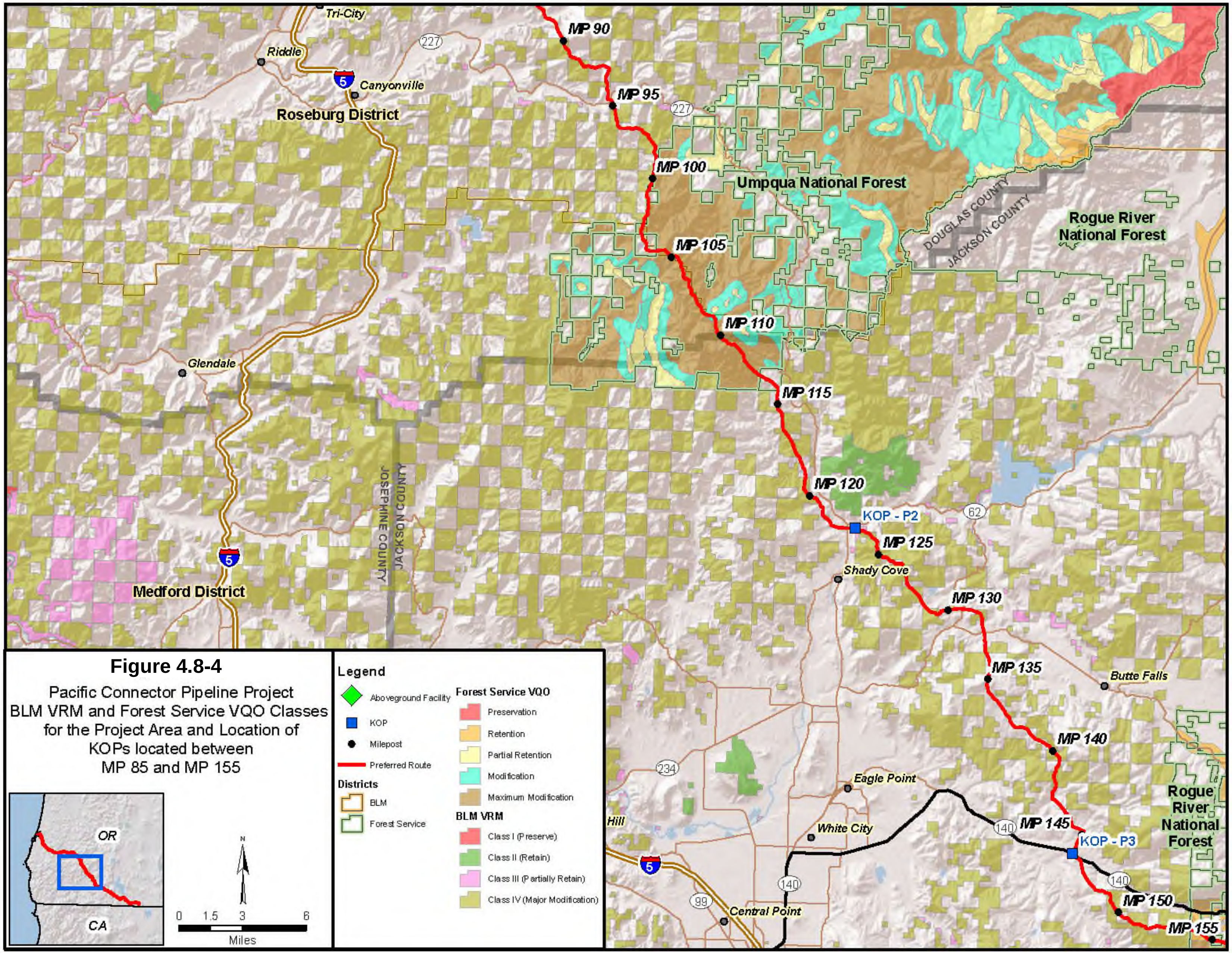


Figure 4.8-3
Pacific Connector Pipeline Project
BLM VRM and Forest Service VQO Classes for the Project Area and Location of KOPs located between MP 0 and MP 85


Tri-City
Riddle
Canyonville
Roseburg District
MP 90
MP 95
MP 100
MP 105
MP 110
MP 115
MP 120
MP 125
MP 130
MP 135
MP 140
MP 145
MP 150
MP 155
Umpqua National Forest
DOUGLAS COUNTY
JACKSON COUNTY
Rogue River National Forest
Glendale
JOSEPHINE COUNTY
Medford District
KOP - P2
KOP - P3
Shady Cove
Butte Falls
Eagle Point
White City
Central Point
Hill
Rogue River National Forest
Figure 4.8-4
Pacific Connector Pipeline Project
BLM VRM and Forest Service VQO Classes for the Project Area and Location of KOPs located between MP 85 and MP 155
OR
CA
0 1.5 3 6
Miles
Legend
Aboveground Facility
KOP
Milepost
Preferred Route
Districts
BLM
Forest Service
Forest Service VQO
Preservation
Retention
Partial Retention
Modification
Maximum Modification
BLM VRM
Class I (Preserve)
Class II (Retain)
Class III (Partially Retain)
Class IV (Major Modification)

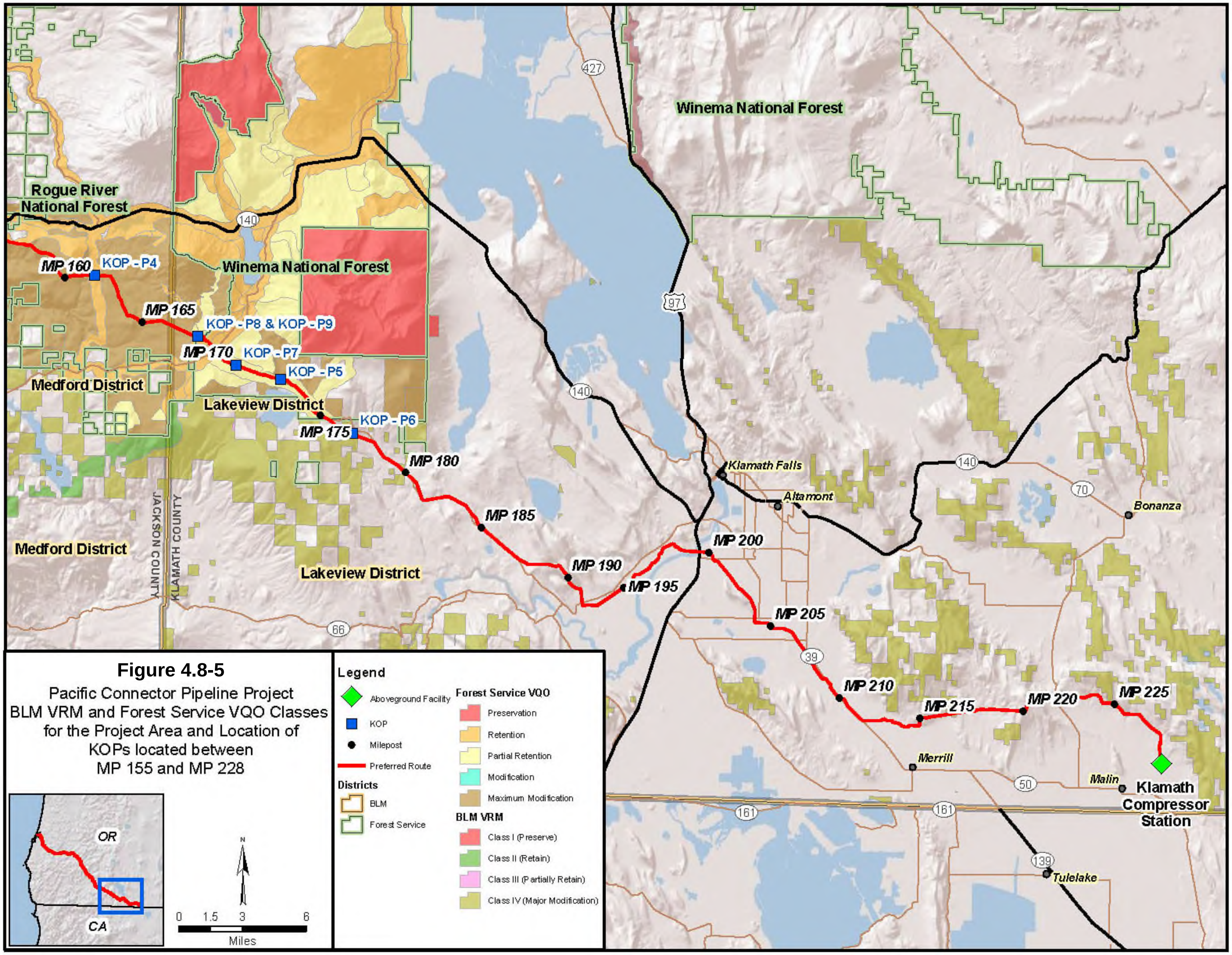


Figure 4.8-5
Pacific Connector Pipeline Project
BLM VRM and Forest Service VQO Classes
for the Project Area and Location of
KOPs located between
MP 155 and MP 228
Legend
Aboveground Facility
KOP
Milepost
Preferred Route
Districts
BLM
Forest Service
Forest Service VQO
Preservation
Retention
Partial Retention
Modification
Maximum Modification
BLM VRM
Class I (Preserve)
Class II (Retain)
Class III (Partially Retain)
Class IV (Major Modification)
0 1.5 3 6
Miles
N
OR
CA
Rogue River
National Forest
Winema National Forest
Winema National Forest
Medford District
Medford District
Lakeview District
Lakeview District
JACKSON COUNTY
KLAMATH COUNTY
MP 160
MP 165
MP 170
MP 175
MP 180
MP 185
MP 190
MP 195
MP 200
MP 205
MP 210
MP 215
MP 220
MP 225
KOP - P4
KOP - P8 & KOP - P9
KOP - P7
KOP - P5
KOP - P6
Klamath Falls
Altamont
Bonanza
Merrill
Malin
Tulelake
Klamath
Compressor
Station
427
140
97
70
66
39
50
161
139

Visual Simulations

Photographs of existing visual conditions were used in preparing computerized visual simulations for each KOP. Because the appearance of the pipeline right-of-way would change with time, a series of simulations were prepared to illustrate how the pipeline right-of-way would look at different timeframes following construction. The KOP photo sets are presented sequentially in appendix K as follows:

- Existing Conditions: How the landscape appeared at the time site photography was conducted.
- Post-Construction (Year 0): The pipeline is in place and backfilled. Soils have been re-contoured, water bars constructed, and cull logs, root wads, and boulders have been scattered across the right-of-way. Seedlings of native trees (Douglas-fir and ponderosa pine) have been planted among the woody debris and boulders, except for a 30-foot-wide corridor directly above the pipeline.
- Post-Construction, Site Repair, and Replanting (Year 5): Douglas-fir and ponderosa pine saplings are starting to show among the woody debris, boulders, and water bars. Grasses are growing across the entire right-of-way. There are no trees growing in a 30-foot-wide corridor directly above the pipeline.
- Year 25: Young Douglas-fir and ponderosa pine trees are growing throughout the right-of-way, except for the 30-foot-wide corridor directly above the pipeline, and some of the woody debris (cull logs and root wads) is beginning to deteriorate. The boulders and water bars remain, and maintenance has occurred to keep only low-growing shrubs and grasses in the 30-foot-wide corridor centered directly over the pipeline.

KOP Analyses

Pacific Connector, with guidance from the Forest Service and BLM, initially selected nine points from which to assess visual and aesthetic impacts. Five points were selected based on their proximity to federal lands with high scenic qualities and associated visual management objectives. A tenth KOP was added later to reflect potential visual impacts at the pipeline crossing of the former Coos Bay Wagon Road, a feature of historic interest. These KOPs would also serve as monitoring points for mitigation. Each KOP is described below.

KOP-P1 ODNRA

KOP-P1 represents views experienced by recreational users at the ODNRA, Horsfall Beach Campground and Day Use Area. KOP-P1 is geographically similar to Viewpoint-3 at and is located north of pipeline MP 0.00 with views of both the LNG terminal and pipeline construction areas (figure 4.8-2). From KOP-P1, visual effects associated with the pipeline would be subordinate to concurrent construction at the proposed LNG terminal, as well as activities associated with nearby industrial areas, air and sea port traffic, and urban development in the Coos Bay region. Visual effects of the pipeline from this KOP are therefore negligible overall. No further visual impact assessment is necessary at this location due to complete visual screening of the pipeline alignment by intervening topography. For this reason, there is no photograph/simulation set for KOP-P1 in the figures that follow.

KOP-P10 Coos Bay Wagon Road

The pipeline would cross the route of the historic Coos Bay Wagon Road on private lands at MP 24.37, about 15 miles southeast of Coos Bay and 2 miles northwest of the community of Fairview. The Coos Bay Wagon Road was a historic backcountry route built in the 1870s to connect Coos Bay and Roseburg, Oregon for freight transportation. The Wagon Road fell into disuse after OR 42 was built in the Coquille River valley during the early twentieth century. Local roads developed along the original road alignment continue to be used as an alternative travel route. KOP-P10 is located where the pipeline would cross the Wagon Road route, which is now a two-lane paved road identified locally as the Sumner-Fairview Road. The KOP represents foreground/middle ground views of the pipeline that would be experienced by travelers on the former Wagon Road route.

Figure K-12a in appendix K provides the existing view from the just outside the proposed pipeline right-of-way, and figures K-12a through K-12c show visual simulations for different stages of construction and restoration (note that for this KOP the set of simulations also includes a view of conditions at Year 10 as requested by the BLM). In Year 0, clearing associated with the pipeline would be visible to road users for approximately 0.25 mile, or approximately one-eighth of a mile on either side of the pipeline crossing. While the pipeline clearing might be visible from locations beyond this area, it is not likely to dominate views or affect landscape character. By Year 10, the right-of-way might not be noticeable to most road users because planted vegetation would mask the corridor unless the viewer is directly adjacent to the 30-foot permanently cleared area.

KOP-P2 Trail Post Office

KOP-P2 is located on private land at the U.S. Post Office in the town of Trail, near MP 123.0 and is representative of the view from Crater Lake Highway (State Highway 62). Simulations show the views to the southeast where the pipeline route crosses private land southwest of the Rogue River HDD crossing. Approximately halfway up the hill, the pipeline would leave private land and cross BLM land designated as VRM Class IV. Existing vegetation depicted in the view from KOP-P2 at the pipeline right-of-way consists of a dense evergreen forest of Douglas-fir and ponderosa pine. There are patches of scrub-oak and manzanita at the right-of-way, and a bare patch of soil north (left) of the right-of-way (figures K-13a and K-13b in appendix K). After pipeline construction, the removed vegetation and exposed earth within the cleared right-of-way would create a moderate to high level of contrast in the short term, until vegetation is re-established. After vegetation is established, the level of contrast would be low to moderate (figure K-13b and K-13c).

KOP-P3 Highway 140 near Little Butte Creek

KOP-P3 is located at MP 145.6, at the point where the pipeline would cross under State Highway 140 near Little Butte Creek on private lands, and represents views to the southeast experienced by travelers along Highway 140 (figures K-14a and K-14b in appendix K). This KOP provides a middle ground/background view of BLM lands classified as VRM Class IV located approximately 2.5 miles southeast of KOP-P3. The pipeline right-of-way would be visible in the foreground where it is located adjacent to Highway 140, and then in the middleground/background where it would be located on a hill on BLM land. Initially, contrast levels would be moderate to high, depending upon the angle of view. Contrast would be reduced over time as vegetation is re-established within the right-of-way.

KOP-P4 Big Elk Road (Forest Road 37)

KOP-P4 represents views to the north experienced by travelers along Big Elk Road (Forest Road 37) at MP 161.4 This road provides access for snowmobilers, anglers, hikers, and others travelling to Lake of the Woods. The pipeline crossing location is located in the Rogue River-Siskiyou National Forest in an area designated with a VQO of Foreground Retention. The pipeline would cross the road at this location in a perpendicular manner, and viewers would experience both foreground and middleground views of the cleared pipeline right-of-way when they are adjacent to or near the road crossing. Simulations show the moderate long-term visual effects of the permanently cleared 30-foot-wide right-of-way that would be visible to passing motorists (figures K-15a and K-15b in appendix K).

KOP-P5, KOP-P6, and KOP-P7 Clover Creek Road

The pipeline would generally parallel Clover Creek Road for approximately 18.2 miles between MP 169.5 and MP 187.7. The Forest Service VQO for MPs 170 and 175 is Partial Retention. The series of three simulations in figure K-16 shows the typical visual effects that would occur in timbered landscapes along this segment of Clover Creek Road.

Simulations prepared for KOP-P5 represent a long-distance view of the right-of-way near MP 172.2 from the perspective of motorists along Clover Creek Road. The simulations show that clearing associated with the pipeline right-of-way would be visible in the immediate foreground, foreground, and middleground from this perspective (figures K-16a and K-16b in appendix K). Contrast created by the clearing of the right-of-way would be reduced over time after restoration, which would involve recontouring, reseeding, scattering of slash across the right-of-way, and replanting.

KOP-P6 represents a second view from the perspective of motorists on Clover Creek Road, near Spencer Creek at about MP 176.8 along the pipeline route, on BLM lands, looking uphill. In this location, the pipeline right-of-way would be immediately adjacent to the road, as shown in figures K-16a and K-16b for KOP-P5 and figures K-17a and K-17b for KOP-P6. The clearing would create a “widening” effect. Contrast created by the clearing of the right-of-way would be reduced over time after restoration, which would involve recontouring, reseeding, scattering of slash across the right-of-way, and replanting.

KOP-P7 represents a third view from the perspective of motorists along Clover Creek Road. KOP-P7 is located at MP 170.1, facing due east and downhill from a motorists’ perspective. There is an existing partial-cut timber harvest area on the north (left) side of the road. Simulations for KOP-P7 show an additional long-distance view of the pipeline right-of-way from along Clover Creek Road. As shown on the post-construction simulation, woody debris (cull logs, slash, and root wads) would be left on the right-of-way to discourage OHV use, which would create visual contrasts. The Year 25 simulation shows pine reforestation on the right-of-way, and in this view, the permanently cleared and maintained area directly over the pipeline would be partially to completely screened from view of the road. This simulation shows the extent of high visual effects of the pipeline, over time, in the immediate foreground, foreground, and middleground of Clover Creek Road (figures K-18a and K-18b in appendix K).

KOP-P8 and KOP-P9, Pacific Crest Trail

The pipeline would intersect the PCT at approximately MP 167.8, in the Fremont-Winema National Forest. At this location, the old-growth forest has a VQO of Foreground Partial Retention to maintain the aesthetic quality of the forest for PCT users. Because the pedestrian landscape has very limited sight distance, only immediate foreground (0 to 300 feet) views are possible. The visual simulations presented in figures K-19 and K-20 in appendix K show the anticipated visible impacts of the pipeline right-of-way and construction work space immediately following construction as well as 5 and 25 years following implementation.

Because the pipeline would create a linear opening in old-growth forest, hikers and equestrians would now have immediate foreground (0 to 300 feet) and foreground (0 to ½ mile) views. In the Year 0 simulation, the pipeline is in place and the trench is backfilled. The right-of-way clearing was “necked down” from 95 feet to 75 feet wide for a length of 300 feet each side of the PCT (the immediate foreground zone). Within this 600-foot-long zone at the PCT, all large diameter trees that are right along the edge of the cleared right-of-way have been retained. All stumps have been flush-cut rather than removed in this area of right-of-way so that equipment can drive over them. All shrubs have been mowed to 6 inches in height in this 600-foot-long zone, rather than stripping the right-of-way to bare ground. The only bare earth was the 10-foot-wide ditch zone. On-site shrubs and ground cover plants were dug from the 10-foot-wide ditch zone, heeled-in root balls in a safe storage location, and then transplanted back into the trench zone. The entire 75-foot-wide right-of-way was seeded with native grasses and forbs for a length of 300 feet each side of the PCT. In this 600-foot-long zone, trees were planted in masses outside of the 30-foot-wide mowed area and would be irrigated via a holding tank and drip system. Beyond 300 feet from the PCT, the right-of-way expanded back to 95 feet wide, and the entire right-of-way was seeded with native grasses and forbs. Seedlings of Douglas-fir and Shasta red fir were planted in the right-of-way outside the 30-foot-wide mowed zone, and logs were placed in the right-of-way. At Year 5, Douglas-fir and Shasta red fir trees are growing larger, and grasses and forbs are growing across the entire right-of-way. At Year 25, Douglas-fir and Shasta red fir trees are growing larger and some of the logs are beginning to lose their bark. Maintenance has occurred to keep only low-growing shrubs, forbs, and grasses in the 30-foot-wide corridor centered directly over the pipeline.

KOP-P8 represents a hiker’s perspective walking northbound on the PCT, looking ahead from the old-growth forest into the 75-foot-wide cleared right-of-way at approximately MP 167.8 and beyond. This vantage point is located between two large trees and is the first opportunity to see the right-of-way clearing, which extends from 67 feet to 142 feet ahead of the camera position. A hiker is shown in the photographs and simulations to represent human scale (figures K-19a and K-19b).

For a typical hiker or equestrian, the duration of view would be short, because it does not take long to walk or ride a few hundred feet along the PCT. The right-of-way would create an opening that would allow more sunlight into this area. The interpretive sign would call attention to the pipeline and explain the changes in the characteristic landscape. As seen from KOP-P8, the overall visual effect would achieve the Foreground Partial Retention VQO.

KOP-P9 is from a hiker’s perspective standing in the middle of the 30-foot-wide cleared area over the right-of-way, looking west from a short distance (48 feet) east of the PCT (figures K-20a and K-20b). The pipeline clearing would extend to the west and then make a dogleg to the northwest, thereby reducing the length of the "tunnel effect" of the right-of-way clearing. If the viewer turned around at this location and looked east, a similar dogleg would be limit the visibility of the right-of-way in that direction. Both of these doglegs reduce the extent of right-of-way clearing that would be visible from the PCT. Duration of view from this vantage point would be longer than for KOP-P8 because the viewer has walked off the trail and stopped to survey the landscape. The right-of-way would create a different viewing experience because of its linear form; however, revegetation with trees, grasses, and forbs, plus placement of logs in the right-of-way, would partially retain the surrounding landscape character. Because of the restoration efforts, the pipeline right-of-way would remain visually subordinate to the characteristic landscape. The interpretive sign would call attention to the pipeline and the changes in the characteristic landscape, causing viewers to stop and look more carefully. As seen from KOP-P9, the overall visual effect would achieve the Foreground Partial Retention VQO.

Visual Impacts

Short-Term Visual Impacts

Construction impacts on visual resources would result from the presence of equipment, materials, and workers along the pipeline right-of-way, at TEWAs and staging areas, and along access roads. Visual effects would also result from the alteration of landforms and vegetation along the right-of-way during construction. Excavation for the pipeline would expose sub-grade soils that would contrast with the color of the existing land surface and the forest canopy. Visual contrast in color, line, and texture between the disturbed, vegetated ground and the adjacent vegetation would be most noticeable in the short term (0-5 years after construction) while the right-of-way is in the process of revegetating. Vehicles, heavy equipment, helicopters, pipeline components, and workers would be visible during site clearing, grading, trenching, pipeline transport, welding, laying in, backfilling, and site/right-of-way cleanup and restoration. Construction equipment and activities would be seen by various viewers close to the sites and pipeline corridor, including adjacent and nearby residents, recreationists on trails and roads, motorists on public roadways and, in some cases, pedestrians. Much of the Pacific Connector pipeline route is in remote locations seldom visited by the public, although visitors in such remote areas may be relatively sensitive to changes in visual quality. Where visible, view durations would vary from brief to extended periods. Construction activities would be most visible for those elements of the pipeline in close proximity to residential neighborhoods and adjacent to major travel corridors, including highways and the PCT; however, these effects would be temporary and would be limited to the construction period. Revegetation and restoration efforts, including placement of slash on the right-of-way in forested areas, would serve to mitigate the visual contrast in color, line, and texture.

Amendments to the Rogue River-Siskiyou and Fremont-Winema National Forest LMPs would be necessary to address consistency with specific standards and guidelines related to VQOs. These amendments would acknowledge the short-term visual effects that would occur that would be inconsistent with current management direction. They would allow for an extended period of time for the areas to recover and meet the VQOs in a reasonable amount of time.

Long-Term Visual Impacts

Pipeline

The landscape setting along the pipeline route is varied, ranging from flat valley floors and agricultural fields, to rolling hillsides covered with oak and madrone woodlands, to steep mountainsides and sharp ridgelines covered with mixed conifer forests. On flat terrain in agricultural settings, the right-of-way would be restored following construction and ranchers/farmers would be allowed to grow shallow-rooted crops over the pipeline. Construction work areas would normally be difficult to distinguish from surrounding areas. Therefore, no long-term visual effects would result from installation of the pipeline in agricultural areas.

In the mountainous terrain, many of the existing landscapes that would be traversed by the pipeline have already been affected by timber harvests, including large clear-cuts. Existing scenic integrity in these areas is low, and the introduction of the pipeline should not create long-term visual contrasts in these settings.

The greatest long-term visual effects would occur where the new right-of-way would create new clearings through forestlands not characterized by large-scale timber harvests. The clearing of the right-of-way would create a sharp-edged linear feature across contiguously forested landscape. The appearance of the corridor would be similar to transmission line corridors. Revegetation and restoration, including replacement of slash in the right-of-way, would be initiated following construction and would mitigate the visual contrast in color, line, and texture. Contrast might also be increased where surface rock or stumps would be scattered across the right-of-way or placed in piles at road crossings to create OHV barriers or habitat features. Over time, contrast would decrease as the right-of-way is revegetated, narrows in width because of revegetation, and becomes more similar in texture and color to the surrounding forest lands. After successful restoration, the cleared area around the right-of-way would be reduced to the 30-foot permanently cleared area, further reducing contrast with the surrounding forested area.

The right-of-way might be noticeable to the casual observer depending on the distance, line-of-sight, topographic, and vegetation conditions at the viewpoint as well as the conditions along the Pipeline right-of-way. The corridor would be most apparent when viewed from a location in-line with the right-of-way, and might not be visible when viewed from a perpendicular location due to vegetative screening. Where it crosses ridges, the cleared right-of-way might be visible as a "notch" in the treeline from perpendicular or near-perpendicular viewpoints. Many forested areas crossed by the pipeline are away or visually screened from roads, trails, and populated areas, and therefore are not immediately visible to viewers.

Aboveground Facilities

The aboveground facilities proposed by Pacific Connector would be long-term structural features on the landscape. A detailed description of the aboveground facilities is provided in chapter 2. The MLV sites are all located within the pipeline ROW, and consist of a 50-foot x 75-foot (0.9 acre) site that would be enclosed by a 7-foot-high, chain-link fence. Five of the MLVs would require a 40-foot-tall tower to be installed within the site. Pacific Connector has attempted to locate MLVs adjacent to existing roads to facilitate access and minimize the length of new access roads, and to set block valves back from crossings in sensitive viewsheds. Where not screened by topography or vegetation, the MLV sites would be visible to roadway travelers. On federal lands, all aboveground piping would be painted with a color approved by the managing federal agency in order to meet visual quality objectives and visual screening would be implemented. The MLVs would all be located within the pipeline right-of-way and therefore, with the mitigation measures applied to federal lands, would have low effects on visual quality of the surrounding area. MLV 13 was previously located adjacent to the Dead Indian Memorial Highway, but has been relocated back from Clover Creek Road and accessed from an existing private road to screen the block valve from view.

The Klamath Compressor Station (MP 228.1) would have visual effects on nearby residents and travelers along Malin Loop Road and Morelock Road (figure 4.8-6). The location is on private land in a rural area that is relatively flat and is currently covered by grasses, sage, and juniper. To reduce visual contrast, the buildings at the compressor station would be painted a color selected to blend as well as possible with the surrounding landscape, and portions of the outward facing sides of the station would be landscaped to reduce potential visual effects on area residences. The station would be surrounded by a 7-foot-tall chain-link fence with screening slats. The station would include exterior lighting to be used only when operations personnel are actively performing nighttime work at the station. Pacific Connector has stated that during operation of the station nighttime work or maintenance activities would generally not be scheduled; therefore, these lights would only be used periodically and possibly for short periods during the winter when daylight working hours are shorter. Pacific Connector has not identified specific lighting arrangements, although standard practice is for outside lights at infrastructure facilities such as compressor stations to be shrouded to direct light to the specific work areas within the station.

Pacific Connector anticipates that communications towers would be required at the compressor meter stations, several automated MLVs, and at leased space on existing communication towers (see chapter 2 for location descriptions). The towers at the meter stations, compressor station, and automated MLVs would be located within the fenced facility sites. The Communication Facilities Plan[164] describes the construction, modification, operation, and maintenance of communication facilities on lands managed by the BLM and the Forest Service.

The proposed communication facilities are not expected to significantly alter or impair the visual setting. Pacific Connector would co-locate communications towers with existing facilities whenever possible, if leased space is available within existing facility sites at the time of construction. If construction of new facilities is required, Pacific Connector would seek to obtain an approximate 100-foot by 100-foot (0.23 acre) area for each of the new tower installations in the immediate vicinity of the existing communication tower facilities. A variance would be needed to allow installation of any new tower under such conditions. Because additional towers are anticipated to be co-located with existing tower facilities, they are not expected to impair the existing visual setting.

Proposed Mitigation Measures

Pacific Connector produced an *Aesthetics Management Plan*[165] that outlined measures to reduce visual impacts along its pipeline route. Generally, these measures include:

- reducing the width of the right-of-way and elimination of TEWAs at sites with high visual sensitivity;
- strategic alignment of the right-of-way where it crosses roads or trails to reduce the visible extent of the corridor (for example, crossing roads or trails at right angles);
- strategic placement of construction debris (slash, stumps, and boulders) in visually sensitive areas;

[164] Appendix D of Pacific Connector's POD filed with the FERC in January 2018.
[165] Appendix A to Pacific Connector's POD filed with the FERC in January 2018.

- place natural barriers where the right-of-way opening is adjacent to trails and roads to prevent potential unauthorized OHV use;
- clear additional timber outside the right-of-way in selected locations to scallop and feather the edges of the clearing, to reduce the hard line of forested lands adjacent to the right-of-way;
- revegetation of the right-of-way after pipeline installation, including planting trees in TEWAs that were cleared of forest or woods and strategic placement of trees to help reduce contrast between the cleared right-of-way and surrounding forest lands;
- planting rows or clusters of trees and shrubs across the right-of-way (outside of the 30-foor permanently cleared corridor) to provide visual screens at specific sensitive trail or road crossings, using native species whenever possible; and
- painting aboveground facilities in color schemes that would blend into the background landscape.

It should be noted that some visual mitigation measures are not shown in the visual simulations. These include opportunities for revegetation with large-sized trees (tree-spade efforts), forest edge scalloping, and/or feathering treatments to decrease stand density contrasts at the right-of-way edges. Therefore, these simulations represent a worst-case scenario at each KOP.

4.8.2.3 Environmental Consequences on Federal Lands

Visual Resources on Federal Lands

Regulatory Setting and Visual/Scenic Management Systems

The responsibility of protecting visual resources on lands owned or under the jurisdiction of the federal government is established by FLPMA, which places emphasis on the protection of scenic resources on public land, and the Forestland and Rangeland Renewable Resources Planning Act (1974) which empowers the Forest Service to manage scenery resources. The National Forest Management Act (1976) required the completion of Forest Plans that established VQOs for the National Forests.

NFS Lands

The Forest Service seeks to manage NFS lands to attain the highest possible quality of landscape aesthetics and scenery commensurate with other appropriate public uses, costs, and benefits. Scenic integrity is defined as "*a measure of the degree to which a landscape is visually perceived to be* "*complete.*" The highest scenic integrity ratings are given to those landscapes that have little or no deviation from the character valued by constituents for its aesthetic appeal. Scenic integrity is used to describe an existing situation, standard for management, or desired future condition" (Forest Service 1995b).

National Forests use a Visual Management System (VMS) to manage visual resources on NFS lands and to analyze visual effects of proposed projects. The VMS has a rating system known as VQO to establish standards for scenery resource management. The VMS was outlined in FSH 462, published in 1974. Since then, scenery management on NFS lands has been updated by Handbook 701, which introduced the Landscape Aesthetics, Scenery Management System (SMS). The SMS utilizes a rating system similar to VMS to evaluate project impacts on visual quality. The SMS is based on the relative scenic quality of each portion of the landscape and its sensitivity based on the visibility from, and uses in, the surrounding areas. The SMS uses Scenic Integrity Objectives to establish the desired conditions for management of an area.

Under the former VMS system, management prescriptions and related VQOs were developed for all NFS lands. VQOs for each national forest crossed by the pipeline are identified in their respective LRMPs. VQOs are management standards that identify five degrees of alteration to the natural landscape based on a landscape's diversity of natural features and the public's concern for scenic quality. Because the aforementioned forest plans have not been amended to use the SMS, both VMS and SMS are used in this EIS section. A crosswalk between the two systems is described in *Landscape Aesthetics: a Handbook for Scenery Management* (Forest Service 1995b), and summarized in table 4.8.2.3-1.

BLM Lands

The BLM has a Visual Resource Management (VRM) system that is comparable to the Forest Service VMS. Based on a matrix of three factors (scenic quality, sensitivity level, and distance), BLM lands are placed into one of four visual resource inventory classes (table 4.8.2.3-2). These classes represent the relative value of the visual resources, Class I (Preserve Character) and Class II (Retain Character) being the most restrictive, Class III (Partially Retain Character) relatively less restrictive, and Class IV (Major Modification of Character) being least respective. The class objectives describe the different degrees of modification, or contrast, allowed to the basic visual elements of the landscape in each class. VRM management classes are then established through the RMP process and adjusted as necessary to reflect the resource allocation decisions made in RMPs.

The Pacific Connector pipeline route would cross 46.9 miles of BLM lands that are classified as VRM Class IV in the 2016 Southwestern Oregon and Northwestern and Coastal Oregon ROD/RMPs. VRM Class IV areas allow high levels of change from projects to the characteristic landscape. Management activities may dominate the view and will be the major focus of viewer attention. The construction, operation, and maintenance of the pipeline would be consistent with the objectives of this class.

TABLE 4.8.2.3-1

Forest Service Crosswalk Between Visual Quality Objectives, Scenic Integrity Objectives, and Scenic Integrity Levels a/

Visual Management System (VMS) 1973 Direction Visual Quality Objective (VQO)	Scenery Management System (SMS) 1995 Direction Scenic Integrity Objective (SIO)	Definition of Scenic Integrity Levels
Preservation	Very High	*Unaltered*: Valued landscape character "is" intact with only minute if any visual deviations. The existing landscape character is expressed at the highest possible level.
Retention	High SIO	*Appears unaltered*: Landscapes where the valued landscape character "appears" intact. Visual deviations (human-made structures or activities) may be present but must repeat the form, line, color, texture, and pattern common to the landscape character so completely and at such a scale that they are not evident.
Partial Retention	Moderate SIO	*Appears slightly altered*: Noticeable deviations must remain visually subordinate to the landscape character being viewed.
Modification	Low SIO	*Appears Moderately Altered*: Visual deviations (human-made structures or activities) begin to dominate the valued landscape character being viewed but they borrow valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes or architectural styles outside the landscape being viewed. They should not only appear as valued character outside the landscape being viewed but compatible or complimentary to the character within.
Maximum Modification	Very Low SIO	*Appears Heavily Altered*: Visual deviations (human-made structures or activities) may strongly dominate the valued landscape character. They may not borrow from valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes or architectural styles within or outside the landscape being viewed. However deviations must be shaped and blended with the natural terrain (landforms) so that elements such as unnatural edges, roads, landings, and structures do not dominate the composition.
For Inventory and Scenic Effect Prediction Purposes Only		
Unacceptable Modification UM	Unacceptably Low	*Extremely altered*: Landscapes where the valued landscape character being viewed appears extremely altered. Visual deviations (human-made structures or activities) are extremely dominant and borrow little if any form, line, color, texture pattern or scale from the landscape character. Landscapes of this level of integrity need rehabilitation. This level should only be used to inventory existing integrity. It must not be used as a management objective.

a/ Scenic Integrity Objectives establish desired conditions for management (equivalent to purpose of Visual Quality Objectives under former VMS); Scenic Integrity Levels describe the current condition of the scenic resource.

TABLE 4.8.2.3-2

BLM Visual Resource Management Classes

VRM Class	Definition
Class I Preserve Landscape Character	Manage Visual Resource Management Class I areas in accordance with natural ecological changes. Prohibit activities that would lower the Visual Resources Inventory class of Visual Resource Management Class I areas. The level of change to the characteristic landscape will be very low and will not attract attention. Changes will repeat the basic elements of form, line, color, texture, and scale found in the predominant natural features of the characteristic landscape.
Class II Retain Landscape Character	Manage Visual Resource Management Class II areas for low levels of change to the characteristic landscape. Management activities will be seen but will not attract the attention of the casual observer. Changes will repeat the basic elements of form, line, color, texture, and scale found in the predominant natural features of the characteristic landscape.
Class III Partially Retain Landscape Character	Manage Visual Resource Management Class II areas for low levels of change to the characteristic landscape. Management activities will be seen but will not attract the attention of the casual observer. Changes will repeat the basic elements of form, line, color, texture, and scale found in the predominant natural features of the characteristic landscape.
Class IV Major Modification of Landscape Character	Visual Resource Management Class IV includes all lands that are not designated as Visual Resource Management Classes I, II, or III. Manage Visual Resource Management Class IV areas for high levels of change to the characteristic landscape. Management activities may dominate the view and will be the major focus of viewer attention.

<u>Sensitive Viewsheds on Federal Lands</u>

The federal land managing agencies identified areas they consider possessing sensitive viewsheds along the pipeline route and, as appropriate, developed site-specific amendments to LMPs to ensure compliance with the LMPs if the Project were authorized. Pacific Connector outlined measures it would implement to reduce visual impacts at those areas in its *Aesthetic Management Plan for Federal Lands* (Appendix A to the POD). Table 4.8.2.3-3 lists the sensitive viewsheds on federal land, their visual objective classes, and proposed mitigation measures.

TABLE 4.8.2.3-3

Sensitive Viewsheds on Federal Lands and Proposed Mitigation Measures

MPs	Viewshed Area	Agency/Unit	Visual Class or Objective	Sensitivity Level	Mitigation Methods a/
161.07-161.64	Big Elk Road (FS Road 37) – South Fork Little Butte Valley	Forest Service – Rogue River National Forest	VQO – Foreground Retention	High	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13
167.49-167.93	PCT	Forest Service – Rogue River National Forest	VQO – Foreground Partial Retention	High	1, 2, 3, 4, 5, 6, 10, 13
156.3 to 156.8 and 157.2 to 157.5	Little Butte Creek	Forest Service – Rogue River National Forest	Middleground Partial Retention	Moderate	1, 2, 6, 12, 13
168.40-169.00	Dead Indian Memorial Highway	Forest Service – Winema National Forest	VQO – Foreground Retention	High	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
169.00-174.40 176.15-176.45; 176.60-177.04	Clover Creek Road	Forest Service – Winema National Forest	VQO - Foreground Partial Retention	Moderate-High	1, 2, 3, 4, 5, 6, 7, 8, 10

a/ 1 – Mulch right-of-way and use colorant of dark brownish green for hydro-mulch;
2 – Scallop and feather edges of the right-of-way by removing or cutting some tall trees as directed by land manager;
3 – Transplant trees 15-20 feet tall in clusters spaced 660 feet apart;
4 – Transplant trees in clusters in TEWAs and combine with partly buried boulders;
5 – Bury root wads and boulders in foreground along right-of-way;
6 – Reduce soil compaction according to the ECRP;
7 - Plant 1-2 gallon-sized shrubs and protect them with plant guards;
8 – Construct a berm with boulders to discourage OHV access;
9 – Screen corridor from viewer by leaving trees near roadway and transplanting trees 15-20 feet tall in foreground;
10 – Plant deciduous trees and shrubs such as willow, ceanothus, ribes, huckleberry and chinquapin;
11 – Recontour cut bank to discourage OHV access;
12 – Fund Forest Service tree thinning activities
13 – Necking-down, or narrowing, construction corridor.
b/ This VRM class is inconsistent with figure 4.8-16. The VRM Class shown here is correct.

Visual Resources Specific to Consistency with Federal LMPs

BLM Lands

BLM lands crossed by the Pacific Connector Pipeline Project are VRM Class IV where high levels of change in the landscape character are permitted. The Pacific Connector Pipeline would meet the VRM Class IV standards on all BLM lands.

NFS Lands

Umpqua National Forest

The VQO for all lands crossed by the Pacific Connector Pipeline Project on the Umpqua National Forest is Maximum Modification. The pipeline would be within the VQO standards of Maximum Modification upon completion of corridor restoration and revegetation.

Rogue River National Forest

The Pacific Connector pipeline would meet the VQOs of the Rogue River National Forest LRMP with the following three exceptions:

(1). At the crossing of the Big Elk Road at Pacific Connector pipeline MP 161.4 in Section 16, T. 37 S., R. 4 E., W. M., Oregon.

This location has a VQO of Foreground Retention (Management Strategy 6, Rogue River National Forest LRMP, page 4-72). Standards and guidelines for Foreground Retention where the Pacific Connector pipeline route crosses the Big Elk Road require that VQOs be met within one year after completion of the Project and that management activities not be visually evident. The pipeline project would not meet that standard at that location. Amendment RRNF-2 of the Rogue River National Forest LRMP is proposed at this location to make provision for the Pacific Connector pipeline. This proposed amendment would change the VQO at this location to Foreground Partial Retention (Management Strategy 7, LRMP page 4-86) and allow 10 to 15 years for the amended VQOs to be attained. The Big Elk Road in the vicinity of the Pacific Connector pipeline crossing would be affected by this proposed amendment. This is a site-specific amendment that would apply only to the Pacific Connector pipeline. It does not change VQOs for any other project.

Temporal and Spatial Boundaries of Impacts

This proposed change would affect about 5 acres in the year of construction and approximately 2 acres after 10 years. The 5 acres represents the 75-foot-wide construction right-of-way as seen from Big Elk Road. The 2 acres represents the area seen from Big Elk Road associated with the 30-foot-wide operational permanent easement for the pipeline that would be kept clear of tall trees (more than 15 feet tall) 10 years after right-of-way restoration and revegetation. This would not achieve the Forest Plan goals and objectives of a natural appearing forest at that location one year after construction. Drivers passing the corridor would be able to see it for approximately 15 to 20 seconds. This change would affect only recreation and VQOs in the vicinity of the Big Elk Road–Pacific Connector pipeline intersection. No other LRMP goals and objectives would be affected by this change.

(2). At the crossing of the PCT at Pacific Connector pipeline MP 168 in Section 32, T. 37 S., R. 5 E., W. M., Oregon

This location has a VQO of Foreground Partial Retention (Management Strategy 7, Rogue River National Forest LRMP page 4–86). Standards and guidelines for Foreground Partial Retention require that VQOs be met within three years of completion of the Project, and that activities be visually subordinate to the landscape. The Pacific Connector pipeline would not meet that standard at that location. Amendment RRNF-3 is proposed at this location to change the VQO to Modification (USDA Forest Service Agricultural Handbook 478) and to allow five years for amended VQOs to be attained. The PCT in the vicinity of the Pacific Connector pipeline crossing would be affected by this proposed amendment. This is a site-specific amendment that would apply only to the Pacific Connector pipeline. It does not change VQOs for any other project.

Temporal and Spatial Boundaries of Impacts

This proposed change would affect approximately 5 acres of seen area in the year of construction. The 5 acres would encompass the 75-foot-wide pipeline construction right-of-way seen from the PCT. Vegetation growth and mitigation measures would reduce the seen area to approximately 2 acres after five years. This would not achieve the Forest Plan goals and objectives of a natural appearing forest at that location within 3 years after construction. Hikers and horseback riders passing the corridor would be able to see it for approximately 1 to 3 minutes. This change would affect only recreation and VQOs in the vicinity of the PCT–Pacific Connector pipeline intersection.

(3). Along the ridgetop south of State Highway 140 between Pacific Connector pipeline MPs 156.3 to 156.8 and 157.2 to 157.5 in Sections 11 and 12, T. 37 S., R. 3 E., W. M., Oregon

This location has a VQO of Middleground Partial Retention. Standards and guidelines for Middleground Partial Retention (Management Strategy 9, Rogue River National Forest LRMP Page 4– 112) require that VQOs for a given location be achieved within 3 years of completion of the Project. The Pacific Connector pipeline would not meet this standard at that location. Amendment RRNF-4 of the Rogue River National Forest LRMP is proposed at this location to make provision for the pipeline project. This proposed amendment would allow 10 to 15 years to meet the Middleground Partial Retention standard at this location. Approximately 0.8 mile or 9 acres of the Pacific Connector right-of-way in the Middleground Partial Retention VQO visible at distances of 0.8 to 5 miles from State Highway 140 would be affected by this proposed amendment. This is a site-specific amendment that would apply only to the Pacific Connector pipeline. It does not change VQOs for any other project.

Temporal and Spatial Boundaries of Impacts

This proposed change would affect approximately 9 acres or about 0.8 mile of the pipeline corridor as seen from Highway 140 in the year of construction. For the next 10 to 15 years, the pipeline corridor would remain visually dominant to the surrounding landscape but would become less evident each year. Vegetation growth and mitigation measures would allow the area to meet the assigned VQO of Middleground Partial Retention after 10 to 15 years.

This proposed amendment would not change VQOs, but instead allow more time to meet the VQO of Middleground Partial Retention as seen from Highway 140. To the degree that travelers look up as they are headed west on Highway 140, this location would be visible from a distance of 0.8 to 5 miles for a few minutes. Duration would depend on travel speed but would likely be less than 10 minutes, and would likely not be continuous because of the height of roadside trees and line of sight from the highway. This location would not be visible from other key observation points or travel routes such as the Big Elk Road.

Winema National Forest

The Pacific Connector pipeline would meet the VQO of the Winema National Forest LRMP with the following exceptions:

(1). Where the Pacific Connector right-of-way crosses the Dead Indian Memorial Highway at approximately pipeline MP 168.8 in Section 33, T. 37 S., R. 5 E., W. M., Oregon

This location has visual standard of Foreground Retention. Standards and guidelines for Scenic Management, foreground retention (Winema National Forest [WNF] LRMP 4–103, Management Area 3A, Foreground Retention) requires visual standards for a given location be achieved within one year of completion of the Project. The Pacific Connector pipeline would not meet that standard at that location. Amendment WNF-2 is proposed to allow 10 to 15 years to meet the specified visual standard at this location. This is a site-specific amendment that would apply only to the Pacific Connector pipeline in the vicinity of the Dead Indian Memorial Highway and would not change future management direction for any other project.

Temporal and Spatial Boundaries of Impacts

This proposed amendment would affect about 3 acres of Management Area 3A initially, but over a period of 10 to 15 years, the affected area would decrease to around one-quarter of an acre because of the growth of vegetation at the highway crossing. Installing the pipeline across Dead Indian Memorial Highway would create a corridor that would be visible for about 10 to 15 seconds for travelers along the highway. The area affected by pipeline construction at the crossing would be much less than one percent of Management Area 3A. This is a project-specific amendment that would affect only and recreational experiences in a limited area. This proposed amendment would not change visual standards, but instead allows more time to meet the visual standards of foreground retention as seen the Dead Indian Memorial Highway.

(2). Where the Pacific Connector right-of-way is adjacent to the Clover Creek Road from approximately pipeline MP 170 to 175 in Sections 2, 3, 4, 11, and 12, T. 38 S., R. 5 E., and Sections 7 and 18, T. 38 S., R. 6 E., W. M., Oregon

This location has a visual standard of Foreground, Partial Retention. Standards and guidelines for Foreground Partial Retention (LRMP, page 4–107, Management Area 3B) require that visual standards be met within three years of completion of a project. The Pacific Connector pipeline cannot meet that standard at that location in three years after construction. Amendment WNF-3 is proposed to allow 10 to 15 years to meet the standard of Foreground, Partial Retention at this location. This is a site-specific amendment that would apply only to the Pacific Connector pipeline in the vicinity of the Clover Creek Road and would not change future management direction for any other project.

Temporal and Spatial Boundaries of Impacts

The Winema National Forest LRMP would be amended to allow 10 to 15 years to meet the VQO for Scenic Management, Foreground Partial Retention from MPs 170 to 175. This change would potentially affect approximately 50 acres and 6 miles of corridor as seen from the Clover Creek Road. This is a site-specific amendment that would apply only to the Pacific Connector pipeline in the vicinity of Clover Creek Road and would not change future management direction for any other project. Over a period of 10 to 15 years, the affected area would decrease to about 29 acres because of changes in vegetation. Initially, the affected area would be visually evident for the entire 5 miles on NFS lands adjacent to the Clover Creek road. Over time, this would become less visually evident because of the ingrowth of vegetation and mitigation measures adopted by the Pacific Connector pipeline. At an average speed of 40 mph, the 5-mile-long area affected by this amendment would be visible for approximately 10 to 12 minutes.

4.8.2.4 Conclusion

Constructing and operating the Jordan Cove LNG Project would result in substantial short-term and long-term changes to the existing landscape within the viewshed of the Project. As described in the preceding sections, the LNG tanks and related facilities at the terminal would be visible from a range of viewpoints within the surrounding area and the visual effects were assessed to be low to high dependent on the user and viewpoint location. Jordan Cove attempted to optimize design factors for the LNG tanks and has adopted various measures to mitigate for the visibility of the Project facilities, including use of landform contouring and stabilization, vegetative screening, architectural treatments, and use of hooded lighting. However, based on the size and location of the proposed LNG facilities we conclude that the Jordan Cove LNG portion of the Project would significantly affect visual resources for some views and viewing locations.

Constructing and operating the Pacific Connector Pipeline Project would result in short-term and long-term visual effects as described in the preceding sections. However, Pacific Connector's proposed procedures and mitigation measures are expected to result in reduction of the long-term visual contrast in color, as well as line and texture created by clearing of the pipeline right-of-way. Measures such as structure co-location, painting, landscaping, and screening are expected to limit the visual effects of the associated aboveground Project facilities. Based on the proposed construction, operation, and minimization measures, the Project, excluding the LNG facility, would not significantly affect visual resources.

4.9 SOCIOECONOMICS

This section addresses the potential effects of Project construction and operation on the following components of the social and economic environment: population, housing, the local economy and employment, infrastructure and public services, recreation and tourism, other commercial activities, and environmental justice. The following discussion is divided into two main sections that address the Jordan Cove LNG Project and Pacific Connector Pipeline Project separately. Both projects would involve construction and operation activities in Coos County. Potential impacts to Coos County are discussed separately by Project, with the combined impacts of both Projects discussed in section 4.9.2.

4.9.1 Jordan Cove LNG Project

4.9.1.1 Population

The closest cities to the Jordan Cove LNG Project are North Bend and Coos Bay. These two cities had estimated 2017 populations of 9,800 and 16,615, respectively (see table 4.9.1.1-1). The total estimated population of Coos County in 2017 was 63,310.

TABLE 4.9.1.1-1

Population by State, County, and Community

State/County/Community	2000	2010	2017	2010 to 2017 Net Change	2010 to 2017 Percent Change
Oregon	3,421,399	3,831,074	4,141,100	310,026	8.1%
Coos County	62,779	63,043	63,310	267	0.4%
City of Coos Bay	15,374	15,967	16,615	648	4.1%
City of North Bend	9,544	9,695	9,800	105	1.1%

Source: Portland State University 2012, 2017a, 2017b

As described previously, Jordan Cove estimates that construction of the Jordan Cove LNG Project and associated facilities would take place over a roughly 5-year period. Following an initial 9-month period of site clearing, construction of the Jordan Cove LNG Project would occur over a 53-month construction period. Jordan Cove's estimated construction workforce would average 1,023 workers over the 53-month construction period, with projected employment expected to peak in month 30 with an estimated 1,996 workers employed on site (ECONorthwest 2017a). Construction would require workers in highly skilled crafts, such as pipefitters, ironworkers, electricians, carpenters, and management staff, including safety specialists. Jordan Cove anticipates that the workers hired will already have these skills, having gained experience in other related industries, including the oil and gas and power industries.

Jordan Cove estimates that an average of 221 workers would commute daily from their normal place of residence to the Project site, leaving an estimated average of 802 workers temporarily relocating to the Project vicinity. A portion of this workforce would be accompanied by family members, resulting in the total estimated addition of an average of 901 people (workers and family members) to the Project vicinity. The addition of 901 people would be equivalent to approximately 3.4 percent of the combined populations in the cities of Coos Bay and North Bend in 2017 (26,415), and approximately 1.4 percent of the total county population (63,310) (table 4.9.1.1-1).

At the peak of construction, an estimated total of 1,752 people would temporarily relocate to the Project vicinity (ECONorthwest 2017a). This temporary increase would be equivalent to about 6.6 percent of the combined populations of Coos Bay and North Bend and 2.8 percent of the county total (table 4.9.1.1-1). These estimated peak population increases would be temporary and short term. Very few, if any, of the temporary construction workers relocating to the Project area are expected to stay permanently. Impacts associated with construction-related population increases are discussed throughout this section.

In the first full year of operations, Jordan Cove would directly employ 200 workers in Oregon, 180 at the Jordan Cove LNG Project and 20 at the company office in Portland. Unlike construction, once the Project is operating, the employees would live permanently near their workplaces. Workers would either be hired locally or permanently relocate to the area. ECONorthwest (2017a) estimated that about 40 percent of the operating workforce at the Jordan Cove LNG Project would be hired locally, with the remaining 60 percent relocating to Coos County from out-of-state or elsewhere in Oregon. Assuming an average household size of 2.74, this would result in the addition of 296 new residents, which would be equivalent to about 1.1 percent of the combined populations in the cities of Coos Bay and North Bend in 2017.

Crime

We received several comments on the Project that expressed concern that the temporary influx of construction workers and the development of "man-camps" would result in increases in crime, drug and alcohol use, prostitution, human trafficking, and domestic violence, as well as other criminal activities. Local tribal members also expressed concern about the potential for increased crime to disproportionally affect Native Americans and suggested that staff consider natural resource development impacts on crime in North Dakota and Wyoming. Based on this concern and to assess the Project's potential impact on crime rates, we reviewed existing published literature that considers the link between crime and natural resource development, as well as (based on historical patterns) the potential for disproportionate impacts on tribal communities. Most of the research into the link between natural resource development and crime focuses on "boomtowns," where large-scale resource development, especially oil and gas extraction, has resulted in rapid population growth that has weakened existing social ties in the affected communities (O'Connor 2017). Some might consider the introduction of a workforce to construct the Project as analogous to a "boomtown"; however, the number of individuals that are expected to temporarily migrate to the Project area would, as described above, result in a minor increase in the local population.

Based on official crime statistics and interviews with law enforcement officers, studies in North Dakota and Wyoming found that the crimes that increased the most during boom periods included traffic-related crimes (e.g., driving under the influence), felony and simple assault, disorderly conduct, drug-related crimes, thefts, burglaries, and domestic violence (Archbold 2015; Archbold et al. 2014; Jacquet 2005; Jayasundara et al. 2016). Police officers in North Dakota attributed the increase in domestic violence calls to housing shortages and cramped living quarters and stated that violent crimes in their jurisdictions were not increasing to the extent that local, regional, and national media outlets reported (Archbold 2015). Some articles (Harvard 2015; Adler and Hillstrom 2015; Gillette 2016; Briody 2017; Deer and Nagle 2017; Nienaber 2017) have focused on the Bakken Oil Field in North Dakota, near the Fort Berthold Indian Reservation. These articles focus on links between semi-permanent worker camps and negative impacts on female Native

American populations. The influx of large numbers of well-paid male oil workers at the North Dakota camps coincided with increases in sex trafficking, rape, and physical violence.

Other studies found inconclusive links between crime and increased oil and gas activity or only minor increases in crime (Ruddell et al. 2014; Kowalski and Zajac 2012; Luthra et al. 2007; Price et al. 2014). A recent study in North Dakota found few significant relationships linking increased drilling to increases in crime and concluded that the impact of drilling is localized, with different counties experiencing different levels and types of crime-related impacts (O'Connor 2017).

The experiences of oil- and gas-related boomtowns in North Dakota and Wyoming have limited applicability when considering the potential for increased crime in the Project area. As discussed above, temporary construction-related increases in population would range from about 3.4 percent (average) to 6.6 percent (peak) of the combined populations in the cities of Coos Bay and North Bend in 2017. These numbers would, however, be higher when pipeline construction workers employed in Coos County are added to the total (see section 4.9.2.1). This population increase would be temporary, and we conclude that attempts to estimate related increases in crime would be speculative, but were they to occur such increases would likely be commensurate with the relative increases in population.

4.9.1.2 Housing

In 2015, Coos County had an estimated total of 30,482 housing units[166], with a rental vacancy rate of 6.7 percent and 660 housing units available for rent. In addition, an estimated 1,462 units were identified for seasonal, recreational, or occasional use. In the cities of North Bend and Coos Bay, an estimated 124 and 172 housing units, respectively, were available for rent, with an additional 26 and 230 units identified for seasonal, recreational, or occasional use (U.S. Census Bureau 2017a, 2017b).

A housing analysis and action plan completed for Coos County in 2018 (czbLLC 2018) found limited affordable housing units available for rent or purchase in Coos County, with very little new construction over the past decade and existing units being converted to vacation and seasonal use. The study identified a deficit of affordable rental units for almost all income groups, including low-income households. In addition, the study noted that anecdotal examples exist of newcomers being unable to find quality housing at a reasonable price (czbLLC 2018).

ECONorthwest (2017b) identified 23 hotels and motels in Coos County, with a combined total of 1,442 rooms. More than half of these rooms (776 or 54 percent) were located in the cities of Coos Bay and North Bend, with a further 34 percent (496 rooms) located in Bandon, about 30 miles south of the site. There were also at least 26 smaller lodging establishments (less than 15 rooms) in Coos County, with an estimated total of 214 rooms (ECONorthwest 2017b). The number of rooms available for rent by construction workers would vary by season. Average occupancy data for Coos County compiled from January 2011 through July 2017 indicate that average monthly occupancy rates range from about 38 percent in January to 78 percent in July and 80 percent in August (ECONorthwest 2017a). Applying these percentages to the estimated total supply of hotel, motel, and inn rooms in Coos County (1,656) suggests that on average 1,025 rooms would likely

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[166] The Census Bureau defines a housing unit as a house, apartment, mobile home or trailer, group of rooms, or single room occupied or intended to be occupied as separate living quarters. Data are 5-year estimates (2011 to 2015) from the U.S. Census American Community Survey. Estimates are annual totals based on 5 years of data (U.S. Census Bureau 2017a, 2017b).

be available for rent in January, with 330 rooms potentially available in August. It should also be noted that occupancy rates vary during the week, and tend to be higher during weekends.

Jordan Cove identified 39 recreational vehicle (RV) parks and campgrounds in Coos County, with a combined total of approximately 2,206 managed spaces (ECONorthwest 2017b). In addition to these identified designated camping facilities, camping is also allowed outside of designated facilities on some public land. This "dispersed camping," as it is known, is common throughout Coos County. As with hotels, demand for RV spaces is highly seasonal and the highest demand is usually on weekends.

As described previously, Jordan Cove proposes to build a workforce housing facility at the South Dunes site to address concern that demand for rental housing by construction workers will have a negative impact on the availability and cost of rental housing for local residents. Units would be added in phases beginning with approximately 200 units in the fall of year 2, and peaking at up to 700 units (depending on demand) in early year 3, with the number of units on-site gradually reduced starting in the latter half of year 4.

Potential housing options for relocating workers include rental housing (houses, apartments, and mobile homes), hotels and motels, and RV parks and campgrounds, as discussed above. In addition, construction workers commonly rent extra bedrooms in existing owner- or renter-occupied homes. Finally, workers would also have the option to stay in the Workforce Housing Facility.

ECONorthwest (2017a) estimated that during an average month 147 workers would seek rental housing, 337 workers would seek hotel and motel rooms, RV or campground spaces, or individual room rentals; with 311 workers expected to reside at the workforce housing facility. During peak construction, they estimated that 274 workers would seek rental housing, 588 workers would seek hotel and motel rooms, RV or campground spaces, or individual room rentals; and 693 workers would be expected to reside at the workforce housing facility.[167]

For rental housing, the estimated average demand for 147 units and peak demand for 274 units would be equivalent to approximately 22 percent and 42 percent of the total 660 units estimated to be available for rent in Coos County. However, as noted above, potential shortages of rental housing have been identified in Coos County (czbLLC 2018). Average and peak demand for other types of housing units (337 and 588 units, respectively) would exceed the estimated available supply of hotel and motel rooms in Coos County in August (330 rooms). However, a share of this demand would also likely be met by RV and campground spaces and individual room rentals in existing owner- or renter-occupied housing. Construction-related demand would result in lower vacancy rates and upward pressure on rental/room rates. Other visitors seeking temporary accommodation near the terminal site may be temporarily displaced during peak season, especially on summer weekends. These estimates also assume, as described above, that about one-third of the workers temporarily relocating to the area would be housed at the workforce housing facility, thereby reducing demand for other types of housing in the Project vicinity. Construction workers associated with the Pacific Connector pipeline would also be seeking temporary housing in Coos

[167] These estimates developed on behalf of Jordan Cove are "likely housing choices based on information provided by contractors, union PLA documents, comparable Oregon projects, JCEP, and estimates by ECONorthwest" (ECONorthwest 2017a, p. 16). In addition to the above, they assumed that a handful of non-local construction workers (7 to 13) would seek to purchase housing.

County. The combined impact of housing demand from LNG terminal and pipeline workers is discussed below in section 4.9.2.2.

In 2024, the first full year of operations, Jordan Cove would directly employ 180 workers in Coos County. ECONorthwest (2017a) estimated that about 40 percent of the operating workforce (72 workers) at the LNG terminal would be hired locally, with the remaining 60 percent (108 workers) relocating to Coos County from out-of-state or elsewhere in Oregon. Many of the relocating workers would likely buy homes, while others would choose to rent. Estimates from the U.S. Census Bureau's American Community Survey indicate that Coos County's existing housing for sale (480 units) and for rent (660 units) currently exceeds this potential demand (U.S. Census Bureau 2017b). However, as noted above, the 2018 Coos County housing analysis and action plan identified potential shortages of rental housing, as well as anecdotal evidence of newcomers to the area being unable to find quality housing at a reasonable price (czbLLC 2018).

4.9.1.3 Property Values

Numerous stakeholders expressed concern about the Project's impact on property values. The nearest residences to the Jordan Cove LNG Project are located across the bay in the cities of North Bend and Coos Bay, more than a mile from the site. The proposed terminal site is located near other industrial uses and the Southwest Oregon Regional Airport. Real estate property values are dependent on a number of factors, including, but not limited to, location, lot size, property condition, proximity to public services and infrastructure, and market trends. Staff has repeatedly attempted to address property value concerns; however, due to the lack of independently prepared, peer-reviewed studies regarding natural gas export terminal facility impacts on property values, we are not able to determine what, if any, impact the Project would have on property values. A property's value is ultimately determined by the amount a purchaser is willing to pay, and we are not aware of any conclusive evidence linking natural gas terminal infrastructure to a decrease in property value.

Studies that assess the impact of LNG export terminals on property values are limited. However, a study conducted by the Argonne National Laboratory (Clark and Nieves 1994) examined the economic impacts of eight types of "noxious" facilities on local wages and property values. The study examined the effects of 262 facilities, 11 of which were LNG facilities. The study concluded that the presence of five of the eight types of "noxious" facilities has a significant negative effect on property values and a positive effect on wages. However, the study concluded that the presence of an LNG facility did not have a significant positive or negative effect on either wages or property values (Clark and Nieves 1994).

More recently, Davis (2011) assessed the impact of 92 large power plants that opened in the U.S. between 1993 and 2000. Using the hedonic price method, Davis estimated impacts to housing values and rents within 2 miles of each new facility and found "modest declines" of 4 to 7 percent, with somewhat larger decreases within 1 mile.

For Jordan Cove, ECONorthwest (2006) reviewed property values within 1 mile of existing LNG "peak storage" facilities in Newport and Portland, Oregon. Using data from the Lincoln County Tax Assessors Office, ECONorthwest found that property values around the Newport LNG plant were not depressed and 25 homes within 0.5 mile and overlooking the facility had above average market values. They also argue that the presence of many other industrial and commercial properties around the Portland LNG facility, including the second-largest industrial employer in the city, suggest that the presence of this facility has not discouraged other businesses from locating in the area (ECONorthwest 2006).

4.9.1.4 Economy and Employment

Coos County had a total estimated civilian labor force of 26,521 in 2016 (Oregon Employment Department 2017). The average annual unemployment rate in Coos County in 2016 was higher than the statewide average, 6.5 percent versus 4.9 percent. State and local government and retail trade were the two largest sectors in the county in 2015 based on employment (U.S. Bureau of Economic Analysis 2016a). The median household income in Coos County in 2015 was $38,934 (U.S. Census Bureau 2016).

Jordan Cove estimates that construction of the Jordan Cove LNG Project would cost about $7.3 billion over the 53-month construction period, with an estimated $2.99 billion expected to be spent in Oregon (ECONorthwest 2017c).

Using IMPLAN economic modeling software, ECONorthwest (2017c) estimated the total (direct, indirect, and induced) regional economic impacts of Project construction (table 4.9.1.4-1). Direct impacts are those that happen at the initial source of the economic activity, in this case the project construction sites. Indirect impacts are generated by the expenditures on goods and services by suppliers who provide goods and services to the construction project. Indirect effects are often referred to as "supply-chain" impacts because they involve interactions among businesses. Induced impacts are generated by the spending of households associated either directly or indirectly with the Project. Workers employed during construction, for example, will use their income to purchase groceries and other household goods and services. Workers at businesses that supply the facility during construction or operation will do the same. Induced effects are sometimes referred to as "consumption-driven" impacts. Spending associated with the Project produces multiplier spending effects for other sectors of the state economy as businesses respond to supply-chain and consumption-driven demands for goods and services.

TABLE 4.9.1.4-1

Regional Economic Impacts of Construction of the Jordan Cove Project in Oregon

Impact Type	Output b/	Value Added b/	Labor Income b/	FTE Jobs b/	Average Number of Jobs per Year c/
Total Direct Impacts	$7,300	na	$1,235	4,527	1,023
Local Impacts (State of Oregon) a/					
Direct	$2,990	$1,027	$967	3,531	798
Indirect	$1,743	$992	$776	14,107	3,194
Induced	$1,725	$982	$571	13,435	3,042
Total d/	**$6,458**	**$3,001**	**$2,314**	**31,073**	**7,034**

Notes:
FTE – full-time equivalent; na – not applicable
a/ Local impacts in this context are impacts that would occur within the state of Oregon. Direct impacts are the share of the total direct impacts expected to occur in Oregon.
b/ Impacts are presented for the entire 53-month construction period. Output, value added, and labor income are expressed in millions of dollars.
c/ Average number of jobs per year based on 53 months of construction.
d/ Totals may not sum due to rounding.
Source: ECONorthwest 2017c

Total impacts are estimated in terms of economic output, value added, labor income, FTE jobs, and average jobs per year. Economic output represents the dollar value of goods and services produced, and serves as a broad measure of economic activity. Value added represents the net contribution of industries to the local economy and consists of revenues less intermediate inputs. Labor income is the sum of employee compensation and proprietary (self-employed) income. FTE jobs represent employment for 2,080 hours per year; FTE jobs do not necessarily translate into the number of affected workers. Two jobs that last 6 months each, for example, count as one FTE job.

As stated in section 4.9.1.1, Jordan Cove estimated that they would employ an annual average of 1,023 workers over the 53-month-long construction period, with a peak of 1,996 employees during month 30. Total direct employment over the 53-month construction period was estimated to be equivalent to 4,527 FTE jobs, with the equivalent of 3,531 FTE jobs expected to be filled by Oregon workers. Construction of the Jordan Cove LNG Project would be a union project, with Jordan Cove requiring the major contractor to sign a project labor agreement with the key signatory unions to the National Construction Agreement. Union locals believe they can supply the majority of skilled crafts workers from within Oregon. ECONorthwest (2017a), in an analysis prepared on behalf of Jordan Cove, assumed that almost four-fifths of all construction workers, managers, and staff for the Jordan Cove LNG Project would come from Oregon. In addition, ECONorthwest (2017a) estimated that Project construction would support a total of 14,107 indirect and 13,435 induced FTE jobs in Oregon over the life of the Project (table 4.9.1.4-1).

During the first full year of operations, Jordan Cove would directly employ 200 workers in Oregon, 180 for the LNG terminal, and 20 for the company office in Portland, with total labor compensation (including benefits and payroll taxes) expected to exceed $44.8 million. This direct employment in conjunction with facility expenditures on Oregon sourced goods and services would support additional economic activity in Coos County and elsewhere in Oregon. Using expenditure data provided by Jordan Cove, ECONorthwest (2017d) estimated that annual Project operation would support total (direct, indirect, and induced) employment of 1,602 FTE jobs in Oregon in 2024, with total associated labor compensation of approximately $132.3 million. Viewed in 2017 dollars, total compensation would be about $111.3 million or $69,477 per FTE job (ECONorthwest 2017d). Indirect and induced impact estimates developed by ECONorthwest (2017c, 2017d) are based on the share of construction and operation expenditures that Jordan Cove estimates would occur in Oregon. Changes in actual levels of in-state spending would result in changes to the indirect and induced impact estimates.

No commercial enterprises would be displaced by the Project, and construction and operation of the terminal would not result in the loss of local business revenues or taxes.

4.9.1.5 Tax Revenues

Total revenues for Coos County were approximately $52.3 million in fiscal year 2016. Tax revenues accounted for $10.5 million of this total, with 96 percent of tax revenues generated by property taxes (Coos County 2017). Other sources of revenue included intergovernmental transfers (state and federal funds); licenses, fees, and permits; charges for services; and timber sales on county forestlands (table 4.9.2.5-1). The LNG terminal would contribute to the fiscal health of local communities through a local Community Enhancement Plan (CEP) in Coos County. Construction and operation of the Jordan Cove LNG Project would also generate state and local tax revenues, including revenues from payroll taxes.

4.9.1.6 Public Services

Law Enforcement and Fire Protection

Coos County is served by one sheriff's office, seven police departments, and 17 fire departments. To minimize potential impacts, Jordan Cove would reimburse Coos County to cover any costs associated with public safety during construction and operation. Jordan Cove has also committed to building and funding the SORSC within the Jordan Cove LNG Project site. In addition, a continuously manned Jordan Cove Fire Station would be located on-site and Jordan Cove would be responsible for funding additional security measures to protect LNG carrier marine traffic.

Jordan Cove would also be responsible for funding additional security measures outlined in the Coast Guard's WSR and LSR to protect LNG carrier marine traffic to and from the terminal within the waterway; this would include escort boats operated by the County Sheriff's department.

Medical Facilities

Coos County is served by three hospitals. The Southern Coos Hospital is designated a critical access hospital as well as a full-service, general acute care hospital. It is ranked as a Level 4 Trauma Center (Southern Coos Hospital & Health Center 2017). The Coquille Valley Hospital in Coquille is ranked as a Level 4 Trauma Center (Coquille Valley Hospital 2017). The Bay Area Hospital in the city of Coos Bay is the closest to the Jordan Cove LNG Project site, approximately 6 miles away. This facility is rated a Level 3 Trauma Center (Bay Area Hospital 2017). In addition, North Bend Medical Center is a regional health care cooperative with five locations and more than 70 providers in the Coos Bay area (North Bend Medical Center 2017).

During construction, Jordan Cove would provide on-site medical facilities and personnel to provide care for the project workforce both at the site and at the Workforce Housing Facility. Care would include first aid, emergency response, and treatment of common illnesses. Potential construction injuries requiring treatment could range from scrapes and bruises through broken bones and injured limbs, concussion, and wounds requiring stitches, with injured parties requiring off-site treatment for more severe injuries should they occur.

During plant operation, Jordan Cove would have a licensed nurse practitioner on staff with offices located in the Operations Building. The primary functions for the nurse practitioner would be to assess routine employee needs, manage employee wellness programs to reduce the need for emergency visits, and handle triage of any job-related injuries that might occur within the Project site. Additionally, to address public concern, Jordan Cove signed an MOU with the State of Oregon that requires it to equip the Bay Area Hospital according to State policies for all hospitals in treating burns.[168] Other potential injuries that might occur are expected to be similar to those already treated at the hospital and by the North Bend Medical Center.

Schools

Coos County has six school districts, with total enrollment of 10,051 in the 2016-17 school year (Oregon Department of Education 2017). The Coos Bay School District operates five schools, serving about 3,100 students (Oregon Department of Education 2017). The North Bend School

[168] Memorandum of Understanding and Agreement No. 14-008 By and Between Jordan Cove Energy Project and the State of Oregon for LNG Emergency Preparedness. Filed July 1, 2014, in FERC Docket No. CP13-483.

District operates four schools serving about 4,400 students (Oregon Department of Education 2017). In addition, there are four private schools in North Bend serving approximately 250 students (ECONorthwest 2017a). The Bandon School District #54 has three schools, serving about 697 students (Bandon School District 2018).

As described previously, numerous non-local workers are expected to temporarily relocate to the Project area during construction, but very few are expected to be accompanied by family members. ECONorthwest (2017a) estimated that 57 households would temporarily relocate to the Project area during Project construction. Assuming an average household size of approximately 2.74 persons, including 0.55 school-aged children, would result in the addition of an estimated 31 students to Coos County schools. This addition would be equivalent to 0.3 percent of total county enrollment in 2016-17, or 0.4 percent of the combined enrollment in the Coos Bay and North Bend School Districts.

Assuming the same average household size as above, Project operation would result in the potential addition of 59 students to Coos County schools. This addition would be equivalent to 0.6 percent of total county enrollment in 2016-17, or 0.8 percent of the combined enrollment in the Coos Bay and North Bend School Districts.

Utilities

Constructing and operating the terminal facilities would require connection to and use of public electric, water, waste disposal, and communications systems/utilities. Jordan Cove has indicated that there is sufficient electric power on the North Spit to serve existing customers and meet Project needs during construction. Liquefaction operations would be powered directly by gas-fired combustion turbines and would not require externally sourced electric power from the grid. The SORSC and low load remote instrumentation would be connected to the local grid.

Solid waste generated during Jordan Cove LNG Project's construction would be collected on-site and items that cannot be reused or recycled would be hauled to licensed landfills by authorized waste haulers and disposal companies. Sanitary waste would either be collected and taken off-site for disposal by a licensed contractor, or treated prior to discharge to the IWWP, and any solid waste would be disposed of off-site by a licensed contractor. All waste generated by the workforce housing facility would be handled in a similar manner.

During operation of the terminal, sanitary waste water would be treated on-site and effluent sent to the IWWP. Solid waste would either be recycled or hauled from the site and disposed of by private licensed waste disposal companies without the need for city or county resources.

4.9.1.7 Recreation and Tourism

Recreation and Tourism

Approximately 1 million people visited Coos County in 2016, staying on average 2.6 nights (Dean Runyan Associates 2017). An estimated 43 percent of these nights were spent in hotels or motels, which accounted for approximately 70 percent of visitor spending. Travel-related spending in Coos County in 2016 totaled about $265.3 million, and supported an estimated 3,280 jobs (approximately 10.2 percent of total county employment), $76.6 million in earnings, and an estimated $9 million in local and state tax revenue.

Commenters during public scoping expressed concern that the Project could negatively affect the local economy by harming the recreation and tourism sectors. Potential effects on tourism could also occur during the summer when construction workers would likely compete with visitors to Coos County for accommodations. Potential combined demand for hotel and motel rooms, RV or campground spaces, and individual room rentals would exceed the estimated available supply of hotel and motel rooms in Coos County in August, even with the workers camp in place. However, as discussed in section 4.9.1.2, a share of this demand would also likely be met by RV and campground spaces and individual room rentals in existing owner- or renter-occupied housing. Construction-related demand would result in lower vacancy rates and upward pressure on rental/room rates. Other visitors seeking temporary accommodation near the terminal site may be temporarily displaced during peak season, especially on summer weekends. This could result in reduced demand for some recreation outfitter/guide services, as potential clients seek recreation opportunities elsewhere.

4.9.1.8 Other Commercial Activities

Commercial Fishing

Coos Bay was the third most important port in Oregon in terms of commercial fish harvested in 2015, accounting for about 10 percent of the total catch by volume. Pacific shrimp constituted almost two-thirds (64 percent; 13.3 million pounds) of the Coos Bay catch in volume and one-half (48 percent) of its catch in value. The other major catches by volume were groundfish (3.2 million pounds), albacore tuna (1.2 million pounds), and sardine (1.4 million pounds) (The Research Group 2016). An estimated total of $54.7 million in total personal income was generated by the fishing industry in the Coos Bay area in 2014, including income from both landed fish and revenue returned from distant water fisheries (The Research Group 2015).

Almost 200 commercial fishing vessels operate in Coos Bay on average per month from March to October, with just over 100 based in Coos Bay for the entire year (ECONorthwest 2017b). The actual number of commercial fishing vessels traveling through Coos Bay might be greater due to some transient travel to deliver products, buy ice, or seek other services. A fisherman's market cooperative and a small commercial fishing fleet are located in Charleston (located a few miles south of the Project area near the mouth of the bay). The Charleston Marina provides infrastructure and services to locally-based and visiting commercial fishing vessels (Oregon International Port of Coos Bay 2018a).

As described previously, numerous cargo ships (vessels and barges) would deliver materials to the terminal site during construction and, once in operation, the site would be called upon by up to 120 LNG carriers per year. Fishing boats would avoid cargo ships and barges similar to how they currently deal with commercial deep-draft ship and barge traffic into and out of the Port. Coos Bay pilots have indicated they typically encounter about two commercial fishing boats when they guide deep-draft commercial ships through the navigation channel (ECONorthwest 2017b).

During LNG carrier transit in the waterway to the terminal, fishermen would be required to move out of the security zone, which would result in delays in transit. The LNG marine traffic would overlap with the portion of the navigation channel used by the ocean-going fishing fleet from Charleston for about 2 miles. There may be slight delays resulting from meeting situations between an LNG carrier and a commercial fishing vessel, because of the security and safety zones or other conditions imposed by the Coast Guard. Jordan Cove has indicated that the impact on boats at any point in the channel would last about 20 to 30 minutes, the same as when other deep-draft vessels use the channel.

Commercial Ship Traffic

According to the Oregon International Port of Coos Bay (2018b), the Port is a major deep-draft coastal harbor moving more than 1.5 million tons of cargo each year. In 2017, 47 deep-draft vessels and 34 tugs and barges docked at Coos Bay port facilities.

The existing Coos Bay channel is wide enough to accommodate only one deep-draft ship in one direction. The Coast Guard, as part of its Waterway Suitability Report (WSR) and LOR, requires Jordan Cove to develop a Transit Management Plan to outline how conflicts with other commercial vessels would be avoided.

Ships associated with the construction and operation of the terminal could be affected by or affect other commercial ship traffic. Because the navigation channel can only accommodate one deep-draft transit, Project-related vessels may need to wait for the channel to clear. Conversely, other commercial ship traffic may need to wait for Project-related vessels to clear the channel, resulting in delays in transit. These potential impacts would be temporary and similar to those associated with existing deep-draft vessels calling at the Port.

Other Industries

There are several industrial enterprises located in proximity to the terminal site including the Southwest Regional Airport, Roseburg Forest Products, the Southport Lumber Company (Southport Lumber), and D.B. Western. The Southwest Oregon Regional Airport is addressed in section 4.10. Jordan Cove would temporarily lease land from Roseburg Forest Products for a staging area (i.e., a “laydown area”) during construction of the Jordan Cove LNG Project. Also, two warehouses located on the Roseburg Forest Products site would be removed during site preparation.

Southport Lumber operates a sawmill about a mile southwest of the terminal site. This facility includes a barge slip at about NCM 6.3 and a rail spur. The D.B. Western factory and berth is located at NCM 5.6, about 2 miles south of the terminal site. Based on the distances to the terminal site, impacts on these facilities are not expected. However, access to these facilities, as well as the Roseburg Forest Products facility, by road and water could be affected by Project-related vehicle traffic on the Trans-Pacific Parkway and vessel traffic in the navigation channel. Project-related effects on the Trans-Pacific Parkway and related mitigation plans are further discussed in section 4.10. Mitigation would likely include staggered work shifts, construction of a dedicated eastbound left-turn lane at the intersection of U.S. 101 at the Trans-Pacific Parkway, and implementation of a temporary signal at the intersection for the duration of construction activities (see section 4.10). Impacts on commercial ship traffic are discussed in the preceding section.

4.9.1.9 Environmental Justice

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires federal agencies to consider if impacts on human health or the environment (including social and economic aspects) would be disproportionately high and adverse for minority and low-income populations and appreciably exceed impacts on the general population or other comparison group.

As described below and consistent with our understanding of EO 12898, we reviewed the Project to determine if resulting impacts would be disproportionately high and adverse for minority and low-income populations and appreciably exceed impacts on the general population or other comparison group. Our area of analysis for the LNG terminal consisted of a 3-mile radius centered on the LNG terminal site. Our comparison groups for this analysis consisted of the general population in Coos County and the State of Oregon.

In comments provided on the draft resource reports prepared for this Project, the EPA requested that the FERC conduct appropriate public outreach to ensure that the public and Native American tribes are informed about the Project and the possible impacts on their communities and trust resources. The EPA also stated that it considers children, the disabled, the elderly, and those with limited English proficiency to be potential environmental justice communities due to their unique vulnerabilities. In several different filings with the FERC, the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians (Coos Tribe) stated that the Jordan Cove LNG Project would be within their ancestral lands. The Coos Tribes indicated that this EIS should address adverse environmental and cultural impacts on low-income and minority populations, and consider protection of cultural resources of importance to the tribes. Cultural resources are discussed further in section 4.11.

Review Methodology

Based on guidelines provided by the CEQ (1997) and EPA (1998), we used a three-step approach to conduct our review. These steps were:

1. Determine the presence of minority and/or low-income populations.
2. Determine if the Project would result in high and adverse human health or environmental effects.
3. Determine if high and adverse human health or environmental effects would fall disproportionately on minority and/or low-income populations.

Environmental Justice and Vulnerable Populations

Guidelines provided by the CEQ (1997a) and EPA (1998) indicate that a minority community may be defined as one where the minority population comprises more than 50 percent of the total population or comprises a meaningfully greater share of total population than the share in the general population. Minority communities may consist of a group of individuals living in geographic proximity to one another, or a geographically dispersed set of individuals who experience common conditions of environmental effect. Further, a minority population exists if there is "more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds" (CEQ 1997a, p. 26).

Minority populations identified by the U.S. Census include Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, and Other Race, which are considered races, and as well as persons of Hispanic or Latino origin, which is considered an ethnicity.

The CEQ and EPA guidelines indicate that low income populations should be identified based on the annual statistical poverty thresholds established by the U.S. Census Bureau. Like minority populations, low income communities may consist of individuals living in geographic proximity to one another, or a geographically dispersed set of individuals who would be similarly affected by the proposed action or program.

We used the EPA's Environmental Justice Mapping and Screening Tool (EJSCREEN) to assess the potential presence of environmental justice communities in the vicinity of the Jordan Cove LNG Project site. In accordance with EO 12898, EJSCREEN provides information on low income and minority populations. The tool also provides summary information for four other factors: less than high school education; linguistic isolation; individuals under age 5; and individuals over age 64, which are considered potential indicators of vulnerable populations. Data for the six demographic variables assessed in EJSCREEN are presented in table 4.9.1.9-1. Review of EJSCREEN indicated that there are no residents within 1 mile of the Jordan Cove LNG Project site.

TABLE 4.9.1.9-1

Demographic Indicators

Selected Variables a/	North Bend	Coos Bay	3-Mile Radius	Coos County	Oregon	United States
Total Population	16,062	9,583	12,156	62,775	3,939,233	316,515,021
Percent of Total						
Minority Population	19	18	19	14	23	38
Low Income Population	37	46	43	44	36	34
Linguistically Isolated Population	1	1	0	1	3	5
Population with Less Than High School Education	7	12	10	11	10	13
Population under Age 5	6	6	6	5	6	6
Population over Age 64	19	21	17	23	15	14

a/ Data are originally from the American Community Survey 2011-2015 five-year estimates compiled by the U.S. Census Bureau.
Source: EPA 2018b

The data presented in table 4.9.1.9-1 indicate that the minority share of the population in the cities of North Bend and Coos Bay and within 3 miles of the site is higher than the Coos County average. Minority shares in all four areas are, however, lower than the statewide average. The data also indicate that the share of the population considered low income by EJSCREEN in the city of Coos Bay, within 3 miles of the site, and in Coos County is higher than the statewide average. The data also indicate that the share of the population over age 64 is higher than the state average in North Bend, Coos Bay, within 3 miles of the site, and in Coos County as a whole.

Coos County has a higher percentage of Native Americans (2.5 percent) than the state of Oregon (0.9 percent) as a whole. This is also the case with the cities of Coos Bay and North Bend, where Native Americans constitute 2.5 percent and 1.9 percent of the total population, respectively (U.S. Census Bureau 2018).

Larger and more populated geographic areas may have the effect of "masking" or "diluting" the presence of concentrations of minority and/or low income populations (CEQ 1997a; EPA 1998). Data were, therefore, also reviewed at the census tract level to identify the potential existence of minority and/or low-income communities within a 3-mile radius of the LNG terminal site (figure 4.9-1). A total of 10 census tracts are fully or partially located within 3 miles of the LNG terminal site. Data were reviewed at the census tract level for the minority and low-income variables identified in table 4.9.1.9-1 using EJSCREEN. The resulting shares of the population were compared to two benchmark areas – Coos County and the state of Oregon – to identify potential environmental justice and/or vulnerable populations within 3 miles of the LNG terminal site.

Four of the 10 census tracts (03, 04, 05.04, 07) had minority populations that were higher than the county share (14 percent). The minority share for these four census tracts ranged from 17 percent to 26 percent, substantially lower than the 50 percent measure identified in CEQ (1997a) and EPA (1998) guidelines, and less than the state average (23 percent) in all but one case.

The share of the population considered low income by EJSCREEN is higher than the state average (36 percent) in Coos County (44 percent) (table 4.9.1.9-1). The low income share of the population was higher than the county average in one of the 10 census tracts (05.04), and higher than the state average in 6 of the 10 census tracts. The low income share in the six census tracts ranged from 37 percent to 55 percent.

The share of total population with less than a high school education was higher than the state average in 5 of the 10 census tracts. Almost all of the census tracts (9 out of 10) had larger shares of their population over age 64 than the state average, while two tracts also had larger shares of total population below age 5. The share of the population identified as linguistically isolated was below the state average in all 10 census tracts.

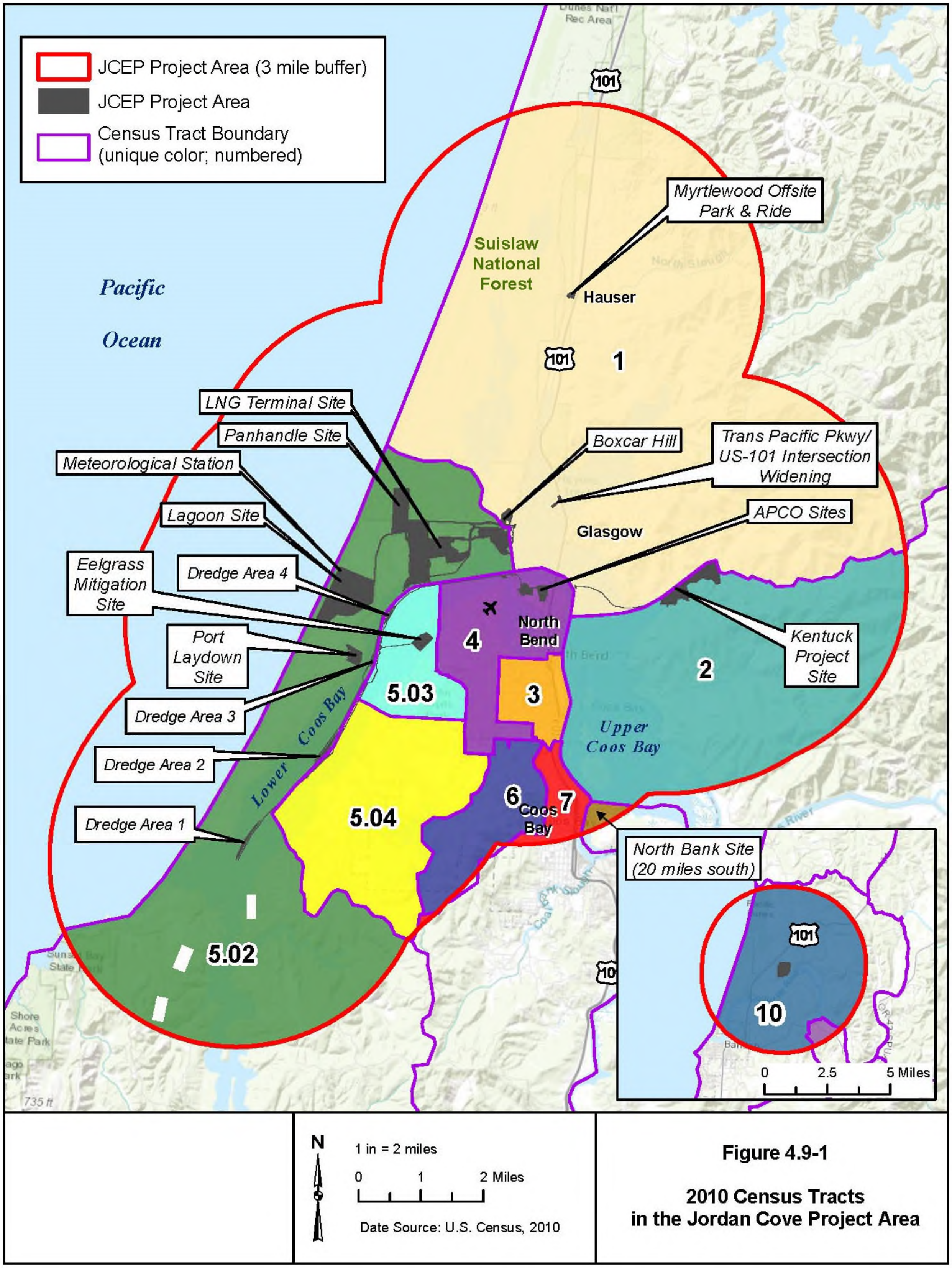

Figure 4.9-1

2010 Census Tracts in the Jordan Cove Project Area

High and Adverse Impacts

The impacts of constructing and operating the Project on the natural and human environments are identified and discussed throughout the environmental analysis section of this document. As described in the numerous environmental resource-specific discussions, we conclude that with two exception, the Project would not significantly impact the environment or have high and adverse effects on human health or the environment. Constructing and operating the LNG terminal would result in a significant impact on the visual character of Coos Bay. Additionally, the combined demand for housing from LNG terminal and pipeline workers would result in a significant impact on housing in Coos County.

Disproportionate Impacts on Environmental Justice Populations

Low-income communities are present in the vicinity of the LNG terminal site. However, none of the potential low-income populations are located within 1 mile of the LNG terminal site (there are no residents within 1 mile of the site) and the potential for these populations to be disproportionately affected relative to other populations within 3 miles of the site is low. Increased demand for rental housing would affect the market as a whole, but would likely be more acutely felt by low-income households who are spending a large share of their income on housing.

Tribal populations are a minority population with the potential to be disproportionately affected by construction and operation of the terminal as a result of their unique relationship with the surrounding environment. Government-to-government consultations between the FERC and Indian tribes are still ongoing and are discussed in detail in section 4.11 of this EIS. Issues raised by the tribes are summarized in section 4.11.1.3 and explicitly recognized in the related environmental analysis sections of this document. An assessment of the potential effects of the Project on tribal uses of those resources or the tribal members themselves has been requested by FERC staff to be presented in a forthcoming ethnographic study (see section 4.11.3.1).

4.9.2 Pacific Connector Pipeline Project

4.9.2.1 Population

Population data for the four counties that would be crossed by the pipeline are summarized in table 4.9.2.1-1. The pipeline route mainly passes through sparsely populated rural areas, with population densities in 2017 ranging from 11.4 people per square mile in Klamath County to 77.9 people per square mile in Jackson County. Estimated population in the affected counties in 2017 ranged from 63,310 in Coos County to 216,900 in Jackson County.

TABLE 4.9.2.1-1

Population by State and County

State/County	Population 2000	Population 2010	Population 2017	Percent Change in Population 2010-2017	Persons per Square Mile 2017
Oregon	**3,421,399**	**3,831,074**	**4,141,100**	**8.1%**	**43.1**
Coos County	62,779	63,043	63,310	0.4%	39.7
Douglas County	100,399	107,667	111,180	3.3%	22.1
Jackson County	181,269	203,206	216,900	6.7%	77.9
Klamath County	63,775	66,380	67,690	2.0%	11.4
Total a/	**408,222**	**440,296**	**459,080**	**4.3%**	**29.9**

a/ This row is the sum of the four counties that would be crossed by the pipeline.
Sources: Portland State University 2012, 2017a; U.S. Census Bureau 2017c

As described previously, Pacific Connector estimates that construction of the pipeline would occur over a 4-year period, with an average monthly workforce of 885 people over this period. The construction workforce is expected to peak at approximately 4,242 workers in June of Year 3, dropping to 4,027 the following month. The construction workforce would be distributed over seven construction spreads.

Based on Pacific Connector's initial estimates, monthly employment for pipeline construction is assumed to average 241 workers in Coos County, 194 workers in Douglas County, 361 workers in Jackson County, and 89 workers in Klamath County. ECONorthwest (2017a) assumed that approximately 64 percent of the average pipeline workforce would temporarily relocate to the affected counties for the duration of their employment, with about 5 percent of the total expected to be accompanied by their families. Assuming an average household size of 2.74 persons, estimated temporary increases in population would range from 0.1 percent (Douglas, Jackson, and Klamath Counties) to 0.3 percent (Coos County) of their respective county populations in 2017.

Peak construction workforces would include an estimated 1,002 workers in Coos County, 1,350 workers in Douglas County, 1,524 workers in Jackson County, and 366 workers in Klamath County. ECONorthwest (2017a) assumed that approximately 78 percent of the peak workforce would temporarily relocate to the affected counties, with 1 to 2 percent of workers expected to be accompanied by their families. Assuming an average household size of 2.74 persons, estimated temporary increases in population would range from 0.4 percent (Klamath County) to 1.3 percent (Coos County) of their respective county populations in 2017. These estimated population increases and associated impacts would be temporary and short term, with very few if any of the temporary construction workers relocating to the project area expected to stay permanently. Impacts associated with construction-related population increases are discussed throughout this section.

Construction of the Pacific Connector pipeline in Coos County would coincide with Jordan Cove LNG Project construction. Based on the above analyses, the combined temporary increase in population (workers and family members) associated with both projects would average 1,076 workers over the life of the Project. Assuming LNG terminal and pipeline construction activities in Coos County begin at the same time, construction workforces could potentially peak at the same time, resulting in a temporary combined increase in population of approximately 2,555 workers. These potential additions would be equivalent to approximately 1.7 percent (average) and 4.0 percent (peak) of the total estimated population in Coos County in 2017.

Operating the pipeline would require an estimated permanent staff of 15 employees, consisting of six operations technicians in Coos Bay, Coos County, five employees in the Medford pipeline office in Jackson County, and four employees at the compressor station near Malin in Klamath County. Employees are expected to live within driving distance of their work location and are not expected to affect population levels or trends in the counties along the pipeline route.

Crime

We received several comments on the Project expressing concern that a temporary influx of construction workers would result in increases in crime, drug and alcohol use, prostitution, human trafficking, domestic violence, and other criminal activities. Potential increases in crime related to an influx of construction workers is discussed in section 4.9.1.1. As discussed in section 4.9.1.1, increases in crime, were they to occur, would likely be commensurate with the relatively small increases in population (discussed above).

4.9.2.2 Housing

In 2015, the four counties that would be crossed by the pipeline had an estimated total of 204,107 housing units, with almost half of this total (91,782 units) located in Jackson County. An estimated 3,927 of these units were identified as vacant and available for rent. Available rental units ranged from 660 in Coos County to 1,436 in Jackson County. In addition, an estimated 7,138 units were identified for seasonal, recreational, or occasional use, ranging from 1,164 units in Douglas County to 2,335 units in Klamath County. ECONorthwest (2017b) also identified an estimated total of 9,640 hotel, motel, and small inn rooms in the four counties, along with 9,237 sites in managed RV parks and campgrounds (table 4.9.2.2-1).

TABLE 4.9.2.2-1

Housing

Geographic Area	Housing Units 2011-2015 a/ Total Housing Units	Rental Vacancy Rate	Units Available for Rent	For Seasonal, Recreational, or Occasional Use c/	Hotels and Motels b/ Number of Facilities	Number of Rooms	Managed RV Parks and Campgrounds Number of Sites
Coos County	30,482	6.7%	660	1,462	49	1,656	2,206
Douglas County	49,018	5.5%	834	1,164	40	1,990	2,800
Jackson County	91,782	4.3%	1,436	2,177	91	4,457	2,498
Klamath County	32,825	9.4%	997	2,335	37	1,537	1,733
Project Area Total	**204,107**	**5.7%**	**3,927**	**7,138**	**217**	**9,640**	**9,237**

a/ Data are 5-year estimates from the U.S. Census American Community Survey. Estimates are annual totals based on 5 years of data.
b/ Hotel and motels include commercial hotels, inns, and motels, as well as smaller inns and bed and breakfast establishments (B&Bs), with data obtained from STR, Inc. (commercial hotels, inns, and motels) and internet searches (smaller inns and B&Bs) (ECONorthwest 2017b).
c/ Housing units for seasonal, recreational, or occasional use are generally considered to be vacation homes. They are not included in the estimated number of housing units available for rent.
Source: ECONorthwest 2017b, U.S. Census Bureau 2017a, 2017b

Hotel and motel occupancy rates in the Project area follow a seasonal trend, with occupancy rates tending to be higher in the summer (June through September) and lower in the winter (November through February). During peak tourist season (July and August), average hotel and motel occupancy rates are around 80 percent in Coos, Jackson, and Klamath Counties and close to 75 percent in Douglas County (ECONorthwest 2017b). Occupancy rates for RV parks in the pipeline project area are not published, but tend to be more seasonal than those of hotels and motels, largely because RV parks tend to cater to tourists and RV driving is difficult during the rainy season and winter months (ECONorthwest 2017b).

Estimated average and peak housing demand by non-local construction workers is shown by housing type and county in table 4.9.2.2-2. Estimated average and peak demand is compared with estimated supply by housing type and county in table 4.9.2.2-3. Viewed as a portion of available rental housing, peak demand for rental housing would range from 6 percent (Klamath County) to 24 percent (Coos County) and 25 percent (Douglas County) of estimated available units. As discussed in section 4.9.2.1, the 2018 Coos County housing analysis and action plan identified a shortage of affordable rental housing (czbLLC 2018). Similarly, despite Census estimates that almost 1,000 housing units in Klamath County are currently available for rent, a recent newspaper editorial indicated that Klamath Falls and Klamath County are also facing a housing shortage (H&N View 2019).

TABLE 4.9.2.2-2

Estimated Housing Demand by Pacific Connector Construction Workers

Geographic Area	Rental Housing (Apartments, Houses, Mobile Homes) a/,b/		Hotels and Motels, RV and Campground Spaces, and Individual Room Rentals a/	
	Average	Peak	Average	Peak
Coos County	59	157	92	624
Douglas County	48	207	74	845
Jackson County	88	239	138	949
Klamath County	22	57	34	228

a/ Estimated demand by housing type is based on ratios estimated by ECONorthwest (2017a) adjusted to account for subsequent changes in Pacific Connector's construction schedule and workforce estimates.
b/ Assumes that 10 percent of individual workers would share a rental unit with another construction worker.

TABLE 4.9.2.2-3

Estimated Housing Demand by Pacific Connector Construction Workers as a Share of Estimated Supply

Geographic Area	Rental Housing (Apartments, Houses, Mobile Homes)		Hotels and Motels and RV and Campground Spaces a/b/	
	Average	Peak	Average	Peak
Coos County	9%	24%	2%	16%
Douglas County	6%	25%	2%	18%
Jackson County	6%	17%	2%	14%
Klamath County	2%	6%	1%	7%

a/ Percentages represent estimated demand as a share of the total estimated supply of hotel and motel rooms and RV sites, not the share that would normally be available for rent. Percentages do not include special living situations, such as bedrooms in single-family homes that home owners may rent to construction workers

Peak demand for hotels and motels, RV and campground spaces, and individual room rentals would range from about 7 percent of the total supply of hotel and motel rooms and RV spaces in Klamath County to 18 percent of the total in Douglas County. Total supply in this context refers to the total number of units and is not adjusted to account for seasonal occupancy rates. During peak season (July and August), peak demand would exceed the normally available supply of hotel and motel rooms in Coos (330 rooms), Douglas (511 rooms), and Jackson (833 rooms) Counties. A share of this demand would, however, also likely be met by RV and campground spaces and individual room rentals in existing owner- or renter-occupied housing.

During peak tourist season (July to September), short-term accommodations in some communities, especially those in Coos, Douglas, and Jackson Counties, would experience lower vacancy rates and upward pressure on rental rates. The availability of short-term housing, especially at hotels, motels, and RV parks, could become limited in the immediate pipeline vicinity, and workers and others seeking temporary accommodation in those areas may pay higher rents or have to commute farther than desired. Additionally, during peak construction worker demand, tourists would likely be displaced, particularly during summer weekends. Visitors seeking outdoor recreational opportunities do, however, have a wide range of destination choices in southern Oregon and would be likely to recreate elsewhere in the region if they were interrupted by pipeline construction at a particular location.

These potential issues would be exacerbated in Coos County, where the Pacific Connector Pipeline Project construction would coincide with Jordan Cove LNG Project construction, resulting in higher levels of demand for temporary housing. The following discussion addresses the combined demand from both projects and assumes that housing demand would peak for both projects during the same month. Combined, estimated average and peak demand for hotel and motel rooms, RV or campground spaces, or individual room rentals would be for 429 and 1,212 units, respectively, equivalent to 11 percent and 31 percent of the total supply of hotel and motel rooms and RV spaces in Coos County. These peak levels of demand would exceed the share of hotel and motel rooms and RV spaces that are usually vacant and available for rent during the summer, resulting in increased competition for temporary housing among workers, as well as the potential displacement of tourists and other visitors who would be unable to find temporary accommodation in Coos County.

For rental housing, the combined estimated average and peak demand would be for 207 and 432 units, respectively, equivalent to approximately 31 percent and 65 percent of the total 660 units estimated to be available for rent in Coos County. As noted in section 4.9.2.1, potential shortages of rental housing have been identified in Coos County (czbLLC 2018). Increased demand from Project-related construction workers would likely reduce vacancy rates and place upward pressure on rental rates, resulting in the potential displacement of other existing or potential residents seeking rental accommodation.

Operation of the pipeline would require 15 permanent employees and would have no noticeable effect on the local housing markets.

4.9.2.3 Property Values

We received numerous comments concerning the potential effect of the pipeline on property values. These comments included concerns that the pipeline would negatively affect sales prices and result in an inability to sell one’s property. Concern was also expressed that a decrease in property values would result in reduced property tax revenues for the affected counties.

A number of studies have sought to determine whether the presence of a pipeline affects property values using a range of statistical techniques including paired sales and other sales comparisons, linear regression and hedonic price modeling, and descriptive statistics. These studies include two national case studies conducted by the Interstate Natural Gas Association of America (Allen, Williford & Seale, Inc. 2001; Integra Reality Resources 2016), two case studies that evaluated the effects of the South Mist Pipeline Extension in Clackamas and Washington Counties, Oregon (Fruits 2008; Palmer 2008), and studies from Arizona and Nevada (Diskin et al. 2011; Wilde et al. 2014). These studies suggest that natural gas pipelines dos not necessarily negatively affect the value of that property. The effect a pipeline may have on a property’s value depends on many factors, including the size of the tract, the values of adjacent properties, the presence of other utilities, the current value of the land, and the current land use. Subjective valuation is generally not considered in appraisals, but may affect individual decisions when a property is offered for sale. Purchase decisions are often based on the purchaser’s plans for the property, such as occupancy, use for agriculture, future residential development, or commercial/industrial development. If the presence of a pipeline interferes with a purchaser's plans, the potential buyer may decide against acquiring the property. However, each potential purchaser has different criteria and differing capabilities to purchase land. Therefore, based on our review of available studies and our understanding of property valuation, we conclude that the likelihood of the pipeline resulting in a long-term decline in property values and a related decrease in property tax revenues is low.

4.9.2.4 Economy and Employment

The four counties that would be crossed by the pipeline had a total combined estimated labor force of 203,614 in 2016. Labor force estimates by county ranged from 26,521 in Coos County to 101,776 in Jackson County (table 4.9.2.4-1). Annual unemployment rates in 2016 ranged from 5.8 percent in Jackson County to 6.5 percent in Coos and Klamath Counties and were higher than the state average (4.9 percent) in all four counties. Table 4.9.2.4-1 also presents average per capita income and median household income by county, and identifies the two largest economic sectors based on total employment data compiled by the U.S. Bureau of Economic Analysis (2016a). Average per capita income in 2015 (the most recent year available) was lower than the state average ($43,783) in all of the affected counties. Median household income was also below the state median ($54,074) in 2015 in all four counties.

TABLE 4.9.2.4-1

Employment and Labor Statistics for the Pacific Connector Pipeline Project Area

State/ County	Civilian Labor Force 2016 a/	Unemployment Rate (%) 2016 a/	Per Capita Income ($) 2015	Median Household Income ($) 2015	Two Largest Economic Sectors 2015 (By Percent of Employment) b/
Oregon	2,055,114	4.9	$43,783	$54,074	Health Care and Social Assistance (12%); Retail (11%)
Coos	26,521	6.5	$38,475	$38,934	State and Local Government (16%); Retail Trade (12%)
Douglas	45,891	6.4	$35,977	$41,696	Health Care and Social Assistance (12%); Retail (12%)
Jackson	101,776	5.8	$40,698	$44,855	Health Care and Social Assistance (15%); Retail Trade (13%)
Klamath	29,426	6.5	$35,216	$42,384	State and Local Government (13%); Health Care and Social Assistance (13%)

a/ Labor force and unemployment data are annual averages.
b/ Employment by economic sector is summarized in more detail in table 4.9.2.4-2.
Sources: Oregon Employment Department 2017; U.S. Bureau of Economic Analysis 2016a, 2016b; U.S. Census Bureau 2016, 2017c

All four counties were identified as distressed on Business Oregon's Temporary Distressed List for January 2017 (Business Oregon 2017). A county is considered distressed by Business Oregon based on an index calculated from four composite factors (unemployment rates, per capita personal income, changes in covered payroll by worker, and changes in employment). Twenty-three of Oregon's 36 counties were identified as distressed in January 2017.

Similar to the analysis prepared for the Jordan Cove LNG Project (see section 4.9.1.4, above), ECONorthwest (2017c) used IMPLAN to estimate the total (direct, indirect, and induced) regional economic impacts of pipeline construction and operation. Pacific Connector estimates that constructing the pipeline and related facilities would cost about $2.46 billion, with an estimated $1.4 billion expected to be spent in Oregon (ECONorthwest 2017c). ECONorthwest (2017c) estimated that total direct employment over the 24-month construction period would be equivalent to 2,854 FTE jobs, with the equivalent of 1,712 FTE jobs expected to be filled by Oregon workers. [169] Total direct labor income during pipeline construction would be approximately $926 million; with $544 million of this total expected to be paid to Oregon workers (table 4.9.2.4-2).

Constructing the Project would also support an estimated total of 4,102 indirect and 6,344 induced FTE jobs, with an estimated average of 2,051 indirect and 3,172 induced FTE jobs supported each year. In addition, Project construction would support total (direct, indirect, and induced) output, value added, and labor income of $2.8 billion, $1.3 billion, and $1.1 billion, respectively (table 4.9.2.4-2).

TABLE 4.9.2.4-2

Regional Economic Impacts of Construction of the Pacific Connector Pipeline Project in Oregon

Impact Type	Output b/	Value Added b/	Labor Income b/	FTE Jobs b/
Total Direct Impacts	$2,460	na	$926	2,854
Local Impacts (State of Oregon) a/				
Direct	$1,400	$578	$544	1,712
Indirect	$591	$313	$241	4,102
Induced	$820	$467	$272	6,344
Total d/	$2,811	$1,359	$1,056	12,159

Notes:
na – not applicable.
a/ Local impacts in this context are impacts that would occur within the state of Oregon. Direct impacts are the share of the total direct impacts expected to occur in Oregon.
b/ Impacts are presented for the entire construction period. Output, value added, and labor income are expressed in millions of dollars.
c/ Pacific Connector revised its construction workforce estimates in a November 2018 filing with the FERC, increasing the length of the construction period and the total number of FTE workers. These changes would likely result in an increase in direct impacts in Oregon, with smaller potential increases in indirect and induced impacts.
d/ Totals may not sum due to rounding.
Source: ECONorthwest 2017c

In the first full year of operations, Pacific Connector would directly employ 15 workers in Oregon, with total labor compensation (including benefits and payroll taxes) of approximately $3.1 million. This direct employment in conjunction with facility expenditures on Oregon sourced goods and services would support additional economic activity in Coos, Douglas, Jackson, and Klamath Counties and elsewhere in Oregon. Annual Project operation is estimated to support total (direct, indirect, and induced) employment of 180 FTE jobs in Oregon in 2024, with total associated labor compensation of approximately $11.3 million. Viewed in 2017 dollars, total compensation would be about $9.5 million or $53,200 per FTE job (ECONorthwest 2017d).

As noted with respect to the Jordan Cove LNG Project, indirect and induced impact estimates developed by ECONorthwest (2017c, 2017d) are based on the share of construction expenditures that Pacific Connector estimates would occur in Oregon. Changes in actual levels of in-state spending would result in changes to the indirect and induced impact estimates.

[169] Pacific Connector revised its construction workforce estimates in a November 2018 filing with the FERC, increasing the length of the construction period and the total number of FTE workers. These changes would likely result in an increase in direct impacts in Oregon, with smaller potential increases in indirect and induced impacts.

4.9.2.5 Tax Revenues

The Pacific Connector pipeline would generate federal, state, and local tax revenues during both the construction and operation phases of the Project. Federal tax revenues would be generated from federal income tax on Project-related earnings. There is no sales and use tax in Oregon, but state tax revenues would be generated through income and lodging taxes. Local tax revenues would be generated from property taxes.

Federal lands generate revenues for local counties through 25 percent fund/Secure Rural Schools payments and Payment in Lieu of Taxes (PILT) payments. Secure Rural Schools payments are discussed below in section 4.9.3.2. The PILT program is designed to compensate local governments for lost property tax revenue associated with federal lands. Annual PILT payments to the four affected counties in Fiscal Year 2018 ranged from $649,640 in Coos County to $1,864,853 in Jackson County (U.S. Department of the Interior 2018).

Total revenues for the four counties that would be crossed by the pipeline in fiscal year 2016 ranged from $44.0 million in Klamath County to $149.3 million in Jackson County (table 4.9.2.5-1). The intergovernmental revenue category identified in table 4.9.2.5-1 includes payments from the federal and state governments to the counties. These revenues include PILT payments, which help local governments maintain public services such as firefighting and police protection, public schools and roads, and search-and-rescue operations.

TABLE 4.9.2.5-1

Revenues for the Counties Crossed by the Pacific Connector Pipeline, FY 2016

Revenue Type	Coos County	Douglas County	Jackson County	Klamath County
Property Taxes	$10,150,562	$9,628,905	$41,248,304	$12,527,141
Other Taxes	$373,677	NR	NR	$1,470,964
Intergovernmental Revenues a/	$29,188,456	$40,276,259	$82,404,563	$23,682,220
Licenses, Fees, and Permits	$4,311,496	$1,571,451	$4,257,881	$1,499,150
Charges for Services	$2,132,755	$10,899,007	$18,775,415	$3,877,796
Timber Sales	$5,081,975	NR	NR	NR
Interest on Investments	$239,689	$1,762,954	$2,417,455	$729,486
Other Revenue	$849,807	$5,056,629	$168,413	$206,158
Total	**$52,328,417**	**$69,195,205**	**$149,272,031**	**$43,992,915**

NR – not reported
Sources: Coos County 2017; Douglas County 2016; Jackson County 2016; Klamath County 2016

During construction, Pacific Connector estimates that the pipeline would generate approximately $91 million in federal income tax based on an estimated construction payroll of $537 million and an average federal income tax rate of 17 percent. The estimated construction payroll would also generate approximately $40.1 million in state income tax, assuming an average state income tax rate of 9 percent. Temporary workers associated with pipeline construction would generate approximately $374,000 in state lodging taxes, as well as an estimated $1.9 million in local lodging taxes that would be distributed across the four counties. Pacific Connector also estimates that personal property taxes on approximately $728 million worth of equipment and materials either purchased in or brought into Oregon would generate about $10.9 million in tax revenues.

During operation, Pacific Connector estimates that the pipeline would generate approximately $518,000 in annual federal taxes based on estimated labor income during the first year of operation, as well as an estimated $233,000 in annual state income taxes. Pacific Connector would also pay property taxes based on the value of the installed pipeline and associated aboveground facilities and the number of pipeline miles in each county. ECONorthwest estimated pipeline property taxes based on 2016 tax rates and the number of pipeline miles in all taxing jurisdictions crossed by the pipeline. Over the initial 20 years of operations, the pipeline is expected to generate approximately $4.7 million in average annual property taxes in Coos and Douglas Counties and approximately $5.3 million in average annual property taxes in Jackson and Klamath Counties (ECONorthwest 2017d). Property tax payments would vary over time due to pipeline depreciation and changing tax rates.

The Pacific Connector pipeline would not involve federal land disposal, acquisition, or exchange and is, therefore, not expected to affect existing PILT or 25 percent fund/Secure Rural Schools payments to the affected counties.

4.9.2.6 Local Infrastructure and Public Services

Law Enforcement and Fire Protection

The pipeline route crosses four counties, each with its own Sheriff's office, employing a combined total of almost 400 officers. In addition, 23 municipalities have their own police departments, with a combined total of more than 350 officers. There are more than 30 municipal fire departments and approximately 40 RFPDs in the four counties that would be crossed by the pipeline, with a combined total of approximately 1,750 firefighters. As discussed in section 4.9.2.1, estimated temporary increases in population during peak construction would range from 0.4 percent of the existing total in Klamath County to 1.3 percent in Coos County. This relatively minor and short-term influx of non-local workers and their families during the peak construction period is not expected to adversely affect existing law enforcement or fire-fighting capabilities.

The USDOT is mandated to provide pipeline safety, and the USDOT pipeline standards are published in 49 CFR Parts 190-199. Part 192 of 49 CFR specifically addresses natural gas pipeline safety issues. Part 192 requires that each operator must establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency and to coordinate mutual assistance. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials. Pacific Connector would provide the appropriate training to local emergency service personnel before the pipeline is placed in service. No additional specialized local fire protection equipment is expected be required to handle pipeline emergencies. Pipeline safety is discussed further in section 4.13 of this EIS.

Pacific Connector has developed an *Emergency Response Plan Concept Paper*, a *Fire Prevention and Suppression Plan*, and a *Safety and Security Plan.*[170] Pacific Connector would be responsible for the cost of implementing these plans. Pacific Connector does not anticipate that

[170] Pacific Connector's Overburden and Excess Material Disposal Plan and a Sanitation and Waste Management Plan are included as Appendices Q and W, respectively, in its POD filed with the FERC on January 23, 2018.

implementation of these plans would require additional medical or other public service personnel (including additional police or fire fighting capabilities).

Pacific Connector has indicated that in the event of a pipeline accident, the party deemed responsible for the accident would ultimately be responsible for paying all costs for emergency response, containment, damages, remediation, and repairs for the public and private property affected. In the event of an accident, Pacific Connector would provide emergency support to completely respond to the accident.

Medical Facilities

There are nine hospitals in the four counties that would be crossed by the Pacific Connector pipeline, with a combined total of almost 900 beds (table 4.9.2.6-2). These include four Level III Trauma System Hospitals that can receive helicopter transport and three level IV Trauma Hospitals (table 4.9.2.6-1).

TABLE 4.9.2.6-1

Hospitals in the Counties Crossed by the Pacific Connector Pipeline

County	Hospital	Town	Trauma Level a/	Staffed Beds	Occupancy Rate 2016
Coos	Bay Area Hospital	Coos Bay	III	129	50.1
Coos	Coquille Valley Hospital	Coquille	IV	17	36.1
Coos	Southern Coos Hospital and Health Center	Bandon	IV	19	6.7
Douglas	Lower Umpqua Hospital	Reedsport	NA	16	18.0
Douglas	Mercy Medical Center	Roseburg	III	129	60.1
Jackson	Asante Ashland Community Hospital	Ashland	IV	37	33.9
Jackson	Providence Medford Medical Center	Medford	III	138	54.5
Jackson	Asante Rogue Medical Center	Medford	III	307	74.5
Klamath	Sky Lakes Medical Center	Klamath Falls	NA	100	52.8

a/ Trauma hospitals differ from other hospitals in that they guarantee the immediate availability of surgeons, anesthesiologists, physician specialists, nurses, ancillary services, and resuscitation life-support equipment 24 hours a day and are dedicated to the care of trauma patients. Trauma facilities in Oregon are designated as Level I, II, III, or IV, with Level I and II centers offering the highest level of care (Oregon Health Authority 2018).
Source: Oregon Association of Hospitals and Health Systems 2018

As discussed above, estimated temporary increases in population during peak construction are expected to be short-term and range from 0.4 percent of the existing total in Klamath County to 1.3 percent in Coos County. If construction employment for the terminal and pipeline were to peak in Coos County at the same time, the combined temporary increase in population would be equivalent to about 4.0 percent of the existing total. Existing medical facilities are expected to be adequate to handle issues resulting from the temporary influx of non-local employees working on pipeline construction. Therefore, we conclude that constructing and operating the pipeline is not expected to have significant adverse effects on emergency services or regional hospitals.

Schools

There are 33 school districts within the four counties that would be crossed by the Pacific Connector pipeline, with a total combined enrollment of almost 64,000 students. Enrollment by county in the 2016-2017 school year ranged from about 9,500 students in Klamath County to almost 30,000 students in Jackson County.

As discussed in section 4.9.2.1, Pacific Connector anticipates that approximately 5 percent of the average workforce relocating to the potentially affected counties would be accompanied by family members, with just 1 to 2 percent of the peak non-local workforce expected to be accompanied by family. Assuming an average household size of approximately 2.74 persons, including 0.55 school-aged children, the temporary relocation of these households would result in the addition of 2 (Klamath County) to 10 students (Jackson County) to county schools. These additions would be equivalent to 0.1 percent of current enrollment or less for all counties and are not expected to noticeably affect existing school facilities and programs. Construction of the pipeline would coincide with terminal construction, resulting in a combined (pipeline and terminal) addition of an estimated 38 students to Coos County schools, which would be equivalent to about 0.4 percent of total county enrollment in 2016-2017.

Operation of the pipeline would require an estimated permanent staff of 15 employees, consisting of 6 operations technicians in Coos Bay (Coos County), 5 employees in Medford (Jackson County), and 4 employees near Malin (Klamath County). Assuming that these employees would all be hired from elsewhere, their permanent relocation along with their families to the area would not be expected to noticeably affect enrollment in local public schools.

Utilities

All four counties crossed by the Pacific Connector pipeline route have existing public utilities already in place, including water, sewers and sanitation, electricity, natural gas and propane, telephone, and cable. Some of those services are provided by county governments or municipalities, and some by private companies.

Construction of the pipeline would have only minor, temporary effects on local community utilities, services, and infrastructure. Pacific Connector would need to hook up to local utilities, including electric power and telephone lines, at its compressor station, three meter station locations, and new communications towers and buildings. Pacific Connector would also use electric power and telephone lines at its contractor yards, where existing power and telephone lines are available. Other than water required for pipeline hydrostatic testing and dust control during construction, Pacific Connector has stated that its Project would not require public water or sewer services. The pipeline would not require wastewater treatment or the construction or expansion of wastewater facilities and existing stormwater drainage systems.

Pacific Connector developed an *Overburden and Excess Material Disposal Plan* and a S*anitation and Waste Management Plan* as part of its POD.[171] During construction, trash and food waste would be collected on a daily basis and removed from the pipeline ROW. Excess rocks, overburden, large slash, and timber would be removed to established disposal areas. Following construction, all construction-related debris, including mats, skids, rope, and excess padding, would be removed by qualified solid waste disposal companies to appropriate licensed landfills or recycling facilities.

[171] Pacific Connector's *Overburden and Excess Material Disposal Plan* and a S*anitation and Waste Management Plan* are included as Appendices Q and W, respectively, in its POD filed with the FERC on January 23, 2018.

4.9.2.7 Recreation and Tourism

Recreation

A recent report by the Outdoor Industry Association (2017) estimated that outdoor recreation and related expenditures in Oregon generated an estimated $16.4 billion in consumer spending and $749 million in state and local tax revenues, supporting 172,000 jobs and $5.1 billion in wages and salaries (Outdoor Industry Association 2017). This included money spent on gear, vehicles, trips, and travel-related expenses.

Concern was expressed by commenters that the proposed pipeline crossing of the Rogue River would affect recreation-related businesses in the nearby community of Trail in Jackson County. The Rogue River is well known for its salmon and steelhead fishery, and this section of the river is popular for recreational floating using rafts and inflatable kayaks. Visitors spend money on outfitter and guide services, bait, and equipment rentals, as well as lodging, restaurants, transportation, and other local goods and services. Pacific Connector proposes to cross the Rogue River using HDD technology, which would avoid direct effects on the river and its fisheries (see chapter 2 and section 4.3) and reduce potential direct effects on recreationists.

Concern was expressed during public scoping that the pipeline would have negative effects on the communities of Shady Cove and Trail by disrupting traffic along SH 62, which parallels the Rogue River and connects these communities to Crater Lake. Viewed as a share of current traffic, the average expected increase in vehicles would range from 1.1 percent to 2.4 percent of estimated totals, with the peak estimated increase ranging from 2.4 percent to 5.0 percent (table 4.9.2.7-1). Pacific Connector developed a Transportation Management Plan to reduce conflicts between construction traffic and recreational users of local roads (see Appendix Y to Pacific Connector's POD filed with the FERC on January 23, 2018). Transportation issues related to pipeline construction are more fully addressed in section 4.10.2.

TABLE 4.9.2.7-1

Estimated Construction Traffic Impacts on SH62 near Shady Cove and Trail

SH 62 Location Description	Milepost	2015 AADT	Estimated Increase in AADT: Average a/	Estimated Increase in AADT: Peak b/
1.83 miles north of SH 234	15.46	7,900	1.1%	2.4%
0.05 mile south of Brophy Way	18.35	5,500	1.6%	3.4%
0.03 mile north of Indian Creek Road in Shady Cove	19.81	6,200	1.4%	3.0%
0.02 mile north of Rogue River Drive in Shady Cove	20.11	6,400	1.4%	2.9%
Northern city limits of Shady Cove	21.10	4,200	2.1%	4.4%
0.05 mile south of Tiller-Trail Highway (SH 227)	22.37	3,700	2.4%	5.0%

a/ Based on an estimated average of 89 construction-related vehicle round trips per day.
b/ Based on an estimated peak of 187 construction-related vehicle round trips per day.
AADT – average annual daily traffic
Source: Oregon Department of Transportation 2017.

Tourism

Travel spending in the four potentially affected counties in 2016 was approximately $1,187 million, ranging from $141 million in Klamath County to $548 million in Jackson County (table 4.9.2.7-2). Travel spending generated earnings of approximately $334 million and supported approximately 13,760 jobs in the four-county area in 2016. Travel-related employment as a share of total county employment ranged from 4.5 percent (Jackson County) to 10.2 percent (Coos County) (Dean Runyan Associates 2017).

TABLE 4.9.2.7-2

Travel Spending, Earnings, and Employment, 2016

State/County	Travel Spending ($ million)	Earnings ($ million)	Employment	
			Jobs	Percent of County Total (2016) a/
Oregon	11,300	3,100	109,500	Na
Coos	265.3	76.6	3,280	10.2
Douglas	233.2	68.1	3,130	6.1
Jackson	547.9	142.8	5,440	4.5
Klamath	141.0	46.4	1,910	6.3
Project Area Total	**1,187.4**	**333.9**	**13,760**	**Na**

a/ This percentage represents travel-related employment for 2016 as a percent of total employment.
Source: Dean Runyan Associates 2017

As discussed in section 4.9.2.2, during periods of peak demand by pipeline workers and tourists (July to September), short-term housing accommodations in some communities, especially those in Coos, Douglas, and Jackson Counties, would experience lower vacancy rates and upward pressure on rental rates. At peak demand for lodging by construction workers has the potential to temporarily displace tourists at some locations, particularly during weekends of the summer season. As noted in section 4.9.2.2, visitors seeking outdoor recreational opportunities have a wide range of destination choices in southern Oregon and would be likely to recreate elsewhere in the region if they were interrupted by pipeline construction at a particular location. However, this temporary displacement could result in reduced demand for some recreation outfitter/guide services, as potential clients seek recreation opportunities elsewhere.

4.9.2.8 Other Commercial Activities

Commercial Fishing

Commercial and recreational fisheries are discussed in section 4.5 of this EIS and section 4.9.1.8 discusses the commercial fishing industry in Coos Bay. There are no commercial fisheries for vertebrate fish species in the Coos Bay estuary.

Fish are not harvested commercially in the rivers and streams crossed by the pipeline. However, fish such as salmon and steelhead that spawn in affected rivers are commercially harvested in coastal areas off Oregon, Washington, and California, as well as British Columbia and Alaska. A 2009 study estimated that Rogue River salmon commercially harvested off the Northwest coast support annual economic benefits of approximately $1.36 million (ECONorthwest 2009). Constructing the pipeline would affect waterbodies that provide habitat for aquatic resources that are commercially harvested. However, short-term construction-related effects on streams and rivers are not expected to adversely affect the spawning of fish that are commercially harvested from the ocean; as effects such as sedimentation and turbidity would be reduced through the use of erosion control devices. Potential effects resulting from the pipeline crossing waterbodies and mitigation of those effects are discussed in section 4.3, and effects on aquatic resources in stream habitats are evaluated in section 4.5 of this EIS.

Commercial Oyster Farms

Commercial oyster beds are located in South Slough, Haynes Inlet, and Upper Coos Bay, including two commercial oyster operations in the northern portion of Coos Bay near the pipeline crossing: Clausen Oysters and Coos Bay/North Bend Oyster Company. Both companies lease land from the Port of Coos Bay and Coos County and cultivate non-native Pacific and Kumamoto oysters and native Olympia oysters (DeKrey 2017). A study conducted for Pacific Connector estimated that Clausen Oysters had an annual yield of 10 to 13 million oysters, with the potential for gross wholesale revenues of about $2.25 million annually. The same study estimated that Coos Bay/North Bend Oyster Company had an annual yield of 7 to 8 million oysters, with the potential for gross wholesale revenues of about $1.25 million annually. Annual operational costs for both companies were estimated to be approximately 50 percent of gross sales (HDR 2015).

The pipeline would be installed via HDD beneath an active oyster lease area operated by Clausen Oysters. The use of an HDD would generally result avoid impacts on Haynes Inlet and this oyster lease area. Appendix I.2 to Resource Report 2 (i.e., the *Drilling Fluid Contingency Plan*) outlines the measures that would be used during construction to avoid and minimize potential disturbance to oyster populations during construction. However, commercial oyster beds could be affected by an inadvertent release of HDD drilling fluids in the immediate vicinity. Contingency plans would be implemented that would reduce the chance of a frac-out spill being substantial and also result in timely clean up, if needed. This is discussed further in section 4.5 of this EIS.

Other Industries

The pipeline would cross mostly rural areas, avoiding densely populated or urban areas, and not result in the displacement of any businesses. Constructing and operating the pipeline would, however, temporarily and permanently affect forested and agricultural lands and associated businesses. The pipeline would cross about 82.8 miles of mature forested lands and 58.8 miles of recently harvested forested lands. Land ownership of forested lands includes privately-owned timberland, state lands, NFS lands, and BLM lands. Approximately 1,050 MMBF of timber was harvested in the four affected counties in 2016, with an annual average harvest from 2011 to 2016 of 1,047 MMBF (Oregon Department of Forestry 2017). During Project scoping, private timber companies expressed concern about impacts on their operations. The Seneca Jones Timber Company identified a number of concerns, including potential competition between Pacific Connector and private timber companies for the use of ridge tops for access and equipment placement; possible restrictions related to forest yarding or the hauling of heavy equipment over the installed pipeline; and potential increases in the cost of local aggregate materials. Timber harvesting and the mitigation of effects related to the pipeline are discussed in more detail in section 4.7.

Pacific Connector has indicated that it will require a total of approximately 650,00 cubic yards of aggregate to construct the pipeline and associated facilities spread over 2 years, with an estimated 325,000 cubic yards required each year. Using information from DOGAMI, Pacific Connector estimates that this annual demand would be equivalent to approximately 8 percent of the suitable aggregate produced in the four potentially affected counties. In their assessment, they assume that half of the total aggregate (8 million cubic yards) produced in the four counties would be suitable for use in pipeline construction. Therefore, we conclude that pipeline construction is unlikely to result in a measurable decrease in the availability of aggregate or a substantial price increase.

Pipeline construction would affect agricultural land. The majority of the potentially affected land is pasture and cropland used for livestock forage and to grow hay, alfalfa, and food crops. A very small portion of the construction ROW would cross land in orchards, groves, vineyards, and nurseries. Following construction, a smaller area of agricultural land would be retained within permanent easements or acquired for pipeline operation. This area would include the permanent pipeline corridor, surface facilities, and maintenance ROW. The vast majority of these lands could be restored and returned to their original condition and use after the pipeline is installed. Therefore, although impacts could last for several years, most potential effects on agricultural operations would be temporary and short-term in nature. One exception is deep-rooted crops, such as orchards and vineyards, which could not be planted directly over the pipeline. Owners of orchards crossed by the pipeline would lose a percentage of their trees and potential future income. Potential impacts on agriculture are discussed further in section 4.7.

For both temporary and permanent effects, Pacific Connector would negotiate with landowners and provide compensation for timber/crop losses or land taken out of use as a result of pipeline construction.

4.9.2.9 Environmental Justice

Review Methodology

The methodology used for the terminal environmental justice assessment is summarized in section 4.9.1.9. The same methodology was used for the following pipeline assessment.

Environmental Justice and Vulnerable Populations

The Pacific Connector pipeline would cross a mostly rural region. The population in all four counties is predominantly White, with persons of Hispanic or Latino origin making up the largest share of the non-White population in all four counties, and statewide (table 4.9.2.9-1).

TABLE 4.9.2.9-1

Race and Ethnicity in Counties Crossed by the Pacific Connector Pipeline a/

		Percent of Total						
Geographic Area	**Total**	**White b/**	**Hispanic or Latino**	**Black or African American b/**	**American Indian and Alaska Native b/**	**Asian b/**	**Other Race b/, c/**	**Two or more races b/**
Coos County	62,775	85.8	5.9	0.6	2.5	1.2	0.4	3.5
Douglas County	107,194	88.8	5.2	0.3	1.3	0.8	0.1	3.5
Jackson County	208,363	82.4	11.8	0.6	0.6	1.0	0.4	3.3
Klamath County	65,972	79.7	11.6	0.8	3.1	1.1	0.3	3.5
Oregon	3,939,233	77.2	12.3	1.8	0.9	3.9	0.5	3.3

a/ Data are American Community Survey 2011-2015 five-year estimates compiled by the U.S. Census Bureau.
b/ Non-Hispanic only. The federal government considers race and Hispanic/Latino origin to be two separate and distinct concepts. People identifying Hispanic or Latino origin may be of any race. The data summarized in this table present Hispanic/Latino as a separate category.
c/ The "Other Race" category presented here includes census respondents identifying as "Native Hawaiian and Other Pacific Islander" or "Some Other Race."
Source: U.S. Census Bureau 2018

Data for the six demographic variables assessed in EJSCREEN are presented by county in table 4.9.2.9-2. These variables include low-income and minority populations, along with four other indicators considered by EJSCREEN to be potential indicators of vulnerable populations. These data indicate that the share of the population considered low income by EJSCREEN is higher than the statewide average in all four counties. The data also indicate that the share of the population over age 64 exceeds the state average in all four counties (table 4.9.2.9-2).

TABLE 4.9.2.9-2

Demographic Indicators

Selected Variables a/	Coos County	Douglas County	Jackson County	Klamath County	Oregon
Total Population a/	62,775	107,194	208,363	65,972	3,939,233
Percent of Total					
Minority Population	14	11	18	20	23
Low Income Population	44	43	42	44	36
Linguistically Isolated Population	1	1	1	1	3
Population with Less Than High School Education	11	11	11	12	10
Population under Age 5	5	5	6	6	6
Population over Age 64	23	23	19	19	15

a/ Data are originally from the American Community Survey 2011-2015 five-year estimates compiled by the U.S. Census Bureau.
Source: EPA 2018b

Data were also reviewed using EJSCREEN for the 34 census block groups that would be crossed by the pipeline. The share of the population considered minority by EJSCREEN is lower than the state average (23 percent) in all four counties, ranging from 11 percent to 20 percent (table 4.9.2.9-2). None of the census block groups in Coos, Douglas, or Jackson Counties had minority populations that exceeded the state average. Five census block groups in Klamath County had minority populations that exceeded the state average, including one where the minority population was more than 50 percent of the total. The share of the population considered low income by EJSCREEN is higher than the state average (36 percent) in all four counties, ranging from 42 percent to 44 percent (table 4.9.2.9-2). Slightly more than half (19 out of 34) of the census block groups that would be crossed by the pipeline had low income populations that exceeded the state share.

The share of the population considered linguistically isolated by EJSCREEN is lower than the state average (3 percent) in all four counties (1 percent in each) (table 4.9.2.9-2). Two census block groups, both in Klamath County, had linguistically isolated populations that exceeded the state average, with linguistically isolated populations of 8 and 11 percent versus the statewide average of 3 percent. The share of the population with less than high school education was slightly higher than the state average (10 percent) in all four counties, ranging from 11 percent to 12 percent (table 4.9.2.9-2), with the shares in 14 of the 34 census block groups also exceeding the state average. The populations in the census block groups crossed by the Pacific Connector pipeline tend to be older than the state average, as suggested by the county averages (table 4.9.2.9-2), with the share of the population over 64 exceeding the state average in 27 census block groups. Only 7 of the census block groups crossed by the pipeline route had populations below age 5 that exceeded the state average.

High and Adverse Impacts

The impacts of constructing and operating the Project on the natural and human environments are identified and discussed throughout the environmental analysis section of this document. As described in the numerous environmental resource-specific discussions, we conclude that the

Project would not significantly impact the environment or have high and adverse effects on human health or the environment. As discussed elsewhere in this section, the combined impact of housing demand from LNG terminal and pipeline workers does, however, have the potential to cause short-term housing impacts in Coos County.

Disproportionate Impacts on Environmental Justice Populations

The Pacific Connector pipeline route mostly crosses rural regions with low population densities, and avoids towns and cities. Pacific Connector has indicated that they sought to find the shortest, buildable route between Coos Bay and Malin, Oregon, where the pipeline would terminate. Along the way, the pipeline route mostly follows ridges through the mountains. Unlike discrete facilities whose impacts are generally concentrated in one location, a pipeline establishes or expands a narrow corridor often over long distances passing near communities with a mosaic of social and economic characteristics. The preceding review suggests the presence of potential environmental justice or vulnerable populations in several of the census block groups that would be crossed by the Pacific Connector pipeline. Construction and operation of the pipeline are not expected to result in high and adverse human health or environmental effects on any nearby communities and the likelihood that these potential environmental justice and vulnerable populations will be disproportionately affected relative to other populations in the census tracts crossed by the pipeline is low.

As noted in section 4.9.1.9, government-to-government consultations between the FERC and Indian tribes are still ongoing and FERC staff has requested an assessment of the potential effects of the Project on tribal uses of those resources or the tribal members to be presented in a forthcoming ethnographic study (see section 4.11.3.1).

4.9.3 Environmental Consequences on Federal Lands

Potential socioeconomic effects of the pipeline on federal lands would be primarily related to timber harvesting, recreation, and transportation. These are discussed in sections 4.7, 4.8, and 4.10, respectively.

4.9.3.1 Financial Efficiency Analysis

The Forest Service directs that projects involving timber sales include a financial efficiency analysis that compares the anticipated costs and revenues that are part of Forest Service monetary transactions (Forest Service 2002). Pacific Connector prepared a financial efficiency analysis that assesses the net present value of costs and benefits that would accrue to the federal government as a result of construction and operation of the pipeline project. This analysis was prepared in general accordance with direction contained within the Forest Service Handbook.

The analysis is limited to those costs and revenues that would result from the direct use of federal assets (land, timber, and roads) and can be directly quantified based on existing fee schedules. The analysis does not include government administrative revenues that would be generated from the fees charged to process the project application and monitor the ROW. In addition, the analysis does not include non-market economic costs or benefits that are not part of federal monetary transactions.

Costs and benefits were projected over a 50-year time period, where appropriate, and discounted using a real discount rate of 4 percent. The analysis identifies two sources of direct government revenue: (1) Pacific Connector's payment for timber that would need to be cut, and (2) Pacific Connector's rental payments for construction access and the pipeline ROW. The analysis also identifies three sources of government costs: (1) the value of lost timber productivity along the new ROW, (2) the value of non-merchantable trees that would need to be cut prematurely (lost timber growth), and (3) the incremental cost of future maintenance for existing roads that Pacific Connector may upgrade above their existing federal maintenance level (Levy 2008). The present values of these projected revenues and costs are summarized in table 4.9.3.1-1. The projected net present value of the Pacific Connector Pipeline Project based on this analysis is $7.77 million in 2015 dollars (table 4.9.3.1-1).

TABLE 4.9.3.1-1

Financial Efficiency Analysis of the Pacific Connector Pipeline Project

Category	Timing	Present Value in 2015 (2010$ millions)
Revenues		
Timber Revenue a/	2021 to 2022	5.25
Temporary Use Permit and Right-of-Way Revenue b/	2021 to 2073	2.67
Costs		
Lost Timber Productivity c/	2021	-0.004
Lost Timber Growth d/	2021	-0.058
Incremental Road Maintenance e/	2023 to 2073	-0.083
Net Present Value		7.77

a/ Timber revenue was calculated based on the pond value of the estimated timber volume, less the costs of logging and hauling the timber to the mill, slash disposal, and road work. Timber volumes and other values used in this estimate are based on preliminary estimates prepared by Pacific Connector.
b/ This analysis assumes that Temporary Use Permits would be required for construction for 2 years and the ROW would be required for 50 years. Revenues are estimated based on the federal 2020-2023 Linear ROW Rental Schedule values per acre for the affected counties. The analysis assumes that Pacific Connector would make a one-time payment, rather than make annual payments over the life of the project.
c/ Lost timber productivity was estimated based on the soil expectation value of the lands that would be permanently lost to timber production and is based on an average soil expectation value of $14.30 per acre.
d/ Lost timber growth accounts for the value of non-merchantable trees that would be cleared in the ROW. This value is based on the projected value of these trees at merchantable age. Premature harvest of these trees represents foregone revenue for the federal government and is, therefore, counted as a cost here.
e/ Non-design improvements, such as turn-outs, widening, or blading/grading, to existing roads on NFS and BLM lands would likely be necessary as part of this project and may change the maintenance level of the existing road (by, for example, adding base and gravel to an existing road surface of native materials) and, as a result, impose an incremental maintenance cost on the government. This analysis assumes that all roads on federal lands used by Pacific Connector for construction access would be upgraded from native materials to gravel and, therefore, result in costs at the upper end of the range of possible outcomes. Incremental cost increases are assumed to be $343 per mile per year.
Source: Levy 2008

This analysis does not, however, as noted above, account for other costs and benefits that are not assigned monetary values by the federal government. Other potential impacts (not valued) to federal lands include impacts on recreation, the PCT, grazing, LSRs, and Riparian Reserves (Levy 2008). While no monetary value is assigned to these potential impacts, they are considered in detail elsewhere in this document.

4.9.3.2 Secure Rural Schools and Community Self-Determination Act

Prior to 2000, in states with national forests and certain BLM lands, 25 percent of the returns to the U.S. Treasury from revenue-producing activities, such as timber sales, were returned to each state for distribution back to counties having acreage within a national forest. Those payments were called the “25 percent fund payments” and were dedicated by law to roads and schools. In October 2000, the *Secure Rural Schools and Community Self Determination Act of 2000* was enacted to stabilize federal payments to states in response to declining federal receipts. The legislation was authorized for implementation for fiscal years 2001 through 2006, and has subsequently been reauthorized, most recently in May 2018 (Forest Service 2018). As mentioned above, the Pacific Connector pipeline would not involve federal land disposal, acquisition, or exchange and is, therefore, not expected to affect existing 25 percent fund/Secure Rural Schools payments to the affected counties.

4.9.3.3 Mitigation of Impacts on Federal Lands

No mitigation of impacts on federal lands specifically related to socioeconomics is currently being considered.

4.9.4 Conclusion

Construction and operation of the Project would result in impacts on socioeconomic resources as described in the preceding sections. Temporary impacts during construction would include increased demand for law enforcement and fire protection, and medical services. These potential construction-related impacts would be temporary and short term. In addition, constructing the Project would provide direct employment for local workers, support jobs and income elsewhere in the local and state economies, and generate tax revenues for local, state, and federal agencies. However, when the combined effects of the Jordan Cove LNG Project and Pacific Connector Pipeline Project are taken into consideration collectively, construction of the Project has the potential to cause significant affects to short-term housing in Coos County. These impacts could include potential displacement of existing and potential residents, as well as tourists and other visitors. Tourists and other visitors could also be displaced during peak construction in Douglas and Jackson counties as Project-related demand for hotel and motel rooms would likely exceed the normally available supply. With the applicant’s proposed construction and operations procedures and mitigation measures in place, construction and operation of the LNG terminal and pipeline facilities are not expected to result in significant impacts on socioeconomic resources or services, with the exception of housing availability.

4.10 TRANSPORTATION

4.10.1 Jordan Cove LNG Project

4.10.1.1 Marine Traffic

Marine traffic in Coos Bay includes deep-draft cargo ships that call at the Port; tugs and barges; and commercial and private fishing and recreational boats. In 2015, 42 deep-draft cargo ships called at the Port, down from about 200 calls per year in the mid-1990s. Nearly 200 commercial fishing vessels operate in Coos Bay from March to October, with just over 100 based in Coos Bay year-round. There is also some transient travel from other commercial vessels through Coos Bay delivering products, buying ice, or seeking other services. Barges, commercial fishing boats, and recreational boats are all shallow-draft vessels that can move out of the navigation channel to avoid deep-draft cargo ships when necessary.

All deep-draft cargo ships servicing Coos Bay use the existing navigation channel. They enter and exit the Port under the control of a Coos Bay Pilot. According to ECONorthwest (2017b), the Coos Bay Pilots Association typically encounters an average of six recreational boats and two commercial fishing boats during the transit of each deep-draft vessel through the Federal Navigation Channel.

The LNG terminal would receive approximately 70 water deliveries over a 2-year period. Deliveries would be via a mix of ocean-going vessels and barges. During construction, Jordan Cove would also use barges to transport dredge materials from the LNG terminal access channel and slip for fill at the Kentuck project site, resulting in an estimated 225 barge deliveries over a 4- to 5-month period. The addition of these vessels, about 25 trips per month, would not adversely impact other bay users, such as other commercial ship traffic, fishing vessels, or recreational boaters. Transits would be scheduled with the pilots and follow normal procedures in use for commercial vessel traffic. Jordan Cove would consult with the Coast Guard regarding other requirements for construction equipment ships and barges (see appendix B).

As described in chapter 2, Jordan Cove anticipates that LNG carriers would call on the terminal up to 120 times per year. Travel time from the offshore buoy at the beginning of the navigation channel to the terminal is estimated to be about 90 minutes at typical speeds of 4 to 10 knots. Coos Bay pilots would not pilot an LNG carrier through the Federal Navigation Channel under severe weather conditions, or when the volume of other ship traffic in the channel is so heavy that transit to the LNG terminal could be unsafe.

The Federal Navigation Channel can accommodate only one-way deep-draft vessel traffic (i.e., only one vessel at a time, see chapter 2). An LNG carrier would be unable to use the channel when another deep-draft commercial ship is in transit in Coos Bay, and would instead be held either at the buoy outside the bay or in the marine slip at the Jordan Cove LNG terminal until the other deep-draft ship has completed its transit.

Impacts on fishing and recreational boats in Coos Bay resulting from Project-related ship traffic would be similar to those from current deep-draft cargo ship traffic in the Federal Navigation Channel. In general, as a deep-draft vessel enters the channel, other boats move out of its way, and boats in the ocean near the mouth of the channel defer entering the channel until the larger ships have passed. The escort boats accompanying each LNG carrier would facilitate moving other boats out of the way in a timely manner. As they currently do for other commercial cargo ship traffic, the Coast Guard and OSMB would remind recreational boaters of their obligation to not impede deep-draft vessels transiting in the Federal Navigation Channel. Interactions between deep-draft cargo ships and other boats rarely occur in Coos Bay. The likelihood of a collision between an LNG carrier and another boat would be extremely low because of the mitigation measures imposed by the Coast Guard's WSR, including the implementation of a TMP, and a security zone around LNG carriers in the waterway (typically around 500 yards in size). While an LNG carrier is moored at berth at the terminal, a security zone would be established around the slip. This security zone would not extend as far as the Federal Navigation Channel and would not affect vessels transiting through the channel.

The addition of approximately 70 water deliveries via a mix of ocean-going vessels and barges during the two-year construction period and 120 LNG carriers per year transiting to and from the Jordan Cove LNG terminal during its operation would increase the total number of deep-draft vessels calling at Coos Bay. This increase in marine traffic combined with current deep-draft vessel traffic would be less than historic ship traffic through the channel. Therefore, based on this historic capacity, current traffic practices in the bay, and the implementation of Coast Guard shipping measures, we conclude that some marine traffic might be temporarily inconvenienced, but the passage of LNG carriers and other Project-related marine traffic through the channel would not significantly affect other boats in Coos Bay.

4.10.1.2 Motor Vehicle Traffic

As described in chapter 2, the construction work force would use public roads and highways (U.S. Highway 101 and the Trans-Pacific Parkway) to deliver supplies and access LNG terminal site workspaces.

On behalf of Jordan Cove, DEA prepared a *Traffic Impact Analysis* for the Jordan Cove LNG Project (DEA 2017b) based on a Project study area established by ODOT, Coos County, and the City of North Bend.[172] The 14 intersections that comprise the study area are governed by operational targets or standards established by the applicable jurisdiction (City of North Bend, Coos County, and/or ODOT). The existing conditions (August 2017) analysis performed by DEA found that all study area intersections met the applicable mobility targets during both midweek AM and PM analysis hours. All intersections but one also met the applicable LOS mobility targets during both Friday PM and midday Saturday analysis hours.[173] The exception, the westbound left turn from Ferry Road to U.S. 101, was identified as operating at level of service (LOS) E and, therefore, exceeding the applicable "LOS D" mobility target established by the City of North Bend).[174]

The DEA analysis assessed impacts for four analysis hours, which coincide with peak workforce shift changes. The DEA construction phase analysis assumed two work shifts, with start times staggered by one hour, with only one shift occurring during peak analysis hours. The analysis,

[172] This report was filed as part of Jordan Cove's response to FERC's January 3, 2018 Environmental Information Request.

[173] LOS is measured as a function of control delay at intersections, with six established targets ranging from LOS A, where there is little or no delay, to LOS F, where there is delay of more than 50 seconds at unsignalized intersection, or more than 80 seconds at signalized intersections.

[174] Project construction and operation would not add any traffic to the westbound left turn from Ferry Road to U.S. 101 and, therefore, this intersection is not discussed further.

therefore, looked at only half the proposed workforce, with the other half of the workforce assumed to travel outside of peak analysis hours. The use of two staggered work shifts is intended to reduce construction impacts and assumed to be in place in all the construction-related analyses.

The DEA study analyzed impacts for two construction phases—(1) just before the proposed workforce housing and Park and Ride (PnR) lots are active; and (2) when the construction workforce would be at its peak with the proposed housing and PnR lots also at peak usage—and the first year of operations.

For the first construction phase, the study found that the intersection of U.S. 101 at the Trans-Pacific Parkway would fail to meet operational targets during the midweek PM and Friday PM analysis hours if no mitigation were provided, with construction-related traffic resulting in significant vehicle queuing and delays. To address this failure, Jordan Cove would construct a dedicated eastbound left-turn lane (approximately 600 feet in length) and implement a temporary signal at the intersection for the duration of construction activities.

This intersection would also fail to meet operational targets during the second construction phase evaluated in the DEA study. In addition, U.S. 101 at Hauser Depot Road was predicted to fail to meet operational targets during the midweek PM and Friday PM analysis hours, with estimated traffic volumes exceeding intersection capacity resulting in traffic congestion and delays. Jordan Cove would mitigate this impact by implementing manual flagging of the intersection during the PM hours when the construction workforce would be leaving the Myrtlewood Off-site Park and Ride lot.

The DEA analysis of the first year of operation found that all intersections meet the applicable mobility targets.[175]

In summary, the DEA (2017b) study indicates that Project-generated trips during peak construction would result in operational impacts at two study area intersections if no other mitigation were provided. In addition to staggered work shifts (assumed in the analysis), the *Traffic Impact Analysis* recommended the following strategies and mitigation measures:

- U.S. 101 at Trans-Pacific Parkway – construct a dedicated eastbound left-turn lane and employ temporary signalization of the intersection.
- Hauser Depot Road at U.S. 101 – employ manual flagging at the intersection during the PM hours when the workforce is leaving the Myrtlewood Off-site Park and Ride lot.
- Use PnR lots to bus workers not residing at the North Spit housing facility to the Project site.

The Traffic Impact Analysis recommends that Jordan Cove enter into development agreements with ODOT, Coos County, and the City of North Bend to allow the various entities to work through different scenarios should they occur during construction. Such development agreements would provide the framework to allow for timely identification and development of response actions or

[175] The one exception would be the westbound turn from Ferry Road to U.S. 101, which currently fails to meet operational targets. As noted above, operation of the project would not add any traffic to this intersection.

mitigation for unforeseen scenarios that develop during construction. We concur with these findings. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Jordan Cove should file documentation that it has entered into development agreements with ODOT, Coos County, and the City of North Bend, as recommended in the *Traffic Impact Analysis* report.**

During construction of the LNG terminal slip, excavated material would be transported by truck to upland sites. The excavated material truck haul route would be on Jordan Cove or Roseburg Forest Products owned land and would not cross the Trans-Pacific Parkway. The haul trucks and other equipment using the haul road would consist of large off-road vehicles common for large civil infrastructure or mining projects. The only potential conflict would be with Roseburg chip truck traffic, when the Jordan Cove excavated material trucks cross Jordan Cove Road. This potential impact would be mitigated by construction of a temporary traffic overpass that would segregate traffic traveling to and from the Roseburg Forest Products facility from large, off-road haul trucks and equipment.

4.10.1.3 Railroad Traffic

The existing Coos Bay rail line would be used for the delivery of sheet piling. Over the first year 16 deliveries of sheet piling would occur. However, Jordan Cove has indicated that pending further analysis, additional use of the rail line may be necessary. All rail shipments would be off-loaded at an existing rail spur at the Roseburg Forest Products yard, which runs into the construction laydown area. No new rail construction is anticipated for the purpose of transporting materials and equipment to the site. Rail deliveries would be coordinated with Roseburg Forest Products and Coos Bay Rail Link to minimize impacts on their operations.

4.10.1.4 Air Traffic

The Southwest Oregon Regional Airport is located in the city of North Bend, directly across Coos Bay and less than 1 mile from the LNG terminal site. The airport is owned and operated by the Coos County Airport District and provides commercial passenger services to the region. The Coast Guard also has five helicopters based at the airport. The number of fixed wing aircraft based at the Southwest Oregon Regional Airport has ranged from 51 to 68 for the past 20 years, with 51 aircraft based at the airport in 2010.

Commercial passenger service to and from the airport is currently provided by United Airlines, with one flight daily to and from San Francisco, four days a week. United Airlines also provides seasonal twice-a-week roundtrip flights to and from Denver. Federal Express and Ameriflight operate cargo services out of the airport.

During operation of the Jordan Cove LNG Project, LNG carriers in the Federal Navigation Channel would cross he airport approach pathway. Jordan Cove has indicated that aircraft would be delayed by about 13 minutes for each passing vessel, consisting of a 10-minute advance notice period, and 3 minutes of actual time during which airspace would be potentially obstructed. LNG carrier transit times could also be adjusted to avoid conflict with air traffic, if the need arises.

Comments during public scoping requested that the EIS evaluate the potential impact of thermal plumes from the Jordan Cove LNG terminal on airport operations. Jordan Cove commissioned a thermal plume study for the previously proposed LNG terminal in 2013 (TRC Environmental

Corporation 2013) which showed that the combustion turbines that were part of the previously proposed South Dunes Power Plant were identified as the main potential source of thermal plumes from the terminal. The South Dunes Power Plant is not part of the current proposal and therefore the LNG terminal would not general thermal plumes.

Title 49 CFR §193.2155 of the USDOT's regulations requires that an LNG storage tank be at least 1 mile from the end of an airport runway, or 0.3 mile from the nearest point on a runway, whichever is longer. This issue is discussed further in section 5.1.13, Reliability and Safety.

4.10.2 Pacific Connector Pipeline Project

4.10.2.1 Access Roads

Pacific Connector would use a variety of vehicles including standard pick-up trucks, earth-moving equipment, tractor trailers, and pipe-stringing (and other materials/equipment) trucks to construct the pipeline. These vehicles would traverse Project-area roadways and access workspaces via existing and new construction access roads. Equipment and materials would be transported from various laydown areas and storage yards to the pipeline right-of-way and associated construction workspaces. Most construction equipment would remain on the right-of-way during construction.

As described previously, existing roads, including federal and state highways, as well as local, private, and BLM and Forest Service roads, would be used to access workspaces and move construction equipment, materials, and personnel (see table D-2 in appendix D).

Major state and federal highways that would be affected by the pipeline include:

- U.S. Highway 101 (MP 1.2) and State Highway 42 (MP 51.5) in Coos County;
- I-5 (MP 71.2) and State Highway 227 (MP 94.7) in Douglas County;
- State Highway 62 (MP 122.6), Butte Falls Highway (132.5), and State Highway 140 (MP 145.6) in Jackson County; and
- State Highway 66 (MP 191.5), U.S. Highway 97 (MP 199.6), and State Highway 39 (MP 208.8) in Klamath County.

The pipeline would be installed in Coos Bay under U.S. Highway 101. State Highways 42, 140, 66, and 39 would be crossed with conventional road bores. Pacific Connector proposes to use direct pipe technology to cross under I-5. State Highway 62 and U.S. 97 would be crossed with HDDs. Highway 227 and the Butte Falls Highway would be crossed with open cuts. Smaller roads would also typically be crossed with open cuts.

Constructing the pipeline would temporarily impact Project-area roads and their users. Temporary impacts include increased road traffic, traffic delays, and road wear. To facilitate construction of the pipeline, some existing roads would be improved. Improvements would generally occur on smaller roads and would include widening, base improvement (gravel), and the installation of pullout/passing spaces. Minor improvements (i.e., filling potholes, grading to remove ruts, and/or limbing to remove overgrowth) would be needed in some areas to accommodate oversized and heavy construction equipment. In other cases, roadway improvements would require reconstruction to make the roads usable for access to the construction right-of-way. Pipeline-stringing trucks would haul 40- to 80-foot lengths (joints) of pipe, which would often require travel outside an existing road footprint. Widening access roads would be necessary to accommodate the potential for the stringing trucks to "walk" outside of the existing road footprint. In some circumstances, it may also be necessary for oncoming traffic to pull off of the existing road footprint to pass.

To reduce impacts on affected roads and users, Pacific Connector would implement the measures described in its TMP.[176] These measures include:

- Obtain all necessary permits from ODOT, BLM, Forest Service, and the counties to cross and/or use roads, and implement all permit stipulations.
- Notify landowners or managers 7 days in advance of planned road work. In cases where there are unforeseen changes to the schedule, provide a minimum 48-hour notice.
- Use flaggers, signs, lights, barriers, and other common traffic control measures.
- Maintain at least one lane of traffic with detours around the construction by plating over the open portion of the trench or by other suitable methods. Where road closures are necessary, limit closures to 24 hours, post signs in advance, provide access for emergency vehicles, and evaluate alternate access for local residents.
- Keep roads free of mud and other debris that may be deposited by construction equipment. Ensure track-driven equipment crosses roads on tires or construction pads to minimize road damage. Repair any roadways damaged by construction activities.

In addition to its use of public roads, Pacific Connector would construct 10 new TARs and 15 new PARs (table 4.10.2.1-1). Eight of the TARs and 12 of the PARs would be located on non-federal land . After the pipeline is installed, unless specifically requested by the landowner, the TARs would be removed, and the land restored to its original use. Most of the new PARs would be located within Pacific Connector's permanent pipeline easement and would provide access during construction as well as for operations and maintenance activities while the Pacific Connector pipeline is in service.

TABLE 4.10.2.1-1

Proposed New Temporary and Permanent Construction Access Roads

Access Road (TAR/PAR-MP)	Width (feet)	Length (feet) a/	Jurisdiction	County
TAR-27.06	20	1,500	BLM	Coos
TAR-29.92	16	2,249	Private	Coos
TAR-88.69	20	416	Private	Douglas
TAR-94.81	20	114	Private	Douglas
TAR-101.70	25	1,517	Private/NFS	Jackson
TAR-141.10	25	471	Private	Jackson
TAR-143.19	20	146	Private	Jackson
TAR-145.60	20	391	Private	Klamath
TAR-208.72	20	281	Private	Klamath
TAR-215.72	14	728	Private	Klamath
Total TAR		**7,813**		
PAR-15.07	25	258	Private	Coos
PAR-29.48	25	85	Private	Coos
PAR-48.58	25	222	BLM	Douglas
PAR-59.58	25	195	Private	Douglas
PAR-71.46	25	692	Private	Douglas
PAR-80.03	25	92	BLM	Douglas
PAR-94.66	25	501	Private	Douglas
PAR-113.66	25	73	Private	Jackson
PAR-122.18	25	181	Private	Jackson

176 Pacific Connector filed its TMP as Appendix Y to its POD filed with the FERC on January 23, 2018.

TABLE 4.10.2.1-1 (continued)

Proposed New Temporary and Permanent Construction Access Roads

Access Road (TAR/PAR-MP)	Width (feet)	Length (feet) a/	Jurisdiction	County
PAR-132.46	25	271	Private	Jackson
PAR-150.70	25	282	BLM	Jackson
PAR-169.48	25	342	Private	Klamath
PAR-187.46	25	438	Private	Klamath
PAR-196.53	25	106	Private	Klamath
PAR-211.58	25	72	Private	Klamath
Total PAR		**3,810**		

TAR = Temporary Access Road; PAR = Permanent Access Road; MP = milepost
a/ All or portions of the PARs are located within the permanent pipeline easement. Estimated total disturbance from TAR = 3.8 acres, total disturbance from PAR = 2.2 acres.

4.10.2.2 Additional Traffic on Local Roads

Pacific Connector assumes that approximately 80 percent of workers would travel each morning to a construction yard, and then make the return trip in the evening. These workers would then be transported from the contractor yard to and from construction workspaces on crew buses. The remaining 20 percent of the workforce would drive their own vehicles to construction workspaces using local roads and highways, with 30 percent of this total expected to carpool with approximately two workers per vehicle. The 20 percent of the workforce using their own vehicles would make two to three daily trips from the contractor yards to various construction locations.

Pacific Connector estimates that between three and four pipe-stringing trucks would make approximately two roundtrips per day between the pipe storage yards and pipeline work sites for the duration of project construction. Three water trucks and three dump trucks would make up to six roundtrips per day to deliver materials and equipment to the right-of-way and control fugitive dust. Another five fuel/lube/maintenance trucks and five equipment trucks would make approximately one roundtrip per day between the storage yards and work sites. Based on these assumptions, average heavy truck traffic during mainline construction is estimated to include 53 vehicle round trips per day along each construction spread. The routes taken by these vehicles would vary depending on the location of construction activities.

Based on these assumptions, construction-related peak vehicle round trips per day would range from 461 to 1,657, including crew buses and heavy vehicle trips (table 4.10.2.2-1).[177]

[177] These estimates are based on five construction spreads as initially identified by Pacific Connector. Pacific Connector has since indicated that they would use eight construction spreads. Increases in the number of spreads would reduce the number of workers traveling to any one location.

TABLE 4.10.2.2-1

Estimated Peak Vehicle Round Trips per Day by Pipeline Spread

Vehicle Type/Journey	Spread a/,b/ 1	2	3	4	5
Personal vehicles from place of residence to work sites c/	413	589	284	171	150
Personal vehicles from place of residence to contractor yards	661	942	455	274	239
Worker vans and trucks from contractor yards to work sites d/	52	74	36	21	19
Heavy Vehicle Trips e/	53	53	53	53	53
Total Traffic f/	**1,179**	**1,657**	**828**	**520**	**461**

a/ The spreads initially identified by Pacific Connector are as follows:
Spread 1: Coos Bay (Coos County) to Camas Valley (Douglas County)
Spread 2: Camas Valley to Milo (Douglas County)
Spread 3: Milo (Douglas County) to Shady Cove (Jackson County)
Spread 4: Shady Cove (Jackson County) to Keno (Klamath County)
Spread 5: Keno to Malin (Klamath County)
b/ Pacific Connector has indicated they now plan to use eight construction spreads, which would reduce the number of workers traveling to any one location.
c/ Personal vehicles are assumed to make between two and three trips per day between work sites and contractor yards.
d/ Worker vans are assumed to be 15-passenger crew vans.
e/ Heavy vehicle traffic includes pipe-stringing, water, dump, material, and fuel/lube/maintenance trucks making between one and six trips per day between work sites and contractor yards.
f/ Totals may not sum due to rounding.

Other trips not included in the estimates in table 4.10.2.2-1 include workers building the aboveground facilities, inspectors, and surveyors traveling to and from various work sites.

4.10.2.2 Operations

Operating the pipeline would require a permanent staff of about 15 employees. Project-related traffic during operations would be minimal, occurring on a sporadic rather than regular basis, and would have negligible effects on traffic volumes on roads in the Project area.

4.10.2.3 Off-Highway Vehicles

Commenters raised concerns during public scoping that the pipeline right-of-way could be used to increase unauthorized OHV, snowmobile, and dispersed motorized access to adjacent lands. OHV use is discussed in section 4.8, Recreation and Visual Resources.

4.10.3 Environmental Consequences on Federal Lands

4.10.3.1 Roads Crossed

The pipeline would cross multiple roads on BLM and NFS lands. Some roads would be crossed at more than one location. The pipeline would be placed within the right-of-way of a number of roads. Open cuts would be used to cross all of the roads on BLM and NFS lands.

4.10.3.2 Roads Used for Access

Pipeline construction would require the use of many miles of existing roads on federal lands, or existing private roads on which federal land-managing agencies hold an easement. The BLM and NFS roads are of varying conditions, and some roads would require improvements to surfacing, brushing, drainage maintenance, and other work to accommodate oversized and heavy construction equipment. In most cases, the potentially affected roads are single-lane forest roads designed and built primarily for the removal of timber using conventional log trucks. Pacific Connector's pipe-stringing trucks would be hauling 40- to 80-foot-long sections of pipe to the right-of-way. These vehicles would be approximately 100 feet long. Because of the size of these and other vehicles that would use these access roads, some minor improvements (straightening, widening, cut and fill, and/or culvert improvements) may be required. In some circumstances, it may also be necessary to construct turnouts for oncoming traffic to "pull out" of the existing road footprint for passing purposes. All road maintenance, reconstruction, and improvements undertaken by Pacific Connector and their contractors would conform to BLM and Forest Service requirements. No maintenance or improvements would be allowed on any road not authorized for use and approved for improvements.

Pacific Connector would construct one new TAR on BLM land. This road would be approximately 0.3-mile-long and would disturb less than approximately 1 acre of land. One TAR would be constructed on NFS lands. This road would also be approximately 0.3 mile long and disturb less than approximately 1 acre of land (table 4.10.2.1-1). These roads would provide access during construction and would be restored to preconstruction conditions following completion of construction; which would result in a short-term impact.

Pacific Connector would construct three new PARs on BLM land, totaling about 600 feet (see table 4.10.2.1-1). Construction of these new roads would permanently impact approximately one-third of an acre. These roads would provide access during construction and for operations and maintenance activities while the Project is in service. No new PARs would be built on NFS land.

Construction activities at proposed federal road crossings would also affect public access, as well as use by permittees, contractors, and cost share users. Pacific Connector's TMP identifies the roads on federal lands that would be used during Project-related timber extraction activities, and pipeline construction and operations, and specifies the standards that would be utilized where improvements on federal roads are necessary.

As discussed in section 4.10.2.3, Pacific Connector's TMP outlines measures Pacific Connector would implement to maintain public access on roads used for construction access or crossed by the construction right-of-way during pipeline construction.

4.10.3.3 OHV Use on Federal Lands

Federal land managers have raised concerns that the pipeline right-of-way could be used to increase unauthorized OHV, snowmobile, and dispersed motorized access to federal lands. Locations where unauthorized access could be exacerbated by the pipeline right-of-way include the area around the PCT; the Camel Hump area; the Obenchain area; along the Clover Creek Road (on NFS land); and various points on BLM lands. In the Obenchain area, four-wheel-drive vehicles have caused extensive resource damage. The Camel Hump and Obenchain areas are located within the Jackson Access and Cooperative Travel Management Area, which encompasses both private and BLM lands, and is generally closed to motorized use from mid-October through April. In the area along the Clover Creek Road, the pipeline would closely parallel the road for 18 miles (on public and private lands); thus, the pipeline right-of-way could potentially turn into an OHV thoroughfare without appropriate barriers and mitigation.

OHV controls were addressed in Pacific Connector's *Recreational Management Plan*. The general measures Pacific Connector would use to limit OHV access to its right-of-way on federal lands would be the same as those discussed for non-federal lands above.

4.10.4 Conclusion

Constructing and operating the Project would not significantly affect marine, railroad, or air traffic. With the proposed mitigation measures mentioned in previous sections in place, the Project would also not significantly affect motor vehicle traffic.

4.11 CULTURAL RESOURCES

Cultural resources are locations of human activity, occupation, or use. According to the FERC's Office of Energy Projects' "Guidelines for Reporting on Cultural Resources Investigations for National Gas Projects," cultural resources include any prehistoric or historic archaeological site, district, object, cultural feature, building or structure, cultural landscape, or Traditional Cultural Property (TCP). Generally, cultural resources are considered to be historic properties[178] under the NHPA if they are at least 50 years old and meet the criteria for listing on the NRHP (36 CFR Part 60.4). Adverse effects to historic properties are typically considered significant impacts under NEPA; however those impacts may be mitigated to less-than-significant levels. It should be noted that consulted Indian tribes have pointed out that their definition of cultural resources is more expansive than that above and may include natural resources or features. As discussed in subsection 4.11.1.3 below, while resources and issues of concern to Indian tribes that do not meet the above definition of cultural resources are described in this section, the reader is referred to the corresponding section of this EIS for a more detailed discussion.

The regulations for implementing Section 106 of the NHPA, at 36 CFR 800.9, encourages the integration of the Section 106 compliance process with the NEPA process; and we have done this in this section below of the EIS. This section is broken into several subsections. The subsections mirror the Section 106 compliance process. The steps of the process, as outlined in 36 CFR 800 are: 1) consultations; 2) identification of historic properties; 3) assessment of effects; and, 4) the resolution of adverse effects. Our first subsection below is a summary of consultations initiated by the FERC staff, and communications the applicants had with various consulting parties, including other federal agencies, SHPO, and interested Indian tribes. Next, we define the APE, and summarize the results of literature reviews and site file searches, and the results of cultural resources inventories conducted by the applicants' consultants. Then we discuss the Unanticipated Discovery Plan (UDP) produced by the applicants for this Project, and reviews by consulting parties. Lastly, we reach conclusions about the status of our compliance with the NHPA. Appendix L includes a cultural context for the Projects, a brief summary of archaeological research in southern Oregon, detailed listings of consultations with SHPO and Indian Tribes, and detailed listings of identified cultural resources in the APEs of the Project, anticipated impacts on those resources, and proposed methods to address those effects.

Section 101(d)(6) of the NHPA states that properties of traditional religious and cultural importance to Indian tribes may be determined eligible for the NRHP. In carrying out our responsibilities under Section 106 of the NHPA, the FERC staff consulted with Indian tribes that may attach religious and cultural importance to properties in the APE. On behalf of all the federal cooperating agencies, as the lead federal agency, the FERC staff conducted government-to-government consultations with Indian tribes that may be interested in the Projects, and may have concerns about potential impacts on cultural resources and historic properties, including traditional religious and cultural properties. Consultations with Indian tribes are detailed below.

[178] Historic properties include any prehistoric or historic district, site, building, structure, or object, and properties of traditional religious or cultural importance to Indian tribes listed on or eligible for listing on the NRHP, as defined in 36 CFR 800.16(l).

Section 106 of the NHPA requires the FERC to take into account the effect of its undertakings[179] (including authorizations under Sections 3 and 7 of the NGA) on historic properties and afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment. Jordan Cove and Pacific Connector, as non-federal applicants, are assisting the FERC in meeting its obligations under Section 106 by providing data, analyses, and recommendations in accordance with 36 CFR 800.2(a)(3) and the FERC's regulations at 18 CFR 380.12(f). The FERC remains responsible for all findings and determinations under the NHPA.

As the lead federal agency for the Project, the FERC will address compliance with Section 106 on behalf of all the federal cooperating agencies in this EIS.[180] However, the federal land-managing agencies still have separate obligations regarding cultural resource management under other federal laws and regulations, including, but not limited to, the Antiquities Act of 1906, Section 110 of the NHPA, Archaeological and Historic Preservation Act of 1974, Archaeological Resources Protection Act of 1979, FLPMA, and the Native American Graves Protection and Repatriation Act.

4.11.1 Consultations

To identify historic properties potentially affected by the Projects and in accordance with Section 106, FERC, on behalf of all of the federal cooperating agencies, consulted with the Oregon SHPO,[181] interested Indian tribes, and other consulting parties prior to making our determinations of NRHP eligibility and Project effects. We also consulted with the SHPO, interested Indian tribes, and other consulting parties to determine the resolution of adverse effects on historic properties that cannot be avoided. All correspondence related to these consultations can be found in the Commission's administrative record. A detailed listing of communications and comments received from Indian tribes are included in appendix L. Our consultations are ongoing and will be updated in the final EIS.

Consultations began with the issuance of the NOI on June 9, 2017. The NOI was sent to a wide range of stakeholders, including other federal agencies such as the ACHP, U.S. Department of the Interior Bureau of Indian Affairs (BIA), BLM, COE, Forest Service, Reclamation, and NPS; state and local government agencies, such as the Oregon SHPO; affected landowners; regional environmental groups and non-governmental organizations; and Indian tribes that may have an interest in the project area. The NOI contained Section 106-specific text initiating consultations with the SHPO and soliciting their views and those of other government agencies, interested Indian tribes, and the public on the Project's potential effects on historic properties.

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[179] "Undertaking means a project activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; those requiring a Federal permit, license or approval; and those subject to state or local regulation administered pursuant to a delegation or approval by a Federal agency," as defined in 36 CFR 800.16(y). The Projects are undertakings.

[180] Pursuant to 36 CFR 800.2(a)(2), the EPAct, and the May 2002 Interagency Agreement on Early Coordination of Required Environmental and Historic Preservation Reviews.

[181] In all cases, the SHPO refers to the staff of the Oregon State Historic Preservation Office within the Oregon State Parks and Recreation Department, including the State Archaeologist.

4.11.1.1 Consultations with the SHPO

Throughout the planning process, the FERC staff have consulted with and the applicants have communicated with the Oregon SHPO regarding the Projects. While not specific to the current application, FERC consultations and applicant communications regarding previous versions of the Projects occurred between 2006 and 2015 and informed our current consultations. Those efforts were summarized in the relevant FEISs prepared for Docket Nos. CP07-441-000, CP07-444-000, CP13-483-000, and CP13-492-000. Consultations between the FERC and the SHPO after September 2015, related to Docket Nos. CP17-494-000 and CP17-495-000, are summarized in table L-1 in appendix L. Communications between the SHPO and the applicants after September 2015 are summarized in tables L-2 and L-3 in appendix L.

4.11.1.2 Consultations with Indian Tribes

The unique and distinctive political relationship between the United States government and Indian tribes is defined by treaties, statutes, executive orders, judicial decisions, and agreements. These have resulted in differentiating tribes from other entities that deal with, or are affected by, the federal government. This relationship has given rise to a special federal trust responsibility, involving the legal obligations of the United States government toward Indian tribes and the application of fiduciary standards of due care with respect to Indian lands, tribal trust resources, and the exercise of tribal rights. Indian tribes are defined in 36 CFR 800.16(m), as: “an Indian tribe, band, nation, or other organized group or community, including a Native village, Regional Corporation, or Village Corporation, as those terms are defined in Section 3 of the Alaska Native Claims Settlement Act (43 U.S.C. 1602), which is recognized as eligible for the special programs and services provided by the United States to Indians because of their special status as Indians.”

The FERC acknowledges that it has trust responsibilities to Indian tribes, and so, on July 23, 2003, it issued a “Policy Statement on Consultations with Indian Tribes in Commission Proceedings” in Order 635. That policy statement included the following key objectives:

- The Commission will endeavor to work with Indian tribes on a government-to-government basis, and will seek to address the effects of proposed projects on tribal rights and resources though consultations; and
- The Commission will ensure that Tribal resources and interests are considered whenever the Commission’s actions or decisions have the potential to adversely affect Indian tribes or Indian trust resources.

The FERC contacted Indian tribes that may attach religious or cultural significance to sites in the region or may be interested in potential Project impacts on cultural resources. We identified Indian tribes that historically used or occupied the Project area through basic ethnohistorical sources, such as the *Handbook of North American Indians* (Suttles 1990), communications with the SHPO and the Oregon Legislative Commission on Indian Services, information provided by the applicants, and scoping responses to our June 9, 2017 NOI, including letters from interested Indian tribes.

Indian tribes identified in the region are: the Burns Paiute Tribe, Confederated Tribes of the Lower Umpqua, Coos, and Siuslaw Indians (CTCLUSI), Coquille Indian Tribe (CIT), Cow Creek Band of Umpqua Tribe of Indians (Cow Creek Tribe), Fort Bidwell Paiute Tribe, Confederated Tribes of the Grand Ronde Community of Oregon (Grand Ronde Tribes), Hoopa Valley Tribe, Karuk

Tribe, Klamath Tribes, Modoc Tribe of Oklahoma, Pit River Tribe, Confederated Tribes of Siletz Indians (Siletz Tribes), Tolowa Dee-ni' Nation (formerly Smith River Rancheria), and Yurok Tribe.

A context that identifies Indian tribes that historically used or occupied the area affected by the Project, as well as details of the FERC consultations and the applicants' communications with Indian tribes, can be found in appendix L.

FERC Staff Consultations with Indian Tribes

Similar to consultations with SHPO, government-to-government consultations between the FERC and Indian tribes related to previous versions of the Projects occurred between 2006 and 2015 and were documented in the FEISs produced for Docket Nos. CP07-441-000, CP07-444-000, CP13-483-000, and CP13-492-000.

Consultations between the FERC and Indian tribes after September 2015, related to Docket Nos. CP17-494-000 and CP17-495-000, are listed in table L-4 in appendix L. Consultations between FERC staff and Indian tribes are still ongoing. Tribal consultation efforts were initiated with an e-mail sent on May 9, 2017 to tribes inviting them to participate in a telephone conference call about the Projects. This was followed by the NOI issued by the FERC on June 9, 2017, requesting comments about the Projects. On April 5, 2018, the FERC staff sent out letters to individual Indian tribes. In response to those letters, the CTCLUSI, Coquille Tribe, Grand Ronde Tribes, Karuk Tribe, and Yurok Tribe requested meetings with the FERC staff. Additional meetings and telephone conference calls have occurred between the FERC staff and some of the above tribes to discuss specific concerns about the Projects (see table L-4 in appendix L).

Comments from Native American Individuals

Besides government-to-government consultations between the FERC staff and leaders of interested Indian tribes, various other tribal members and individual Native Americans commented about the Projects during scoping and in response to our notice of applications. Communications between Native American individuals and organizations and the FERC under Docket Nos. CP17-494-00 and CP17-495-000 are listed in table L-5 in appendix L. Of these communications, 26 were letters from Native American individuals submitted as motions to intervene.

In addition to the above letters, several individuals identifying themselves as Native Americans spoke at our public scoping sessions for the Projects. Gary Jackson, who identified himself as a member of the Cow Creek Tribe, spoke at the public scoping session held on June 28, 2017 in Roseburg. Dale Ann Frye Sherman Yaqui and Margaret Robbins, who identified themselves as members of the Yurok Tribe, spoke at the public scoping session held on June 29, 2017 in Klamath Falls. Also at the Klamath Falls session, Monique Sonoquie identified herself as Chumash and Apache residing at the Yurok reservation in California; Mirinda Hart identified herself as Wylocki-Wintu from the Round Valley Confederation of Tribes in California; Anna Powell identified herself as a member of the Hoopa Valley Tribe in California; and Della Sanchez and Taylor Tupper identified themselves as members of the Klamath Tribes. Concerns voiced during the scoping meetings were similar to those identified in the letters from tribal members and Native American individuals listed in table L-5 in appendix L.

Applicants' Communications with Indian Tribes

Jordan Cove and Pacific Connector have also conducted their own, separate Native American contact programs, as part of their investigation efforts. Communications between the applicants and Native Americans informed their current efforts. Those were discussed in the FEISs produced for previous iterations of the Projects under Docket Nos. CP07-441-000, CP07-444-000, CP13-483-000, and CP13-492-000. Current contacts between the applicants and Indian tribes since September 2015 and regarding the current application are listed in tables L-6 and L-7 in appendix L of this EIS.[182] Tribes were provided the opportunity to review research designs and reports. They also participated in cultural resources investigations and monitored surveys and subsurface testing. The applicants have executed a Cultural Resources Protection Agreement (CRPA) with the CTCLUSI.

4.11.1.3 Issues Raised by Indian Tribes

This section summarizes the comments received from consulted Indian tribes. Tribes raised a wide variety of topics, not necessarily limited to historic properties considered under Section 106. In general, issues of concern, outside of the NHPA process, raised by Indian tribes included:

- Indian trust assets;
- traditional lifeways;
- water quality;
- aquatic species/fisheries;
- wildlife;
- forestry and wildfires;
- air quality and climate change;
- aesthetics;
- geologic hazards and general safety of the Project;
- environmental justice and socioeconomics; and
- cumulative impacts of the Project.

We summarize tribal concerns raised in consultations with the FERC, below, by individual tribe. However, where a tribal concern for a resource not considered under Section 106 was discussed, the reader is referred to the corresponding section of this EIS for a more detailed description of those resources, and where applicable, the impacts of the Project on those resources under NEPA.

Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians

In several different filings with the FERC, the CTCLUSI indicated that they consider the geographic area of Coos Bay to be a Traditional Cultural Property (TCP), "Q'alay ta Kukwis schichdii me." The Tribe has issued two resolutions (Resolution No. 2006-097 and Resolution No. 2015-049) mentioning the TCP. The CTCLUSI also began the process of nominating the TCP to the NRHP. The nomination has been approved by the Oregon State Advisory Committee on Historic Preservation and forwarded to the SHPO. It is anticipated to be accepted or denied NRHP-listing by the NPS in June 2019. There are no federal laws that would prevent a project from crossing a TCP. However, there are regulations (36 CFR 800) and an NPS bulletin (Parker and King 1998) that provide guidance about evaluation of significance, assessing impacts, and mitigating effects on TCPs.

[182] These communications were documented in Jordan Cove's and Pacific Connector's September 2017 applications to the FERC and their subsequent responses to staff's multiple environmental information request since January 2018.

The CTCLUSI are concerned that Project-related activities at the terminal (Ingram Yard) and South Dunes area, such as drilling, grading, dredging, and vibro-compaction, may impact buried village sites and Indian graves documented in the Tribes' database of cultural resources. In its January 29, 2018 letter to the FERC staff, the CTCLUSI stated that a pre-contact shell midden deposit was found deeply buried in Coos Bay during geotechnical testing for improvements to the Navigation Channel. Survey reports submitted to the FERC by the applicants, including a September 12, 2018 summary memo by Archaeological Investigations Northwest, Inc. (AINW; Hulse 2018) describing the results of a cultural resources survey conducted for the Coos Bay marine waterway modifications, did not identify any deeply buried shell middens in Coos Bay, as described by CTCLUSI. Jordan Cove's consultants have recommended monitoring of construction by professional archaeologists and Tribal representatives. Any cultural resources or human remains uncovered during monitoring would be handled according to the Project's UDP. In addition, Jordan Cove has executed a CRPA with the CTCLUSI that provides for Tribal monitoring of construction activities.

As articulated in its July 10, 2017 letter to the FERC, the CTCLUSI are concerned that traditional activities of its members in the Project area, including the gathering of traditional plants, harvesting of shell fish, fishing, and hunting, may be restricted by the proposed projects. It should be noted that Jordan Cove's proposed upland facilities would be located on private lands where access to the public has already been limited since the Luse family sold its ranch on the North Spit in 1883 (Beckham 2015).[183]

Jordan Cove agreed to hire a professional ethnographer to conduct research to more clearly document religious and cultural properties important to the CTCLUSI that may be located within the APE, including the TCP reported by the CTCLUSI in the Jordan Cove area. A draft ethnographic study was filed with the FERC on April 4, 2018 (Deur 2018); however, the FERC staff has requested revisions to the document. The revised ethnographic study is expected to address what natural resources are important to the Tribes, such as traditionally gathered plants, fisheries, and hunted species that may still exist in the Project area. The CTCLUSI indicated that they are funding their own independent ethnographic study of the Coos Bay area. However, more recently, Jordan Cove has convened a Native American Working Group, and offered individual tribes financial support for them to produce their own ethnographic studies of the Project area.

In the EIS, we address effects on upland vegetation and timber in section 4.4, terrestrial wildlife in section 4.5.1, and aquatic resources in section 4.5.2. Since the U.S. government never executed a treaty with the CTCLUSI, the Tribes do not have treaty-protected or special fishing or hunting privileges on ceded lands.

The CTCLUSI also expressed concerns about crime, sexual exploitation of women, and negative impacts on the native communities of the Coos Bay area as a result of the operation of a "man-camp" (South Dunes Temporary Workers Housing Complex) during terminal construction; similar to the impacts of man-camps of the Bakken oil fields of North Dakota (see Harvard 2015; Adler

[183] William Luse, the son of H.H. Luse, who established a sawmill at Empire in 1855, was once married to a Coos woman, and was involved in the Indian community at Jordan Cove. The Luses acquired the properties of the Henderson, Barnett, Crawford, and Jordan families, which included Coos members. The lands were consolidated into a large ranch on the North Spit. As long as the Luses owned this land, Indian occupation of the North Spit would have been allowed, but this changed once the property was sold to the Oregon Southern Improvement Company.

and Hillstrom 2015; Gillette 2016; Briody 2017; Deer and Nagle 2017; Nienaber 2017; Finn et al. 2016). We discuss this issue in section 4.9, Socioeconomics, of this EIS.

In its July 10, 2017 letter to the FERC, the CTCLUSI requested to be a cooperating agency in the preparation of our EIS. However, on October 25, 2017, the CTCLUSI filed a motion to intervene in the proceeding. It is Commission policy that intervenors cannot also be cooperating agencies. As such, the CTCLUSI's request to be a cooperating agency cannot be granted.

Also in its July 10, 2017 letter, the CTCLUSI requested a meeting between FERC staff and the Tribal Council as part of our government-to-government consultations. Tribal leaders met directly with the Chair of the Commission at FERC headquarters in Washington, D.C., and representatives of the CTCLUSI met face-to-face with Commission staff in Oregon on March 22 and June 28, 2017, and July 17, 2018. We consider those meetings, our NOI, our letters to the CTCLUSI, and letters from the Tribes to the Commission to constitute government-to-government consultations.

The CTCLUSI believe that the Project may have negative impacts on Coos Bay's tourism and fishing industries. Effects on fisheries are discussed in section 4.5.2 of the EIS, and we discuss the tourism industry in section 4.9.

The CTCLUSI are also concerned about potential safety risks that may be caused by earthquakes related to seismic movements along the CSZ, and that an earthquake-triggered tsunami could hit the North Spit. The CSZ is discussed in section 4.2, and there is a tsunami impact assessment in section 4.1 of the EIS.

The CTCLUSI would like an assessment of potential health impacts on Tribal members and the general community of Coos Bay. This includes Project-related impacts on water quality and air quality. Jordan Cove will arrange for on-site medical professionals to provide basic care for terminal construction workers, reducing the potential influx of patients to the local medical facilities. Further, Jordan Cove signed a MOU with the State of Oregon that requires Jordan Cove to equip the Bay Area Hospital according to state policies for all hospitals in treating burns. The EIS addresses water quality effects in sections 4.3.1 and 4.3.2, while air quality effects are discussed in section 4.12.1.

The CTCLUSI raise concerns about the clearing of forest, and the potential for Project-caused wildfires. Effects on forested lands and the potential for wildfires are discussed in in section 4.4.

In a letter to the FERC dated January 22, 2018, the CTCLUSI stated that Jordan Cove was not providing advance notification of geotechnical investigations in a timely manner and did not provide the Tribes with detailed work plans. Jordan Cove responded to these issues in a letter to the FERC dated January 25, 2018, detailing the geotechnical investigation work plan and notifications provided to the Tribes. In addition, the CRPA contains procedures for notifications to the CTCLUSI concerning future geotechnical investigations proposed by Jordan Cove.

According to their January 29, 2018 letter to the FERC, the CTCLUSI would like to be engaged in the discussion of impacts on the Projects' viewshed. This section discusses indirect impacts on cultural resources through visual and audible intrusions. Section 4.8.2 of the EIS includes a visual assessment. The Tribes also requested that the cumulative impact assessment in the EIS include the Channel Modification Project; which it does.

Coquille Indian Tribe

On November 8, 2017, the Coquille Tribe requested to be a cooperator in the production of this EIS. We accepted that request in a letter to the Tribe dated April 4, 2018. On July 16, 2018, the FERC staff met in-person with the Coquille Tribe at Coos Bay.

The Coquille Tribe requested that this EIS address potential indirect impacts on Indian trust assets, such as the Coquille Forest. Although Jordan Cove has stated that there are no Indian trust assets "directly adjacent to the APE," the pipeline route is in close proximity to three parcels of the Coquille Forest which are held in trust by the BIA and managed by the Coquille Tribe. There should be no direct impacts on lands held in trust by the Coquille Tribe. The proposed pipeline right-of-way would be as close as 65 feet upslope of the three parcels of the Coquille Forest. Indirect impacts on the Coquille Forest would be similar to other forested lands, which are discussed in section 4.4 of this EIS.

In a February 26, 2019 e-mail to FERC staff, the Coquille Tribe provided a list of important traditional-cultural plant and animal species. The Tribe noted that plant species provided much of the sustenance, shelter, and safety for their ancestors. Some of the most important traditional cultural plant species that are found on the Coquille Forest and other Tribal lands include: trees, including their bark and wood (Port Orford cedar, western red cedar, Sitka spruce, big leaf maple, myrtle, red alder, madrone, Pacific yew); the wood, buts, and berries of shrubs (elderberry, willows, hazel, vine maple, rhododendron, azalea, manzanita, ocean spray, Labrador tea, huckleberry, salal, thimbleberry, salmonberry, Oregon grape); the roots and fibers of flowers and vines (yarrow, camas, tiger lily, columbine, various Lomatium and Brodiaeas, iris, trailing blackberry, yurba buena, beargrass), various wet meadow/riparian species (cattail, tule, various sedges and ferns, skunk cabbage, various mosses); and marine/estuary species (eelgrass, giant kelp bull kelp, sea lettuce, surfgrass). The upland vegetation in the Project area and wetlands are discussed in sections 4.4 and 4.3 of this EIS, respectively. Some traditionally used plants are also considered special status species, and are discussed in section 4.6.

The Coquille Tribe noted that animals (including fish and birds) provided food and raw materials for shelter, technologies, economies, and ceremonial purposes. The Tribe provided a list of some of the animal species that are culturally important to them: terrestrial mammals (deer, elk, coyote, cougar, bear, bobcat, raccoon, beaver, squirrel), marine/estuary species (Lamprey, all available salmon species, shellfish, crab, sea mammals, rockfish, lingcod, sculpin, halibut, flounder, perch, herring, greenling, candlefish, snails, mussels, barnacles, chiton, sea urchin, abalone, dentalium, other seasonally available estuary species); and birds (eagles, hawks, owls, cormorant, kingfisher, herons, osprey, flicker, woodpeckers [particularly pileated], grebe, cormorant, crows and ravens, and colorful neo-tropical species). Wildlife and aquatic species are discussed in section 4.5 of this EIS. As with the culturally significant plant species listed above, some traditionally important animals are also considered special status species and are discussed in section 4.6.

Cow Creek Band of Umpqua Tribe of Indians

In a letter to the FERC dated October 20, 2017, the Cow Creek Tribe stated that the Pacific Connector pipeline route would cross about 122 miles of the Tribe's aboriginal territory or ceded lands. The Tribe is concerned about potential Project-related impacts on cultural resources, and is also concerned about river and stream crossings and impacts on water quality and aquatic resources.

As of September 2018, Pacific Connector has identified 79 archaeological sites along the pipeline route within the historic aboriginal territory or ceded lands of the Cow Creek Tribe, from about MP 42 to MP 168. The FERC has determined that 59 of those sites are listed or eligible for the NRHP or are unevaluated; the remaining 20 sites were found not eligible for listing on the NRHP. The Cow Creek Tribe has reviewed previously filed cultural resources inventory and evaluation reports, and treatment plans. The Tribe also monitored previous archaeological investigations in their territory. There is additional cultural resource work to be done for the Projects, including additional investigatory work and consultations. However, we expect that Pacific Connector should execute an agreement with the Cow Creek Tribe, similar to the CRPA with the CTCLUSI described above, to continue Tribal monitoring of future archaeological investigations. In addition, the FERC will require Pacific Connector to provide future reports of cultural resources investigations, and new treatment plans, to the Cow Creek Tribe for review.

Proposed waterbody crossings of the Pacific Connector pipeline route are listed by milepost in table H-3 of appendix H of this EIS. This EIS addresses impacts on waterbodies in section 4.3.2 and impacts on aquatic species in section 4.5.2. The 1853 treaty with the Cow Creek Tribe did not specify the reservation of fishing, hunting, or gathering rights for Indians in lands ceded by the Tribe.

Confederated Tribes of the Grand Ronde Community

In its motion to intervene, filed with the FERC on November 15, 2017, the Grand Ronde Tribes stated that they have maintained a deep connection to the resources and sacred places of their treaty homelands. The Tribes are interested in protecting, enhancing, and restoring tribal culture and natural resources affected by the Projects. Salmon and lamprey have particular cultural significance to the Tribes. In addition, the Grand Ronde Tribes have concerns about other aquatic resources, including ESA federally listed bull trout, and Oregon Conservation Strategy species rainbow trout, cutthroat trout, and Umpqua chub. Birds of concern include federally listed marbled murrelet and northern spotted owl, and state-sensitive common nighthawk, flammulated owl, great gray owl, Lewis's woodpecker, purple martin, white-headed woodpecker, and yellow breasted chat. Other upland mammals that hold the Tribes' attention include American marten, fisher, California myotis, fringed myotis, hoary bat, red tree vole, ringtail, and Sierra Nevada red fox. Reptiles of interest include the federally listed Oregon spotted frog, and state-listed Del Norte salamander, northern red-legged frog, southern torrent salamander, California mountain kingsnake, and western pond turtle.

This EIS discusses aquatic species in section 4.5.2, upland wildlife in section 4.5.1, and ESA protected and other special status species in section 4.6. The FERC will additionally produce a BA that addresses impacts on federally listed species protected under the ESA, and submit this BA to the FWS and NMFS. The 1853 treaty with the Rogue River Tribes and 1854 treaty with the Upper Umpqua Tribes did not specify the reservation of fishing, hunting, or gathering rights for Indians on lands ceded by the Tribes.

The Grand Ronde Tribes stated that their ancestors once occupied the region between MPs 50 and 175 along the Pacific Connector pipeline route. As of 2015, Pacific Connector's consultants recorded 81 archaeological sites along that segment of the proposed pipeline route. Of those, 42 sites were either found to be eligible for the NRHP or are unevaluated; the remaining 39 sites were found not eligible for listing on the NRHP. In a January 16, 2018 letter to the FERC commenting on Pacific Connector's Resource Report 4, the Grand Ronde Tribes requested a reassessment of isolated finds, which do not "accurately reflect the historic land use of the landscape, but is a consequence of many years of cultural resource surveys being undertaken in a piecemeal fashion." In addition, the Grand Ronde Tribes suggested revisions to Pacific Connector's UDP. Pacific Connector has provided the Grand Ronde Tribes with copies of cultural resources investigations reports for their review.

In its May 4, 2018 letter to the FERC, the Grand Ronde Tribes re-asserted their deep connections with the resources and sacred places of their ancestral homelands in southern Oregon, including Usual and Accustomed areas ceded by treaties with the U.S. government. The Tribes requested a study be done to identify sacred places, gathering places, locations of burials, and other places of cultural significance to the Tribes. In response to an earlier request from the FERC staff, the applicants filed with the FERC on April 4, 2018 a draft ethnographic study (Deur 2018). However, in a May 4, 2018 environmental information request to Pacific Connector, the FERC staff asked that the document be revised. The revised ethnographic study is expected to address natural resources that are important to the Tribes, such as traditionally gathered plants, fisheries, and hunted species that may still exist in the Project area. However, more recently, Pacific Connector has convened a Native American Working Group, and offered individual tribes financial support for them to produce their own ethnographic studies.

On July 20, 2018, the FERC staff held a telephone conference call with representatives of the Grand Ronde Tribes. That call discussed the FERC's NEPA process, and our process for complying with the NHPA.

On September 19, 2018 the Grand Ronde Tribes provided the FERC staff with a comment letter regarding the cultural resource studies completed to date and the Tribal Working Group proposed by the applicants. The Tribes noted they were, to date, yet to receive complete materials documenting cultural resource surveys from the applicant for the Tribes' review. Concerns were expressed for a lack of consideration of historic properties of religious and cultural significance to Indian tribes. The Grand Ronde Tribes have apprehensions about the proposal for the Tribal Working Group.

In a letter to the FERC dated October 5, 2018, the Grand Ronde Tribes requested an in-person government-to-government meeting with the FERC staff at their Tribal headquarters. We have been unable to schedule such a meeting to date due to travel considerations and ex parte rules, but continue efforts to establish a meeting with the Tribes.

Karuk Tribe

The Karuk Tribe, in comments to the FERC dated July 5, 2017, raised concerns about potential Project-related impacts on water quality and the salmon fishery in the Klamath River. Since the U.S. government never executed a treaty with the Karuk Tribe, and did not set aside an officially designated reservation for the Tribe, the Karuk Tribe does not have special fishing or hunting privileges on ceded lands that are federally protected as treaty rights.

The Karuk Tribe believes that the Pacific Connector pipeline may contribute sediment to and increase the water temperature of streams crossed. We address impacts on waterbodies in section 4.3.2 of this EIS. Likewise, this EIS discusses aquatic resources in section 4.5.2.

The Karuk Tribe also claims that in the case of a break of the Pacific Connector pipeline, waterbodies would be polluted. However, the pipeline would transport natural gas in gaseous form (not liquid) and, in the unlikely event of an incident and release, natural gas, which is lighter than air, would dissipate into the atmosphere and would not contaminate waterbodies. The Karuk Tribe believes that the Jordan Cove export terminal would include a 420-megawatt power plant. This is not so, as the current proposal has eliminated the power plant.

In their May 3, 2018 letter to the FERC, the Karuk Tribe requested a meeting with staff to discuss the Projects. Again, the Tribe mentioned its concerns about the pipeline crossing of the Klamath River, and its potential impacts on the salmon fishery and the lifeways of the Tribe. The FERC staff met in-person with representatives of the Karuk Tribe in Happy Camp, California, on July 18, 2018.

Klamath Tribes

The Klamath Tribes provided comments about the Project to the FERC in filings on June 7 and 26, September 1, and October 20, 2017, and May 3, 2018. The Klamath Tribes assert that the Pacific Connector pipeline route would cross ceded lands that contain cultural resources of importance to the Tribes, and that former villages and graves may be impacted by construction of the pipeline.

As of 2015, Pacific Connector's consultants have identified 10 pre-contact archaeological sites along the pipeline route in Klamath County. Eight of those sites were evaluated as eligible for the NRHP or are unevaluated. It should be noted that members of the Klamath Tribes participated in Pacific Connector's cultural resources surveys. Pacific Connector has provided the Klamath Tribes with copies of all previous cultural resource reports, for their review. If the Projects are authorized by the FERC, and any unanticipated sites or human remains are found during construction, Pacific Connector would follow the procedures outlined in its UDP, that was previously reviewed by the Klamath Tribes.

The Klamath Tribes requested the opportunity to assist in the drafting of a revision of Pacific Connector's Historic Property Management Plan (HPMP). A draft HPMP was filed with the FERC by Pacific Connector on October 5, 2018; it is unclear if the applicants made that document available to the Klamath Tribes for their review.

The Klamath Tribes are also concerned about water quality, the pipeline route crossings of the Rogue and Klamath River, and the potential for the Projects to impact fish species that are important to the Tribes. The 1864 treaty with the Klamath Tribes stated that the Tribes hold "…*the exclusive right of taking fish in the streams and lakes, included in said reservation, and of gathering edible roots, seeds, and berries within its limits*…." However, the Pacific Connector pipeline route does not cross the Klamath Reservation. Pacific Connector proposes to cross under the Rogue River and Klamath River using HDDs, to avoid impacts on those rivers and their associated fisheries. The pipeline would also cross 17 streams or creeks that form part of the Klamath River headwaters in Klamath County. Pacific Connector would use dry methods (flumes or dams) to cross other streams. Erosion controls that would be implemented at stream crossings would limit turbidity and sedimentation. These stream crossing would not result in significant long-term impacts on the fishery resources associated with the Klamath River system. See sections

4.3.2 and 4.5.2 in this EIS for more details about impacts on waterbodies and aquatic resources, respectively, and proposed mitigation measures.

The Klamath Tribes raised concerns about impacts on regional air quality, and the Project's potential contributions to global warming. Air quality is discussed in section 4.12.1 of this EIS.

The Klamath Tribes are also concerned about the potential for the Projects' facilities to be impacted by earthquakes and landslides. Section 4.1 of this EIS discusses geological hazards, including measures that would be implemented to reduce impacts from earthquakes and landslides.

The issue of "man camps" and tribal community safety in those settings has also been raised by the Klamath Tribes. There are no proposed worker housing camps along the Pacific Connector pipeline route. Instead, workers would be dispersed along spreads and find housing in RV camps, rental houses and apartments, and hotels, as discussed in the socioeconomic section of this EIS.

The Klamath Tribes cite EO 12898 as requiring the study of impacts of the Projects on Environmental Justice communities, including Indian Tribes. Although the FERC is an independent regulatory agency excluded from compliance with Executive Orders, in order to address this tribal and general public concern, we analyze in section 4.9 of this EIS whether the Projects would have disproportional environmental impacts on minority and low-income populations.

Tolowa Dee-Ni' Nation

The Tolowa Dee-Ni' Nation, in its letter dated December 6, 2018 to the FERC, described the Nation's "strong opposition [to] and concern" regarding the proposed Project. The Nation noted they cannot support the Project based on the proximity of the pipeline to the headwaters of the Rogue River and the perceived potential for pipeline leaks to impact the waters of the river. As noted elsewhere in this section, the pipeline would transport natural gas in gaseous form which, in the event of a release, would dissipate into the atmosphere and would not contaminate waterbodies. The pipeline would cross under the Rogue River with an HDD, and Pacific Connector would use dry methods to cross other headwater streams. Those techniques, as explained in section 4.3 of this EIS, would reduce impacts on waterbodies and their associated fisheries.

Yurok Tribe

The Yurok Tribe, in its letter dated July 6, 2017 to the FERC, and in its motion to intervene filed October 26, 2017, stated that Pacific Connector's proposed crossing of the Klamath River could have potential impacts on tribal trust fish species, including ESA-listed coho salmon, Chinook salmon, steelhead, green sturgeon, and Pacific lamprey. Disruption of fish habitat may have negative impacts on the Yurok Tribal economy that depends in part on a commercial salmon fishery. In addition, the Tribe states that the Klamath Riverscape is a district listed on the Yurok Tribe Register of Historic Properties. Pacific Connector's consultants should review the Klamath Riverscape to determine what effects, if any, the Projects would have on it.

When the Klamath Reservation in California was created in 1855 for the Yurok and Hupa people, their rights to fish in the rivers running through the reservation were federally protected. In a 1993 opinion issued by the Solicitor for the U.S. Department of the Interior, it was stated that the entitlement of the Yurok and Hoopa Valley Tribes was limited to 50 percent of the harvest of Klamath-Trinity Basin salmon (Leshy 1993). The Pacific Connector pipeline route does not cross through the Klamath-Trinity Basin of California. The pipeline route would cross the Klamath River in Klamath County, Oregon, within the traditional territory of the Klamath Tribes, where Pacific Connector would use an HDD. The HDD would limit impacts on the Klamath River and its fishery resources.

Impacts on federally listed aquatic species are discussed in section 4.6 of this EIS, together with proposed mitigation measures. The FERC will produce a BA and EFH Assessment that will be reviewed by the NMFS and FWS.

In their May 4, 2018 letter to the FERC, the Yurok Tribe requested a meeting with staff to discuss the Projects. On July 18, 2018, the FERC staff met in-person with representatives of the Yurok Tribe in Klamath, California.

4.11.1.4 Communications with Other Agencies

The BLM, Forest Service, Reclamation, COE, EPA, FWS, and NMFS are federal cooperating agencies in the production of this EIS, and consulting parties with regard to the Section 106 compliance process. The federal land-managing agencies previously provided the FERC with their opinions on NRHP eligibility and pipeline effects for sites on federal land. Comments related to cultural resources received by the FERC from other federal agencies between 2012 and 2015 for Docket Nos. CP13-483-000 and CP13-492-000 are discussed in section 4.11.1.3 of our September 2015 FEIS for those projects. Communications between the FERC and other federal agencies related to cultural resources issues for Docket Nos. CP17-494-000 and CP17-494-000 are discussed below.

In response to our June 9, 2017 NOI for these Projects, the EPA filed comments, dated July 10, 2017. One of its comments was that the EIS should discuss compliance with the NHPA, including consultations with the SHPO. In addition, the document should discuss Project-related impacts on tribal, cultural, or other treaty resources. We address EPA's issues in this section.

The ACHP wrote a letter to the FERC dated January 25, 2018, in response to the January 22, 2018 letter from the CTCLUSI to the FERC about geotechnical testing. The ACHP stated that, in general, their agency has "interpreted geotechnical testing as part of project planning for undertakings and not, in and of itself, subject to review by federal agencies under Section 106." They requested that the FERC respond to the Tribes and clarify the purpose of the geotechnical investigations and the place of those investigations in the FERC's Section 106 compliance process. The FERC staff agrees with the ACHP position that geotechnical investigations are considered part of the pre-planning process and not subject to Section 106 compliance. It is FERC practice that pre-construction geotechnical investigations be conducted without FERC review or approval and are not considered to be cultural resource studies or part of the Section 106 process (see FERC 2017). As such, the applicants do not need permission from the FERC to conduct pre-planning geotechnical work, and these activities do not constitute part of the FERC's undertaking. However, the applicants may need permits from other federal agencies, such as the COE, for those activities.

Jordan Cove's Communications with Other Agencies

Jordan Cove sent email communications to the COE, SHPO, ODEQ, and ODE on May 19 and November 16, 2017, providing a context for the geotechnical work proposed at the APCO site and about sampling at Kentuck Slough, respectively. Project Activity Updates were also provided to the same agencies via email on September 3, 2017 for September 2017; October 2, 2017 for activities scheduled in October; October 13 and 27 and November 9, 2017 for activities in November; December 1, 2017 for activities scheduled for December 2017; and December 14 and 20, 2017 for activities scheduled for January and February 2018. Details of these communications can be found in appendix L.

Pacific Connector's Communications with Other Agencies

Communications between Pacific Connector and federal agencies between 2006 and 2009 were summarized in section 4.10.1.3 of our May 2009 FEIS produced for Docket Nos. CP07-441-000 and CP07-444-000. Communications between Pacific Connector and federal agencies between May 2009 and September 2015 were listed in table 4.11.1.3-2 of our September 2015 FEIS for Docket Nos. CP13-483-000 and CP13-492-000.

On February 24, 2017, Pacific Connector sent an email to the BLM requesting a review of the list of cultural resource sites located along the pipeline route on BLM lands. On February 29, 2017, the Forest Service called Historical Research Associates, Inc. (HRA) to discuss heritage properties on NFS lands that may be affected by the Pacific Connector Project. On May 26, 2017, Pacific Connector sent an email to the COE, ODE, and ODEQ regarding geotechnical testing to support the proposed HDD under Coos Bay. We detail Pacific Connector's communications since 2015 with other federal and state agencies in appendix L.

4.11.2 Area of Potential Effect

As stated in our NOI, we define the direct APE as all areas subject to ground disturbance, including the construction right-of-way, temporary extra work spaces, contractor/pipe storage yards, disposal areas, aboveground facilities, and new or to-be-improved access roads. An indirect APE was also established by the applicants for each project based on each viewshed.

4.11.2.1 Jordan Cove LNG Project

In the case of the Jordan Cove Project, the direct APE includes the footprint of all potential ground-disturbing actions. Specifically, this includes the South Dunes Site, Ingram Yard, Access and Utility Corridor, Meteorological Station, Industrial Wastewater Pipeline, Trans-Pacific Parkway/U.S. 101 Intersection, the planned mitigation sites (Kentuck, Eelgrass, Lagoon, Panhandle, and North Bank), Boxcar Hill laydown and parking area, Roseburg Forest Products and Port laydown sites, APCO Sites 1 and 2, Myrtlewood Off-site Park and Ride, and hydraulic dredge pipelines in Coos Bay. We agree with the definition of the direct APE, provided in Jordan Cove's application to the FERC. The Jordan Cove Project facilities are described in more detail in chapter 2 of this EIS.

The indirect APE is defined to include all areas potentially subjected to the introduction of visual, atmospheric, or audible elements that diminish the integrity of a historic property's significant historic features. Jordan Cove's consultants conducted a windshield survey for a 2-mile radius around the proposed LNG terminal. The existing Boxcar Hill Campground and RV Park was noted in this area. Also found in the indirect APE was a house in the Shorewood area at the northern mouth of Haynes Inlet, the Hilltop House restaurant and Bay Bridge Motel on the north side of the McCullough Bridge, and residential neighborhoods in the City of North Bend (Bowden et al. 2017). The consultants concluded that no historic properties would have a view of the aboveground components of the LNG terminal. As such, the indirect APE was recommended to be the same as the direct APE. We agree with this definition. Section 4.8.2 of this EIS includes a visual impact assessment of the LNG terminal facilities. Section 4.12.2 of this EIS discusses noise impacts related to the construction and operation of the terminal.

The direct APE, which is the same as the indirect APE for the Jordan Cove Project, is depicted in Figure 1-1 of the 2017 survey report (Bowden et al. 2017) filed with Jordan Cove's application to the FERC.

4.11.2.2 Pacific Connector Pipeline Project

Pacific Connector defined the direct APE as all geographic areas that will potentially experience ground disturbances from the construction, operation, and maintenance of the pipeline. The construction right-of-way for the pipeline represents the majority of the direct APE and encompasses the temporary construction right-of-way, permanent easement, TEWAs, USCAs, and MLVs. Areas where elements of the Project extend outside the pipeline corridor generally consist of contractor and pipe storage yards, rock source and disposal sites, hydrostatic discharge sites, new and improved access roads, cathodic protection, and aboveground facilities, including communication towers. We agree with this definition of the direct APE. The Pacific Connector Project facilities are described in more detail in chapter 2 of this EIS.

Pacific Connector defined the indirect APE to include all geographic areas that would potentially experience visual intrusions or changes as a result of the construction, operation, and maintenance of the pipeline. The pipeline will not produce sufficient noise or odors to warrant consideration of audible or atmospheric/olfactory indirect effects in establishing the indirect APE. Section 4.12.2 of this EIS discusses noise impacts related to the construction and operation of Pacific Connector's facilities. Since the pipeline will be buried, the aboveground components of the project will be related to the associated aboveground facilities and the permanent easement itself, which will be maintained as a 50-foot-wide cleared corridor on the landscape. To identify the indirect APE, Pacific Connector's consultants reviewed the pipeline route for instances where the cleared easement may be noticeably visible, considering 1) current heavily vegetated landscapes with adjacent significant topographical differences and 2) landscapes that are relatively unencumbered by modern intrusions. This analysis determined that locations where the indirect effects APE diverges from the direct APE are limited to locations where the permanent easement traverses a steep, heavily vegetated area, then turns sharply so that the permanent easement could be seen directly from a location outside of the direct APE. The SHPO, in a letter to Pacific Connector's consultants dated January 22, 2016, concurred with the methodology for defining the indirect APE. We agree. Section 4.8.2 of this EIS includes a visual impact assessment of the proposed pipeline right-of-way.

Appendix A of the 2017 pipeline addendum survey report (Derr et al. 2017), filed with Pacific Connector's application with the FERC, contains maps that depict the direct and indirect APEs.

4.11.3 Results of Investigations

Archaeological, historical, and ethnographic contexts of the Project area can be found in the numerous survey reports completed for the Project since 2005. A brief historical summary of archaeological studies in the region can be found in appendix L. Studies conducted specifically for the Projects are described and listed below.

4.11.3.1 Ethnographic Studies

On April 4, 2018, the applicants filed a first draft Ethnographic Report (Deur 2018). The FERC staff and several interested Indian tribes reviewed that draft, and the FERC staff, in environmental information requests dated May 4 and October 23, 2018, requested that the applicants revise the ethnographic report. In a filing on November 2, 2018, the applicants declined to revise the ethnographic report, claiming that it is not required for purposes of compliance with Section 106 of the NHPA. This is not true. The regulations for implementing Section 106 at 36 CFR 800.2(c)(2)(ii) require consultations with Indian tribes to identify sites of religious and cultural importance to tribes, in keeping with Section 101(d)(6) of the NHPA. Further, section 6.1 (8) of the FERC staff's guidelines (FERC 2017) directs applicants to produce and file an "ethnographic analysis to identify any living Native American groups or other groups with ties to the project area to identify properties of traditional, religious, or cultural importance to Tribes and other groups." In addition, several interested Indian tribes requested the additional data we asked for in the revision request. In order to meet our obligations under Sections 101 and 106 of the NHPA, **we recommend that**:

- **<u>Prior to construction of facilities and/or use of any staging, storage, temporary work areas, or new or to-be-improved access roads</u>, Jordan Cove and Pacific Connector should file with the Secretary a revised Ethnographic Report describing sites of religious and cultural significance to Indian Tribes and other tribal information as outlined in the FERC staff's October 23, 2018 environmental information request #14, for the review of interested Indian tribes and the FERC staff, and for written approval by the Director of OEP.**

4.11.3.2 Jordan Cove LNG Project

Since 2005 surveys have been conducted for Jordan Cove to identify cultural resources within the LNG terminal direct APE. Table 4.11.3.2-1 lists the surveys that cover Jordan Cove's proposed facilities. More detailed summary descriptions of the surveys are included in appendix L of this EIS.

TABLE 4.11.3.2-1

Cultural Resources Surveys of Jordan Cove's Proposed LNG Terminal Facilities

Facility or Use Area a/	Survey Reports	Inventory Status
Access Channel (Coos Bay)	Byram 2006a, Rose et al. 2014, Punke, et al. 2018, Punke 2018	Survey Complete
Marine Slip (Ingram Yard) including LNG Vessel Berth, Tug Berth, and Emergency Lay Berth	Stubbs 1975, Barner 1978, Simmons 1983, Byram 2006a, Byram 2006b, Rose et al. 2014, Byram and Shindruk 2014; Punke et al. 2018, Punke 2018	Requires Additional Geoarchaeological Deep Testing of High Probability Area
Rock Apron (Ingram Yard & Coos Bay)	Hulse 2018	Survey Complete

TABLE 4.11.3.1-1 (continued)

Cultural Resources Surveys of Jordan Cove's Proposed LNG Terminal Facilities

Facility or Use Area a/	Survey Reports	Inventory Status
Material Offloading Berth (Ingram Yard)	Simmons 1983, Byram 2006a, Byram 2006b, Punke et al. 2018, Punke 2018	Survey Complete
Haul Road (Ingram Yard)	Simmons 1983, Byram 2006a, Byram 2006b, Punke et al. 2018, Punke 2018	Survey Complete
LNG Loading Platform and Transfer Pipeline (Ingram Yard)	Simmons 1983, Byram 2006a, Byram 2006b, Punke et al. 2018, Punke 2018	Survey Complete
LNG Storage Tanks (Ingram Yard)	Simmons 1983, Byram 2006a, Byram 2006b, Macfarlane and Skinner 2013, Punke et al. 2018, Punke 2018	Survey Complete
Liquefaction Processing Area (Ingram Yard)	Simmons 1983, Byram 2006a, Byram 2006b, Macfarlane and Skinner 2013, Punke et al. 2018, Punke 2018	Survey Complete
Refrigerant Storage Area (Ingram Yard)	Simmons 1983, Byram 2006a, Byram 2006b, Macfarlane and Skinner 2013, Punke et al. 2018, Punke 2018	Survey Complete
Gas Processing Area (Ingram Yard)	Simmons 1983, Byram 2006a, Byram 2006b, Macfarlane and Skinner 2013, Punke et al. 2018, Punke 2018	Survey Complete
Utilities (Ingram Yard)	Simmons 1983, Byram 2006a, Byram 2006b, Macfarlane and Skinner 2013, Punke et al. 2018, Punke 2018	Survey Complete
Flare Area (Ingram Yard)	Simmons 1983, Byram 2006a, Byram 2006b, Macfarlane and Skinner 2013, Punke et al. 2018, Punke 2018	Survey Complete
Secondary Terminal Entrance (Ingram Yard)	Simmons 1983, Byram 2006a, Byram 2006b, Punke et al. 2018, Punke 2018	Survey Complete
Laydown Area (Ingram Yard)	Simmons 1983, Byram 2006a, Byram 2006b, Macfarlane and Skinner 2013, Punke et al. 2018, Punke 2018	Survey Complete
Fire Station and Ancillary Buildings at west end of Access and Utility Corridor (north of Roseburg Forest Products)	Byram 2006a, Byram 2006b, Punke et al. 2018, Punke 2018	Survey Complete
Access and Utility Corridor (north of Roseburg Forest Products)	Barner 1977, Simmon 1984, Byram 2006a, Byram 2006b, Byram 2008, Byram and Shindruk 2012, Punke et al. 2018, Punke 2018	Survey Complete
Laydown Areas (Roseburg Forest Products)	Byram 2006a, Byram 2006b, Rose and Davis 2013	Survey Complete
Temporary Dredge Slurry and Water Return Pipelines (Roseburg Forest Products & South Dunes)	Byram 2006a, Byram 2006b, Byram 2008; Bowden et al. 2009	Survey Complete
Truck Haul Route (Ingram Yard and Roseburg Forest Products)	Simmons 1983, Byram 2006a, Byram 2006b, Macfarlane and Skinner 2013, Punke et al. 2018, Punke 2018	Survey Complete
Laydown Area (South Dunes) and Temporary Workforce Housing Complex (South Dunes)	Stubbs 1975, Barner 1978, Byram and Purdy 2007, Byram and Shindruk 2012, Olander et al. 2009, Bowden et al. 2009, Ragsdale et al. 2013, Bowden et al. 2017; Punke 2018	Survey Complete
SORSC (South Dunes)	Byram and Purdy 2007, Bowden et al. 2017	Survey Complete
Administration Building (South Dunes)	Byram and Purdy 2007, Bowden et al. 2017	Survey Complete
Industrial Wastewater Pipeline Replacement and new Water Line (Trans-Pacific Parkway)	Simmons 1984, Lange 1984, Langer 1986, Byram 2009, Byram and Shindruk 2012, Byram and Rose 2013, Rose and Johnson 2014	Survey Complete
Port Laydown Site (North Spit – south of Southport facility)	Darby 2005, Byram and Purdy 2008	Survey Complete
Box Car Hill Laydown Area (North Spit – east side of Causeway)	Langer 1986, Byram 2009, Derr et al. 2017	Partially surveyed/Requires additional survey
Meteorological Station and Access Road (Lagoon)	Goodwin 2014	Survey Complete

TABLE 4.11.3.1-1 (continued)

Cultural Resources Surveys of Jordan Cove's Proposed LNG Terminal Facilities

Facility or Use Area a/	Survey Reports	Inventory Status
Channel Improvement Areas 1-4 (Coos Bay)	AINW 2017; Hulse 2018	Survey Complete
Temporary Dredge Line from Channel Improvement Areas to APCO sites (Coos Bay)	AINW 2017; Hulse 2018	Survey Complete
Temporary Dredge Line to Eel Grass Mitigation Site (Coos Bay)	Bowden et al. 2017	Survey Complete
Eel Grass Mitigation Site (Coos Bay – north of airport)	Byram 2013; Bowden 2018	Survey Complete
Temporary Dredge Line to Kentuck Slough Mitigation Area (Coos Bay)	Bowden et al. 2017	Partially surveyed/Requires additional survey
Trans-Pacific Parkway Causeway and U.S. Highway 101 Intersection Improvements (north of McCullough Bridge)	Simmons 1984, Byram 2006a, Byram 2009, Byram 2013, Goodwin 2014	Survey Complete
APCO Sites 1 and 2 (North Point of North Bend)	Byram 2017, Bowden et al. 2017; Punke and Bowden 2018	Survey Complete
Kentuck Slough Wetland Mitigation Area (Kentuck Slough)	Bowden et al. 2009, Byram and Walker 2010, Ragsdale et al 2013, Bowden et al. 2017, Derr et al. 2017; Bowden 2018	Partially surveyed/Requires additional survey
Myrtlewood RV Park Off-Site Parking Lot (Hauser)	Bowden et al. 2017	Survey Complete
Lagoon Habitat Mitigation Site	N/A	Unsurveyed
Panhandle Habitat Mitigation Site	N/A	Unsurveyed
North Bank Habitat Mitigation Site	N/A	Unsurveyed

a/ Facilities derived from Table 1.4-1 and Figure 1.1-1 of Resource Report 1 attached to Jordan Cove's application to the FERC, and Table 4.2-2 filed November 2, 2018.

Areas that still require additional survey include the dredge slurry lines in Coos Bay; the Boxcar Hill Laydown and Parking Area; and the Lagoon, Panhandle, and North Bank habitat mitigation sites.

Geoarchaeological deep testing and shovel probing have been conducted in Ingram Yard, the Access and Utility Corridor, and the South Dunes area (Punke et al. 2018; Punke 2018a and 2018b), as well as at both APCO sites (Punke and Bowden 2018). A possible piece of archaeological bone material was found in a shovel probe at the South Dunes area. No other archaeological evidence was uncovered by the geoarchaeological studies. However, buried surfaces suitable for human habitation were identified beneath the fill layers at tested areas and may include unrecorded archaeological resources. The geoarchaeological studies identified "high probability areas." Additional geoarchaeological deep testing has been recommended in the high probability area within Ingram Yard, which is yet to be completed. Jordan Cove has indicated that supplemental shovel and auger testing is ongoing and will be provided in a new, comprehensive survey report to be submitted in late 2018 or early 2019. Additionally, Jordan Cove's consultants recommended that archaeological monitoring of construction activities within the high probability areas at the terminal site and the APCO sites be conducted (Punke 2018a and 2018b; Punke and Bowden 2018).

Appendix L summarizes the identified and reported resources that are within or adjacent to the direct APE. We concur with all SHPO determinations of NRHP eligibility and effects. For those resources where SHPO concurrence has not yet been requested (pending additional investigations) or is pending SHPO response, the recommended NRHP eligibilities and effects are preliminarily used for this analysis.

To date, no historic properties have been identified within the APE for the Jordan Cove LNG terminal. One NRHP-listed resource, McCullough Bridge, is avoided by the Project. Jordan Cove's consultants have recommended that construction be monitored by qualified professional archaeologists in the vicinity of sites 35CS221 and 35CS227 at the Ingram Yard and South Dune area respectively; and at site BAC-2014-1 near the intersection of Highway 101 with the North Spit Causeway. Jordan Cove's consultants also recommended that sites 35CS324, 35CS325, 35CS326, 35CS327, and 35CS328, near the Kentuck project site be avoided or tested to assess their NRHP eligibility. In a November 2, 2018 filing, Jordan Cove indicated it would conduct phase II testing in 2019 to determine the NRHP eligibility of site 35CS227. Additionally, the reported site leads require additional testing and/or monitoring during construction. Similarly, the TCP, *Q'alay ta Kukwis schichdii me*, requires further consultation.

4.11.3.3 Pacific Connector Pipeline Project

Pacific Connector hired cultural resources management consultants HRA to coordinate its cultural resources investigations and has conducted surveys of the APE since 2006, as applicable to the various past iterations of the Project. Table 4.11.3.3-1 lists the surveys, including those that cover Jordan Cove's proposed facilities.

TABLE 4.11.3.3-1

Cultural Resources Surveys Conducted for the Pacific Connector Project

Title	Reference	Type	Subsurface Detail	Project Component(s) Surveyed
Pacific Connector Gas Pipeline Project Cultural Resources Survey, Coos, Douglas, Jackson, and Klamath Counties, Oregon	Bowden et al. 2009	Pedestrian and subsurface	Shovel probe, test units	Portions of pipeline corridor and some TEWAs (including co-located aboveground facilities), UCSAs, quarries, laydown areas, and access roads outside the pipeline corridor.
Pacific Connector Gas Pipeline Project Cultural Resources Investigations, Coos, Douglas, Jackson, and Klamath Counties, Oregon, Final Phase II Evaluations	Bowden et al. 2010	Subsurface	Test units	Portions of pipeline corridor.
Pacific Connector Gas Pipeline Project Cultural Resources Survey, Coos, Douglas, Jackson, and Klamath Counties, Oregon, Survey Report Addendum for December 2009 FERC Data Request	Knutson et al. 2010	Pedestrian, intertidal/boat	–	Portions of pipeline corridor and some laydown areas outside the pipeline corridor.
Pacific Connector Gas Pipeline Project Cultural Resources Survey, Coos, Douglas, Jackson, and Klamath Counties, Oregon: 2013 Cultural Resources Addendum	Bowden et al. 2013	Pedestrian and subsurface	Shovel probe	Portions of pipeline corridor, Klamath Falls Compressor Station, and some TEWAs outside the pipeline corridor.

TABLE 4.11.3.3-1 (continued)

Cultural Resources Surveys Conducted for the Pacific Connector Project

Title	Reference	Type	Subsurface Detail	Project Component(s) Surveyed
Pacific Connector Gas Pipeline Project Cultural Resources Survey: 2013 Cultural Resources Addendum #2	Ragsdale et al, 2013	Pedestrian and subsurface	Shovel probe, deep testing, test units	Portions of pipeline corridor, some TEWAs.
Pacific Connector Gas Pipeline Project Cultural Resources Survey: Phase II Evaluation of Site 35DO1284	Willis et al. 2013	Subsurface	Test units	Portion of pipeline corridor and one TEWA in pipeline corridor.
Pacific Connector Gas Pipeline Project Cultural Resources Survey, Coos, Douglas, Jackson, and Klamath Counties, Oregon. 2014-2015 Cultural Resources Addendum	Derr et al. 2015	Pedestrian and subsurface	Shovel probes, deep testing	Portions of pipeline corridor, some TEWAs, and one laydown area.
Pacific Connector Gas Pipeline Project Cultural Resources Survey, Coos, Douglas, Jackson, and Klamath Counties, Oregon. 2017 Cultural Resources Addendum.	Derr et al. 2017	Pedestrian, intertidal/boat, windshield, and subsurface	Test units	Portions of pipeline corridor and some TEWAs and access roads outside the pipeline corridor.
Pacific Connector Gas Pipeline Project Cultural Resources Survey, Coos County, Oregon: 2018 Cultural Resource Addendum 1	Derr et al. 2018	Pedestrian and subsurface	Shovel probes	Portion of pipeline corridor and some TEWAs and access roads outside the pipeline corridor.

As of April 2018, Pacific Connector indicated that approximately 221 miles of the direct APE for the pipeline route (96 percent) was covered by cultural resources surveys. A total of 1,557 work spaces (97 percent) have been surveyed. Surveys has been completed for 26 pipe yards and 16 rock source and disposal sites. All 35 hydrostatic test water discharge sites have been surveyed. About 498 miles (85 percent) of roads has been surveyed.

Access to unsurveyed portions of the 229-mile-long proposed pipeline corridor has either been denied or is pending. The pipeline crossings of Coos Bay/North Point, North Point/Kentuck Slough, Coos River, South Umpqua/I-5, Rogue River, and Klamath River are considered to have potential for buried cultural resources that could be impacted by the proposed HDD technology at these locations. Geoarchaeological deep testing has been conducted at the Klamath River crossing (Derr et al. 2015). Additional deep testing is planned to be conducted at the remaining above HDD crossings when access is obtained.

Survey of work spaces is also partially complete. Forty-one TEWAs (2.6 percent of the total number of TEWAs) remain to be surveyed. One UCSA (0.3 percent of the total number of UCSAs) requires survey.

A total of 17 pipe yards and rock source and disposal sites (34 percent) remain to be surveyed. One hundred and forty-eight access roads, totaling about 81 miles (15 percent) of proposed access roads, need to be surveyed. Lastly, three TARs (30 percent) require survey.

With the exception of the Klamath Compressor Station and new communication towers, all of the proposed aboveground facilities are within the pipeline corridor and/or are co-located with other facilities. Those aboveground facilities within sections of the pipeline corridor that have not yet been surveyed are MLV #2 and MLV #9. This area is 8 percent of the total area of MLVs not co-located with other aboveground facilities. Additionally, the Harness Mountain Communication Tower has not been surveyed. This area is less than 7 percent of the total area of communication towers not co-located with other facilities. Pacific Connector plans to survey this area once specific construction plans are finalized and access to the area is granted. The Klamath Compressor Station was surveyed as part of a previous iteration of the application (Bowden et al. 2013), however the design of the station has changed in the current application (CP17-494 and CP17-495; filed September 21, 2017). As such, a portion of this Project component requires survey. Pacific Connector planned to survey the additional acreage in 2017; however, the results have not yet been submitted to the FERC.

Of the 18 locations identified by Pacific Connector's consultants as having potential to convey indirect effects from viewshed changes related to the pipeline, only five appeared to contain potentially historic features based on a desktop analysis. Only these five areas in the indirect APE were recommended for survey. Surveys have not yet been conducted at the following five locations in the indirect APE: 1) east of Haynes Inlet (MP 5.5R); 2) west side of Kentuck Slough (MP 6.3R); 3) 13674 Sitkum Lane, Myrtle Point (MP 29.5); 4) near Dora Cemetery (MP 29.5): and 5) 2378 Upper Camas Road, Camas Valley (MP 49.5). Other areas of the indirect APE either have no potential to affect historic-period resources because no potential historic properties appear to be present, or historic-period resources are entrenched within a modern viewshed and significant impacts are therefore not expected.

The inventories for the Pacific Connector Project identified 158 archaeological and historic architectural sites (see appendix L); 120 sites are along the proposed pipeline route, and 38 sites are along access roads, within TEWA or UCSA, rock source or disposal areas, or yards. Thirty-seven of these sites are located on federal lands (one is on private and federal lands). In addition to the identified sites, 129 isolated finds were also recorded. Two of these require additional investigations (HRA-724i and HRA-727i). After consulting with the SHPO, we determined that the remaining 127 isolated finds are not eligible for the NRHP and require no further work.

Of the 125 sites on non-federal land (including one site that is on private and federal land), 26 have been evaluated as not eligible for the NRHP and require no further work. The Oregon SHPO has concurred with these recommendations and we agree (see appendix L). Seventy-nine sites are outside the APE or can be avoided. Six sites were previously recorded by other investigators and not relocated by Pacific Connector's consultants. The remaining sites are either NRHP-eligible or unevaluated.

Avoidance plans can be found in the draft HPMP filed with the FERC on October 5, 2018. The HPMP is subject to revision based on ongoing consultations between Pacific Connector, tribes, SHPO, and cooperating agencies. However, not all unevaluated, potentially NRHP-eligible, and NRHP-listed sites that can be avoided by the Project have avoidance plans; therefore, the draft HPMP still needs further revision.

Forty-three sites are unevaluated and cannot be avoided, so they need additional investigations, either survey or testing. The unevaluated sites requiring additional work are listed in in appendix L.

Twenty sites, listed in appendix L, have been determined to be eligible for or listed on the NRHP and cannot be avoided. Data recovery excavations are recommended as mitigation for these sites.

In most cases, the applicants prepared treatment plans for these sites, which were reviewed and accepted by appropriate interested Indian tribes, federal land management agencies, the Oregon SHPO, and the FERC staff.

4.11.3.4 Federal Lands

The Jordan Cove LNG Project would not directly affect any federal lands. The proposed Pacific Connector pipeline route, however, would cross federal lands administered by the BLM, Forest Service, and Reclamation. In total, 38 sites were identified on federal lands or are otherwise managed by one of these federal agencies. Thirty-three of the sites are on BLM lands (three of which extend onto private lands and therefore have dual land ownership), four are on NFS lands, and one is managed by Reclamation. We have included a table in appendix L listing all sites on federal lands.

Of the 33 sites on BLM lands, 10 are not eligible for the NRHP and require no further work. Ten of the 33 sites are treated as NRHP-eligible or are unevaluated and can be avoided. Eight of the sites on BLM lands require additional work, either additional survey or testing, prior to their evaluation for eligibility to the NRHP. Five BLM sites (35DO1104, 35DO1105, 35DO1106, 35DO1110, and 35DO1117) have been determined eligible for the NRHP and cannot be avoided by the Project. Pacific Connector's consultants have recommended that data recovery investigations be conducted to mitigate adverse effects at the unavoidable eligible sites.

Two of the four sites on NFS lands were evaluated as not eligible for the NRHP and require no further work. One Forest Service site (35DO1426) is unevaluated, but can be avoided. The remaining site (35DO1107) on NFS lands is eligible for the NRHP and cannot be avoided. Pacific Connector produced a treatment plan to mitigate adverse effects at 35DO1107, which the Forest Service found acceptable.

The Klamath Project, managed by Reclamation, is eligible for the NRHP. The Pacific Connector pipeline route would cross 16 features associated with the Klamath Project. Pacific Connector proposes to bore under the Klamath Project canals. However, neither Reclamation nor the SHPO have commented to date on this method of reducing impacts on the canals.

4.11.4 Unanticipated Discovery Plans

Jordan Cove included a draft UDP (August 2017) as Appendix B.4 in Resource Report 4 of its September 2017 application to the FERC in Docket No. CP17-495-000. Jordan Cove has stated that it developed its UDP in communications with certain Indian tribes (see appendix L). The Oregon SHPO, as well as the CTCLUSI, Coquille Tribe, Grand Ronde Tribes, and Klamath Tribes, provided Jordan Cove with comments on the plan, and Jordan Cove indicated that it would address those comments. A revised and final version of the UDP has not yet been submitted to the FERC.

Pacific Connector included a copy of its August 2017 draft UDP as Appendix B.4 of Resource Report 4, attached to its September 2017 application to the FERC and as an appendix to the draft HPMP submitted in October 2018 in response to a request by the FERC staff. Pacific Connector has indicated that the CTCLUSI, Coquille Tribe, and the Klamath Tribes commented on the draft UDP. Review of the draft UDP by the SHPO has not yet been completed. As such, a revised and final version of the UDP based on tribal and SHPO review has not yet been submitted to the FERC.

We cannot find the UDPs acceptable until we see final versions that address comments from Indian tribes and the SHPO.

4.11.5 Compliance with the NHPA

We have not yet completed the process of complying with Sections 101 and 106 of the NHPA. Additional consultations, investigations, and/or plans remain necessary.

For the Jordan Cove LNG Project, the planned Lagoon, Panhandle, and North Bank habitat mitigation sites still require surveys. Jordan Cove's consultants recommended that construction be monitored by qualified professional archaeologists in the vicinity of sites 35CS221 and 35CS227 at the Ingram Yard and South Dune area, respectively; and at site BAC-2014-1 near the intersection of Highway 101 with the North Spit Causeway. In a November 2, 2018 filing, Jordan Cove indicated it would conduct phase II testing at site 35CS227 in 2019. Jordan Cove's consultants also recommended that sites 35CS324, 35CS325, 35CS326, 35CS327, and 35CS328, which may be impacted by the dredge slurry line in Coos Bay to the Kentuck project site, should be avoided or tested to assess their NRHP eligibility.

For the Pacific Connector Pipeline Project, about 23 miles (totaling 793 acres) of proposed pipeline route, 41 TEWAs (totaling about 28 acres), 17 pipe yards rock source and disposal sites (totaling about 211 acres), and 148 access roads (totaling about 81 miles) remain to be inventoried. Where access has been denied, Pacific Connector would need a Certificate from the Commission in order to use eminent domain to conduct remaining surveys and other investigations. Forty-three sites are unevaluated and cannot be avoided, so they may be impacted by the Pacific Connector Pipeline Project. Those sites need additional investigations, either survey or testing.

The ethnographic study of the Projects and the identification of traditional cultural resources is also incomplete. We have recommended that the applicants file a revised Ethnographic Report.

Twenty historic properties may be affected by the Pacific Connector Pipeline Project. Those sites require treatment to mitigate impacts. To resolve adverse effects at affected historic properties, the FERC will produce a MOA for the current undertaking, to be circulated among the consulting parties. The MOA would stipulate that the treatment plans should be implemented; with the written permission of the FERC and federal land-managing agencies, as applicable. It would also allow for phased surveys and testing investigations, in areas were access was previously denied. However, the MOA cannot be drafted until after the Commission authorizes the Projects. If the Commission should deny the Projects, no adverse effects on historic properties would occur.

To ensure that the Commission's responsibilities under the NHPA and its implementing regulations are met, **we recommend that:**

- **Jordan Cove and Pacific Connector should <u>not begin construction of facilities and/or use</u> any staging, storage, or temporary work areas and new or to-be-improved access roads <u>until</u>:**

  a. Jordan Cove and Pacific Connector each file with the Secretary:

    1. remaining cultural resources inventory reports for areas not previously surveyed;

2. **site evaluations and monitoring reports, as necessary;**
3. **final HPMP with avoidance plans;**
4. **final UDP; and**
5. **comments on the cultural resources reports and plans from the SHPO, applicable federal land managing agencies, and interested Indian tribes.**

b. **FERC affords the ACHP an opportunity to comment on the undertaking; and**

c. **FERC staff reviews and the Director of OEP approves all cultural resources reports and plans and notifies Jordan Cove and Pacific Connector in writing that treatment plans may be implemented and/or construction may proceed.**

All materials filed with the Commission containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: "CUI//PRIV - DO NOT RELEASE."

4.11.6 Conclusion

We have not yet completed the process of complying with Sections 101 and 106 of the NHPA. Additional cultural resource inventories, evaluations, and associated reports are to be completed, as are a final ethnographic study, HPMP, and UDP. Consultations with tribes, SHPO, and applicable federal land-managing agencies have also not been concluded. As such, the Project would result in an adverse effect under Section 106 of the NHPA and a significant impact under NEPA. However, should the Project be approved by the Commission, an MOA would be developed with the goal of resolving adverse effects under Section 106. It is expected that the resolution of adverse effects through an MOA and implementation of treatment plans would mitigate impacts at affected historic properties to a less-than-significant finding under NEPA.

4.12 AIR QUALITY AND NOISE

4.12.1 Air Quality

Construction and operation of the proposed Projects would affect local and regional air quality. The term "air quality" refers to relative concentrations of pollutants in the ambient air. The subsections below summarize applicable federal and state air quality regulations and describe well-established air quality concepts that are applied to characterize air quality and to determine the significance of increases in air pollution. This includes metrics for specific air pollutants known as ambient air quality standards (AAQS), regional designations to manage air quality known as Air Quality Control Regions (AQCRs), and efforts to monitor ambient air concentrations.

Air quality impacts are spatially dependent, and therefore this section is divided into subsections as follows:

- Impacts in the Coos Bay area associated with the Jordan Cove LNG Project and marine vessels on the waterway are discussed in section 4.12.1.3.
- Impacts associated with the Pacific Connector pipeline—for which the key air pollution sources are emissions from construction and operation of the compressor station in Klamath County—are discussed in section 4.12.1.4.
- Environmental consequences on federal lands are summarized in section 4.12.1.5.

4.12.1.1 Regulatory Setting

Regulatory requirements for air quality—aside from the requirement that the overall project not contribute to a degradation in air quality that results in an exceedance of the national ambient air quality standards (NAAQS)—depend upon the equipment that is proposed to be constructed and the associated emissions. Sources of air pollution at the Jordan Cove LNG Project and in the associated waterway include the following:

- five direct-drive combined cycle combustion turbines, each rated at 524.1 million Btu per hour (MMBtu/hr), to power refrigeration compressors;
- one thermal oxidizer, rated at 110 MMBtu/hr for the gas conditioning system;
- one auxiliary boiler rated at 296.2 MMBtu/hr;
- one enclosed marine flare rated at 0.74 MMBtu/hr;
- one multipoint ground flare rated at 2.13 MMBtu/hr;
- two diesel black-start engines each rated at 4,376 hp;
- two backup engines each rated at 1,073 hp;
- three fire water pump engines each rated at 700 hp;
- two 160,000 cubic meters (m^3) capacity LNG storage tanks;
- fugitive emission sources (valves, flanges, and other equipment); and
- LNG carriers and support vessels.

Regulatory requirements for air quality applicable to the Pacific Connector Pipeline Project depend in part upon the equipment that is proposed to be installed at the compressor station and the associated emissions. Sources of air pollution at the compressor station would include:

- three General Electric PGT25/DLE 1.5 natural gas–fired combustion turbines, each with a maximum site rating of 28,290 hp, and a maximum heat input rate of 194.7 MMBtu/hr at 0°F (the air permit would limit operation to only two turbines at a time; the third is solely for reliability to maintain maximum throughput for the pipeline at times when one of the two operating units is offline for maintenance);
- one 6.28 MMBtu/hr gas-fired hot water boiler;
- one 1,090 kilowatt (kW) natural gas–fired spark-ignition standby generator, limited to no more than 100 hours per year of operation; and
- ancillary activities (fugitive venting, blowdowns, and condensate tank).

Air emission sources for the Jordan Cove LNG Project and the Pacific Connector Pipeline Project are regulated at the federal and state level. Applicable federal and state air quality regulations are summarized below.

Federal and International Air Quality Requirements

Applicable and potentially applicable federal air quality regulations include:

- New Source Review (NSR)/Prevention of Significant Deterioration (PSD) preconstruction permit requirements;
- General Conformity;
- Title V Operating Permit requirements;
- New Source Performance Standards;
- National Emissions Standards for Hazardous Air Pollutants (HAP);
- Chemical Accident Prevention; and
- Mobile Source Regulations.

<u>NSR/PSD Preconstruction Permit Requirements</u>

The federal NSR preconstruction permit program is administered by ODEQ under OAR 340-224 and includes two components: Nonattainment NSR (NNSR), which applies to “major” stationary sources located in nonattainment areas, and PSD, which applies to “major” stationary sources located in attainment or unclassifiable areas. Because existing air quality is classified as “attainment” or “unclassifiable” for all NAAQS pollutants, only PSD regulations are applicable to the Jordan Cove LNG Project. The Project as originally designed was considered a “major” PSD source, and a PSD permit application was submitted to ODEQ in March 2013. However, the current Project design no longer includes the previously proposed South Dunes Power Plant facility, and as a result it no longer qualifies as a major PSD source. A Type B state-only NSR application was submitted to ODEQ in September 2017.

Criteria pollutant emissions from the Pacific Connector Pipeline Project compressor station would be well below major source thresholds. Although GHGs are above previously identified major source thresholds, the Supreme Court made a ruling on June 23, 2014 (*Utility Air Regulatory Group [UARG] v. EPA [No. 12-1146])* that effectively disallowed the triggering of NSR/PSD based on the significance of GHG emissions alone. Therefore, the Pacific Connector Pipeline Project is not expected to trigger NSR/PSD.

General Conformity

For proposed activities that are not covered by NSR/PSD permits—such as construction activities—General Conformity requirements can apply in areas designated as "nonattainment" or "maintenance" with respect to the NAAQS. However, as there are no such areas within the vicinity of the Jordan Cove LNG Project or along construction routes, these requirements do not apply.

Approximately 325 feet of the Pacific Connector pipeline in construction spread 5, between MPs 199 and 200, would be located within the particulate matter with a diameter of less than 10 microns (PM_{10}) maintenance area. Federal regulations at 40 CFR 93 Subpart B require a General Conformity analysis for PM_{10} maintenance areas when emissions of PM_{10} exceed 100 tons per year (TPY). Estimated emissions for this 325-foot length of construction in the PM_{10} maintenance area are presented in table 4.12.1.1-1 and are far below the General Conformity applicability threshold; therefore, the General Conformity requirements do not apply to the Pacific Connector Pipeline Project.

TABLE 4.12.1.1-1

Estimated Construction PM_{10} Emissions in Klamath Falls PM_{10} Maintenance Area (tons) from the Pacific Connector Pipeline Project

Pollutant	PM_{10}
Total Spread 5 nonroad engine emissions (42.5 miles)	2.48
Total Spread 5 fugitive dust emissions (42.5 miles)	26.573
Total Spread 5 PM_{10} emissions	29.053
PM_{10} maintenance area total emissions (300 feet)	**0.039**

Title V Operating Permit

Facilities that have the potential to emit at least 100 TPY of any criteria pollutant, 10 TPY of any individual HAP, or 25 TPY of any combination of HAPs are required to obtain Title V Operating Permits, which are implemented by ODEQ under OAR 340-218. Because the Jordan Cove LNG Project's emissions of oxides of nitrogen (NO_x), carbon monoxide (CO), PM_{10}, and particulate matter with a diameter of less than 2.5 microns ($PM_{2.5}$) would each exceed that threshold for criteria pollutants, it will be required to apply for a Title V Operating Permit. For new sources (such as the ones proposed here), applications for these permits are due one year after the source commences operation. Oregon requires Title V facilities to obtain a Standard ACDP permit prior to construction; see the discussion of state air permitting requirements below.

Facilities that trigger PSD permitting, such as this one, are required to obtain Title V Operating Permits, which are implemented by ODEQ under OAR 340-218. The Pacific Connector Pipeline Project would therefore be required to apply for a Title V Operating Permit. For new sources (such as the ones proposed here), applications for these permits are due one year after the source commences operation.

The Title V Operating Permit will help ensure that the facility continues to comply with all applicable air regulations after it is built. These permits require periodic monitoring to ensure compliance with the permit, annual certification of compliance with all applicable air pollution regulatory requirements, and public comment on permit issuance/renewal and on significant modifications to the permit.

New Source Performance Standards

All new sources of air pollution in specific source categories are required to comply with applicable New Source Performance Standards (NSPS) regulations (40 CFR 60), which establish maximum emission limits for criteria pollutants (and their precursors) and also incorporate monitoring, reporting, and recordkeeping requirements. NSPS regulations that are applicable to the Project are discussed below.

The natural gas–fired turbines at the Jordan Cove LNG Project are subject to NSPS Subpart KKKK, which limits emissions of NO_x from the turbines.

The auxiliary boiler is subject to NSPS Subpart Db, which applies to steam-generating units rated at greater than 100 MMBtu/hr heat input. The auxiliary boiler would be subject to the Subpart Db emission limit for NO_x but would be exempt from the Subpart Db emission limits for sulfur dioxide (SO_2) and particulate matter because it would burn only natural gas.

The two diesel black-start generators, two diesel backup generators, and three diesel fire pump engines are subject to NSPS Subpart IIII, which requires that new or modified stationary engines meet the same emissions standards that manufacturers of comparable nonroad engines are required to comply with. Jordan Cove has proposed to install engines that meet EPA Tier 2 emission standards for the diesel generators, and EPA Tier 3 emission standards for the diesel fire pump engines.

New large storage tanks containing liquids that can emit significant amounts of volatile organic compounds (VOCs) - i.e., where the equilibrium partial pressure exerted by the VOC exceeds 3.5 kilopascals (kPa) - are subject to NSPS Subpart Kb. However, the two largest constituents in LNG that exert partial pressure are methane and ethane (both of which are negligibly photochemically reactive and therefore exempt from the definition of VOC). The remaining VOC constituents in LNG, such as butane, propane, and heavier compounds, have an equilibrium partial pressure of less than 3.5 kPa at the storage temperature, and therefore the LNG storage tanks are not subject to NSPS Subpart Kb.

Certain equipment at crude oil and natural gas production facilities can be subject to NSPS Subpart OOOOa. However, Jordan Cove has determined that none of its proposed facilities or equipment would qualify as affected sources under Subpart OOOOa.

With respect to the Pacific Connector Pipeline Project, the gas-fired combustion turbines located at the Klamath Compressor Station would be new and subject to NSPS Subpart KKKK (and are therefore specifically exempted from NSPS Subpart GG for stationary combustion turbines, as per 40 CFR 60.4305(b)). They would be required to meet an NO_x emission standard of 25 parts per million (ppm) by volume, dry basis, corrected to 15 percent oxygen (ppmvd @ 15 percent O_2) or approximately 1.2 pounds NO_x per megawatt hour generated.

The potential spark-ignition emergency generator at the compressor station would be manufactured after June 12, 2006, and therefore would be subject to NSPS Subpart JJJJ, which requires that NO_x emissions be no higher than 2.0 grams per horsepower per hour (g/hp-hr) = 160 ppmvd @ 15% O_2 and that CO emissions be no higher than 4.0 g/hp-hr = 540 ppmvd @ 15% O_2.

New large storage tanks containing liquids that can emit significant amounts of VOCs—i.e., where the equilibrium partial pressure exerted by the VOC exceeds 3.5 kPa—are subject to NSPS Subpart Kb. While the design of the Klamath Compressor Station has not been finalized, a condensate storage tank is likely to be installed. The potential applicability of NSPS Subpart Kb will be determined once the final storage tank specifications are known.

Certain equipment at crude oil and natural gas production facilities can be subject to NSPS Subpart OOOOa. The fugitive emissions at the Klamath Compressor Station would qualify as an "affected facility" under Subpart OOOOa, and the centrifugal compressors may be subject as well if they are equipped with wet seals. If any pneumatic controllers are installed, they may also be subject to Subpart OOOOa if they have a natural gas bleed rate of greater than 6 standard cubic feet per hour. Storage tanks may be subject to Subpart OOOOa if they have potential VOC emissions of 6 TPY or more; however, the condensate storage tank is unlikely to have potential emissions meeting this threshold. The extent to which NSPS Subpart OOOOa is applicable will be determined once the design of the Klamath Compressor Station is finalized.

National Emissions Standards for Hazardous Air Pollutants

New and existing sources of air pollution are required to comply with applicable National Emissions Standards for Hazardous Air Pollutants (NESHAP), many of which are also incorporated by reference into Oregon's regulations at OAR 340-244-0220. NESHAPs exist for the following source types included at the Jordan Cove LNG Project terminal:

- Stationary Combustion Turbines (40 CFR 63, Subpart YYYY); Stationary Reciprocating Internal Combustion Engines (40 CFR 63, Subpart ZZZZ); and
- Industrial, Commercial, and Institutional Boilers at Area Sources (40 CFR 63, Subpart JJJJJJ).

For natural gas–fired turbines, the requirements of Subpart YYYY were stayed per 40 CFR 63.6095(d), and therefore, there are no applicable requirements. For the engines, compliance with NSPS Subpart IIII satisfies the requirements of 40 CFR 63 Subpart ZZZZ, and therefore, there are no additional applicable requirements. For the auxiliary boiler, the requirements of Subpart JJJJJJ do not apply because it would burn only natural gas.

NESHAPs exist for the following source types included at the Pacific Connector compressor station:

- Stationary Combustion Turbines (40 CFR 63, Subpart YYYY); and
- Stationary Reciprocating Internal Combustion Engines (40 CFR 63, Subpart ZZZZ).

For natural gas–fired turbines, the requirements of Subpart YYYY were stayed per 40 CFR 63.6095(d), and therefore there are no applicable requirements. For the engines, compliance with NSPS Subpart JJJJ satisfies the requirements of 40 CFR 63 Subpart ZZZZ, and therefore there are no additional applicable requirements.

Chemical Accident Prevention Provisions

LNG facilities are subject to safety regulations developed by the USDOT (49 CFR 193) and the U.S. Department of Homeland Security (33 CFR 127). The EPA's Chemical Accident Prevention Provisions (40 CFR 68, which were developed in accordance with Section 112(r) of the Clean Air

Act (CAA) and referenced by Oregon regulations at OAR 340-244-0230) can also apply to owners or operators of stationary sources producing, processing, handling, or storing toxic or flammable substances. However, the EPA's General Counsel has clarified that Section 112(r) and the associated regulations do not apply to LNG stored at terminals because the material is either being transported or stored incident to transportation (EPA 2006).

Aside from LNG, which would be stored incident to transportation, the Project would not be storing hazardous or flammable substances in excess of any thresholds identified in 40 CFR 68, and therefore, those regulations do not apply. However, with regard to the storage of any small quantities of hazardous substances that are not being transported or stored incident to transportation, the 112(r)(1) general duty clause does apply:

> *The owners and operators of stationary sources producing, processing, handling or storing [hazardous] substances have a general duty in the same manner and to the same extent as section 654, title 29 of the United States Code, to identify hazards which may result from [accidental] releases using appropriate hazard assessment techniques, to design and maintain a safe facility taking such steps as are necessary to prevent releases, and to minimize the consequences of accidental releases which do occur.*

Mobile Source Regulations

International Maritime Organization (IMO) Standards for Ships – The IMO has officially designated waters off North American coasts as "Emission Control Areas" (ECAs) under Annex VI, which means that stringent international emission standards will apply to ships operating in these areas. Effective in 2015, the sulfur content in marine fuels used in these waters is required to contain no more than 0.1 percent sulfur (or else vessels can install control equipment to reduce emissions from fuels with higher sulfur contents to equivalent levels). In November 2011, IMO's Marine Environment Protection Committee adopted amendments that exempted boiler-propelled vessels "that were not originally designed for continued operation on marine distillate fuel or natural gas" (such as LNG carriers) from the fuel sulfur requirements until at least 2020 (IMO 2011). However, Jordan Cove has indicated that they would require vessels calling on the LNG terminal to meet the fuel sulfur requirements. In addition, diesel engines installed on vessels manufactured in 2016 or later are required to control NO_x emissions to levels that are approximately 80 percent lower than currently allowable levels ("Tier 1") when operating in ECAs (which in most cases will mean that NO_x control equipment will need to be installed). The IMO regulations also include requirements pertaining to emissions from shipboard incinerators.

EPA Requirements for Marine Diesel Engines – All marine diesels larger than 37 kW that have been manufactured in the United States since January 1, 2004, are required to meet federal emissions standards identified in 40 CFR 94 or 40 CFR 1042; the newest engines are subject to the most stringent requirements ("Tier 4"). Although most engines on existing LNG carriers were not manufactured in the United States, some of the newer engines installed on tugs and other local support vessels may be subject to these regulations, and the Project's emissions calculations reflect the use of "Tier 4" diesel engines in the tugboats.

EPA Requirements for Land-Based Engines and Vehicles – The EPA has promulgated extensive regulations reducing emissions from new on-road vehicles and construction equipment, which has resulted in substantial emissions reductions over time in spite of increased equipment/vehicle populations and usage.

EPA Regulations on Fuels – Any diesel oil or gasoline sold in the United States that is used in or intended for use in marine engines or land-based engines is subject to federal regulations (40 CFR 80). Non-road, locomotive, and marine diesel sold in the United States must have a sulfur content no greater than 15 ppm (0.0015 percent) by weight. Although these requirements do not apply to diesel fuel (or boiler fuel) obtained by LNG carriers outside the United States, diesel fuel used by tugboats, support vessels, and construction equipment would need to meet these criteria. Gasoline is required to have a sulfur content of no more than 80 ppm per gallon, or more than 30 ppm on average for any given refinery or importer.

State Air Quality Requirements

In addition to the rules identified above, ODEQ has state-specific air quality requirements. Those that would be directly applicable to the Jordan Cove LNG Project and/or the Pacific Connector Pipeline Project, and those that may potentially be applicable are discussed below.

Oregon Construction Permit

Oregon requires that facilities subject to Title V Operating Permits obtain a Standard ACDP in accordance with OAR 340-216 prior to construction. As part of this permit, Plant Site Emission Limits are required to be obtained for all regulated pollutants, as per OAR 340-222-0020, and an air quality impact analysis must be conducted in accordance with OAR 340-216. Since the Jordan Cove LNG Project terminal is subject to the Title V Operating Permit regulations, an ACDP is required. Oregon also requires that facilities subject to NSPS regulations with emissions greater than 10 TPY obtain an ACDP, including Plant Site Emission Limits and an air quality impact analysis. The Pacific Connector Pipeline Project is subject to this requirement.

A Standard ACDP identifies all applicable requirements, identifies plant site emission limits (PSELs), and includes testing, recordkeeping, and reporting requirements sufficient to determine compliance with the PSEL. A Type B state-only NSR application for a Standard ACDP was submitted to ODEQ in September 2017.

Air Quality Impact Analysis

Oregon's ACDP regulations cross-reference air quality analysis regulations in OAR 340-225-0050(1) and (2) and OAR 340-225-0060. These regulations are therefore applicable. With respect to the requirement for projects to demonstrate compliance with the NAAQS and PSD increments, ODEQ allows projects to show that their own impacts are below significant impact levels. Projects that cannot demonstrate impacts less than the significant impact levels must show that (a) modeled impacts from the proposed source and other PSD increment-consuming sources are less than PSD increments, and (b) those impacts plus background concentrations are less than the NAAQS. The Project's ACDP permit application demonstrates that the applicable requirements of these regulations are met. More details about the air quality impact analysis are provided under the "Operational Air Impacts and Mitigation" subheadings below.

General Emission Standards

Under OAR 340-226, sources that are not already subject to NSPS requirements (as identified above) or other new source standard and have the potential to emit at least 1 TPY of any criteria pollutant must meet the requirements for Typically Achievable Control Technologies (TACT). Emission limits that meet TACT would be typical of the emission rates achieved by other recently installed emission units of a similar type and size. The use of dry low emission technology and good combustion practices in the Pacific Connector compressor turbines would meet or exceed TACT for gas-fired turbines of this size.

Visible Emission and Nuisance Requirements

State visible emissions and nuisance abatement regulations are codified in OAR 340-208. Both construction and operation phases of the Projects would be subject to visible emission limits stated in terms of opacity. Either Project may not emit contaminants causing opacity to equal or exceed 20 percent in any period or periods aggregating more than 3 minutes in any hour. In addition, no person may create an observable deposition of particulate matter on another person's property (OAR 340-208-540).

This regulation prohibits nuisances and requires that reasonable precautions be taken to minimize fugitive dust emissions in Special Control Areas (which include areas within 3 miles of the corporate limits of any city having a population of 4,000 or more). The LNG Project site is within three miles of North Bend, Oregon, which has a population of approximately 10,000.

Given that visible emissions from the combustion of gaseous fuels are typically far below 20 percent opacity and that the only fugitive dust emissions are likely to be those associated with construction, the Jordan Cove LNG Project is anticipated to meet these regulations.

4.12.1.2 Existing Conditions

Climate

Jordan Cove LNG Project

Climatic conditions, such as ambient temperature, cloud cover, and wind, can significantly change how emissions of pollutants impact local air quality. The State of Oregon is divided into nine climate zones as established by the National Climatic Data Center (NCDC). The Jordan Cove LNG Project and the waterway used by the LNG marine traffic lies in the southern part of Zone 1–The Oregon Coast. The climate of the Project area is characterized by wet winters, relatively dry summers, and mild temperatures year-round. Terrain features include the coastal plain, which extends from less than a mile to a few tens of miles in width, numerous coastal valleys, and the Coast Range, whose peaks range from 2,000 to 5,500 feet above sea level. The National Weather Service (NWS) maintains a climate station at the Southwest Oregon Regional Airport in Coos County, located across Coos Bay approximately 1 mile south of the Project site. Climate data from this station should be representative of conditions in the area of the Jordan Cove LNG Project.

The heaviest precipitation in this zone occurs mainly during the winter months when moist air masses move off the Pacific Ocean onto land. Normal annual precipitation (as measured at the Southwest Oregon Regional Airport) is approximately 65 inches, with normal annual snowfall of approximately 1 inch. The highest monthly precipitation values occur during the months of November, December, and January.

The mean maximum temperature in North Bend/Coos Bay is approximately 60°F, the mean minimum temperature is approximately 46°F, and the mean temperature is approximately 53°F. Temperatures of 90°F or higher occur less than once per year, on average, and freezing temperatures are infrequent, with killing frosts being even less frequent. The growing season (period between minimum temperature occurrences of 28°F) averages approximately 303 days.

Strong winds occur occasionally, usually in advance of winter storms. These winds can exceed hurricane force and have been known to cause significant damage to structures and vegetation. Such events, however, are typically short-lived, and last less than one day. Partly cloudy skies are prevalent during the summer. Winter skies are likely to be cloudy. As a result of the persistent cloudiness, total solar radiation is relatively low in this zone.

Pacific Connector Pipeline Project

As identified above, the State of Oregon is divided into nine climate zones as established by the NCDC. The pipeline runs from Zone 1 (the Oregon Coast; as described in section 4.12.1.1) through Zone 3 (Oregon Southwestern Valleys) to Zone 7 (the South Central Oregon climate region; NCDC 1994). The primary source of air pollutants associated with Project operation is the proposed Klamath Compressor Station, which lies in Zone 7. The region surrounding the Klamath Compressor Station receives an annual average of 14.2 inches of precipitation per year.[184] Average daily temperature is 50.4°F from the same station and reporting period. The prevailing wind direction is from the west at an average daily speed of 6.3 miles per hour (mph).[185]

The air temperature extreme in Klamath Falls ranges from -10°F to 100°F. For the period 1997 to 2008, an air temperature below 0°F was recorded on average 1.3 days per year (Western Regional Climatic Center [WRCC] 2012). Hourly meteorological data for Klamath Falls were obtained from the NCDC for the most recent five-year period (2008 to 2012) (NCDC 2013). During the 2008–2012 period, ambient air temperature at or below 0°F occurred for 84 hours for an average of approximately 17 hours (0.7 day) per year.

Existing Air Quality

Existing air quality is typically characterized relative to EPA's NAAQS, which exist for seven pollutants:

- oxides of sulfur (measured as SO_2)
- CO
- oxides of nitrogen (measured as nitrogen dioxide, NO_2)
- ozone
- PM_{10}
- $PM_{2.5}$
- lead and its compounds (measured as lead)

[184] Based on data from the Western Regional Climatic Center at the Klamath Falls 2 SSW weather station for the period January 1981 through December 2010.
[185] As recorded at the Klamath Falls Airport Weather Station, from November 1997 to December 2008.

These pollutants are referred to as "criteria pollutants" because EPA is required to periodically identify air quality criteria which reflect the latest scientific knowledge (including knowledge regarding the health impacts on children, asthmatics, and the elderly), and revise the NAAQS accordingly. The CAA requires EPA to set both primary NAAQS (which are established to be protective of human health, allowing an adequate margin of safety) and secondary NAAQS (established to be protective of public welfare, which includes effects on wildlife, crops, vegetation, and buildings). Emissions of other non-criteria pollutants are also regulated by EPA and state/local environmental agencies, even though NAAQS are not developed for them.

The EPA, and state and local agencies, have established a network of ambient air quality monitoring stations to measure concentrations of criteria pollutants across the United States. All areas of the United States are classified as being "attainment," "unclassified," or "nonattainment" with respect to the NAAQS. "Nonattainment" areas, where criteria pollutant concentrations exceed the NAAQS, are required to develop plans to meet the standards by specified deadlines, and after meeting the standards are classified as "maintenance areas" (a subcategory of attainment areas, for areas previously designated as nonattainment). Coos County is part of the Southwest Oregon Interstate AQCR and is designated as "attainment" (criteria pollutant concentrations are below the NAAQS) or "unclassifiable" for all of the NAAQS. The NAAQS and the ambient concentrations of criteria pollutants at the nearest ambient air monitoring stations are shown in table 4.12.1.2-1. The monitoring stations selected (Portland for SO_2, CO, and NO_2; Eugene for PM_{10}; and Cottage Grove for ozone and $PM_{2.5}$) are located between approximately 65 and 165 miles from the Jordan Cove LNG Project. These were the closest available stations for each respective pollutant.

TABLE 4.12.1.2-1

Existing Air Quality Concentrations for Criteria Air Pollutants Near the Jordan Cove LNG Project

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	State AAQS	Nearest Ambient Monitoring Site(s)	Monitor Value g/	Background as Fraction of NAAQS
SO_2 (µg/m^3)	1-Hour a/	197	NA	197	Portland	10.5	0.05
	3-Hour b/	NA	1,300	1,300		21.0	0.02
	24-Hour b/	365	NA	260		5.3	0.02
	Annual	80	NA	52		0	0.00
CO (µg/m^3)	1-Hour b/	40,000	NA	40,000	Portland	2,740	0.07
	8-Hour b/	10,000	NA	10,000		2,100	0.21
NO_2 (µg/m^3)	1-Hour c/	188	NA	188	Portland	54.5	0.29
	Annual	100	100	100		17	0.17
Ozone (ppm)	8-Hour d/	0.070	0.070	0.070	Cottage Grove	0.061	0.87
PM_{10} (µg/m^3)	24-Hour b/	150	150	150	Eugene	53	0.35
$PM_{2.5}$ (µg/m^3)	24-Hour e/	35	35	35	Cottage Grove	22	0.63
	Annual f/	12.0	12.0	12		8.2	0.68

a/ NAAQS applies to the 3-year average of the annual (99th percentile) of the daily max.1-hour avg. concentration.
b/ NAAQS is not to be exceeded more than once per calendar year.
c/ NAAQS applies to the 3-year average of the annual (98th percentile) of the daily max. 1-hour avg. concentration.
d/ NAAQS applies to the 3-year average of the annual 4th highest daily max. 8-hour avg. concentration.
e/ NAAQS applies to the 3-year average of the annual 98th percentile 24-hour concentration.
f/ NAAQS applies to the 3-year average of annual concentrations.
g/ For 1-hr SO_2, 1-hr NO_2 ,8-hr ozone, and 24-hour $PM_{2.5}$ the values in this column are the 3-year (2013–2015) averages that the NAAQS applies to. For other pollutants the annual values shown in this column represent the maximum concentrations seen in 2013-2015 and the shorter-term values are high second-high concentrations.

In addition to the NAAQS identified in table 4.12.1.2-1, states are allowed to set more stringent ambient air quality standards. While Oregon has adopted state AAQS that match the NAAQS in most cases, it has set more stringent AAQS for SO_2, as shown in table 4.12.1.2-1.

Each of the criteria pollutants in table 4.12.1.2-1, except ozone, are emitted directly; ozone can also be emitted directly by a few sources but is predominantly a result of reactions between NO_x—predominantly NO_2 and nitrogen oxide (NO)—and VOCs in the air, particularly in the warmer months. For this reason, emissions inventories often refer to NO_x and VOCs as criteria pollutants as well.

In addition to the criteria pollutants, other types of air pollutants include "air toxics" (as defined by ODEQ 340-246)—which include but are not limited to chemicals designated as HAPs by EPA. Air toxics are a set of chemicals and chemical classes that often have carcinogenic, mutagenic, or other especially hazardous properties; most are subsets of criteria pollutants (i.e., several air toxics exist in the form of particulate matter and/or can be classified as VOCs). Ambient air quality standards do not typically exist for these pollutants; ODEQ regulations identify "ambient benchmarks" for some, but not all, and existing monitoring stations do not monitor all of these chemicals either. Aggregate impacts of air toxics are often assessed in terms of the lifetime cancer risk and respiratory hazard index, which are calculated based on conservatively determined cancer risk factors and reference exposure levels. EPA's latest National Air Toxics Assessment (for calendar year 2014) shows that regionally, the lifetime cancer risk associated with ambient air toxics concentrations in Coos Bay and the surrounding area is 30 in a million or less, and the respiratory hazard index is approximately 0.50 or less (EPA 2018c). A respiratory hazard index of less than 1 means that ambient air toxics are unlikely to cause adverse respiratory health effects over a lifetime of exposure.

The term "greenhouse gases" (GHG) refers to the gases and aerosols that occur in the atmosphere both naturally and as a result of human activities, such as the burning of fossil fuels. The primary GHGs are CO_2, methane, and nitrous oxide. GHGs are non-toxic and non-hazardous at normal ambient concentrations, and there are no applicable ambient standards or emission limits for GHG. However, unlike criteria pollutants and air toxics, GHG concentrations have been increasing over time and are continuing to increase. Elevated levels of GHGs are the primary cause of warming of the climatic system.

Emissions of GHGs are typically quantified and regulated in units of carbon dioxide equivalents (CO_2e). The CO_2e takes into account the global warming potential (GWP) of each GHG. The GWP is the measure of a particular GHG's ability to absorb solar radiation as well as its residence time within the atmosphere. The GWP allows comparison of global warming impacts between different gases; the higher the GWP, the more that gas contributes to climate change in comparison to CO_2. Thus, CO_2 has a GWP of 1, methane has a GWP of 25, and nitrous oxide has a GWP of 298.[186]

The Pacific Connector pipeline would pass through predominantly rural areas in Coos, Douglas, Jackson, and Klamath Counties. The Klamath Compressor Station would be located within an agricultural area approximately 1.8 miles northeast of Malin in Klamath County. The areas through

[186] These GWPs are based on a 100-year time period. We have selected their use over other published GWPs for other timeframes because these are the GWPs the EPA has established for reporting of GHG emissions and air permitting requirements. This allows for a consistent comparison with these regulatory requirements.

which the pipeline would pass and in which the compressor station would be located all attain all ambient air quality standards (see section 4.12.1.1), with the exception that approximately 325 feet of pipeline in construction spread 5, between MPs 199 and 200, would be located within the Klamath Falls PM_{10} maintenance area (i.e., an area that currently attains the PM_{10} standard, but was formerly designated as a nonattainment area). The compressor station would be located approximately 14 miles to the southeast of the southeast corner of the nonattainment area. (An additional 4.3 miles of pipeline would be located within the Klamath Falls nonattainment area for the 2006 24-hour $PM_{2.5}$ standard. However, the 2006 $PM_{2.5}$ standard was superseded by the 2012 $PM_{2.5}$ standard, for which the entire pipeline route is in attainment.)

Background air quality data near the compressor station are presented in table 4.12.1.2-2. For SO_2, CO, and NO_2, the nearest active monitors are located in Boise, Idaho for SO_2 and CO (280 miles to the northeast), and in Eureka, California for NO_x (165 miles to the southwest). Because of these great distances, the nearest monitors are not considered to be representative of the ambient air quality near the compressor station location. Therefore, background concentrations are based on values predicted by NW AIRQUEST (2018) Criteria Pollutant Design Value maps and lookup tables. The background concentrations shown for PM_{10} and $PM_{2.5}$ represent the worst-case values recorded by monitors in Klamath, Jackson, and Lane Counties, which respectively are closest to the eastern, central, and western portions of the pipeline. Wildfires in 2014-2015 caused elevated $PM_{2.5}$ near Klamath Falls, resulting in an exceedance of the 24-hour 98th percentile 3-year average for 2013-2015. The ODEQ submitted an exceptional event demonstration in April 2017 requesting that the EPA exclude $PM_{2.5}$ data affected by the wildfire events. The EPA has concurred that a portion of the August 2015 data was affected by an exceptional event, but no formal regulatory action has been taken to exclude the data.

TABLE 4.12.1.2-2

Existing Air Quality Near Proposed Klamath Compressor Station

Air Pollutant	Averaging Period	Most Stringent AAQS	Background Concentration	Background Based On
SO_2 (µg/m^3)	1-Hour a/	197	1.0	Design values for 2009-2011 estimated using NW AIRQUEST (2018)
	3-Hour b/	1,300	1.0	
	24-Hour b/	260	0.8	
	Annual	52	0.5	
CO (µg/m^3)	1-Hour b/	40,000	942	Design values for 2009-2011 estimated using NW AIRQUEST (2018)
	8-Hour b/	10,000	708	
NO_2 (µg/m^3)	1-Hour c/	188	8.1	Design values for 2009-2011 estimated using NW AIRQUEST (2018)
	Annual	100	1.3	
Ozone (ppm)	8-Hour d/	0.070	0.065	Data from Jackson County (Medford) for 2013-2015
PM_{10} (µg/m^3)	24-Hour b/	150	71	Data from Jackson County (Medford) for 2013 (no record)
	Annual	50	-	
$PM_{2.5}$ (µg/m^3)	24-Hour e/	35	40 g/	Data from Jackson County (Medford) for 2013-2015
	Annual f/	12.0	11 g/	

µg/m^3 = microgram per cubic meter
a/ AAQS applies to the 3-year average of the annual (99th percentile) of the daily max.1-hour avg. concentration.
b/ AAQS is not to be exceeded more than once per calendar year.
c/ AAQS applies to the 3-year average of the annual (98th percentile) of the daily max. 1-hour avg. concentration.
d/ AAQS applies to the 3-year average of the annual 4th highest daily max. 8-hour avg. concentration.
e/ AAQS applies to the 3-year average of the annual 98th percentile 24-hour concentration.
f/ AAQS applies to the 3-year average of annual concentrations.
g/ May include data deemed part of the "exceptional event" due to wildfires in the region during 2014 and 2015.

4.12.1.3 Jordan Cove LNG Project Impacts

Construction Air Quality Impacts

During construction, a temporary reduction in ambient air quality may result from emissions and fugitive dust generated by construction equipment. Fugitive dust emission levels would vary in relation to moisture content, composition, and volume of soils disturbed. Fugitive dust and other emissions from construction activities generally do not result in a significant increase in regional pollutant levels, although local pollutant levels could increase temporarily.

Construction air pollutant emissions include exhaust and crankcase emissions from construction equipment, vehicles that transport workers and materials, and vessels that transport equipment and construction materials. Emissions of criteria pollutants from construction activities by year are shown in table 4.12.1.3-1. Emissions would occur over the duration of construction activity, which is anticipated to last five years. The construction emission totals during year 5 including emissions from commissioning and startup of the LNG Project facilities.

Construction tasks for which emissions were estimated include the following broad categories of activity:

- **Site Preparation:** Includes demolition, clearing, and removal of vegetation or existing structures on site; construction of an MOF and TMBB for delivery of construction materials; topsoil removal, cut/fill, and grading of the site; dredge spoil placement; soil improvement to stabilize it against settling and seismic events;
- **Underground Structures:** Includes installation of pilings for the LNG Project structures and marine slip; laying storm drains, utility lines, fire water piping, process piping, and duct banks; construction of all foundations, including the LNG storage tanks, process equipment, and pipe racks; and site restoration, road paving, and landscaping;
- **Marine Facilities:** Includes derrick barges for dredging of the slip basin and access channel; land-based construction equipment to construct the slip face and install armoring; installation of a sheetpile retaining wall; installation of pilings for marine structures, and installation of LNG carrier loading facilities;
- **Marine Waterway Modification:** Includes excavation of submerged areas adjacent to the shipping channel;
- **LNG Storage Tank Construction:** Includes construction of outer concrete foundation, walls, and roof; construction of interior steel plate floor, walls, and roof; hydrostatic pressure testing of the inner tank and pneumatic testing of the outer tank; and installation of insulation, including expanded perlite between the wall liner and inner tank wall;
- **Aboveground Structures:** Includes installation of all process facilities, including both pre-fabricated modules and structures built onsite; installation of aboveground piping; and installation of electrical wiring and instrumentation; and
- **Miscellaneous Construction:** Includes various construction tasks not listed above, including the operation of an on-site concrete batch plant.

TABLE 4.12.1.3-1

Estimated Emissions from Terminal Construction Activities, By Year (tons)

Year	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$	HAP	GHG (as CO_2e)
Year 1	120	351	0.35	23	268	39	7.4	53,397
Year 2	184	404	0.43	32	310	100	11.0	66,708
Year 3	199	269	0.33	31	192	87	11.3	52,768
Year 4	81	43	0.08	10	18	17	3.7	13,615
Year 5 (plus commissioning emissions)	85	72	20.94	71	209	68	4.1	925,856
Total	**669**	**1,139**	**22.13**	**167**	**997**	**311**	**37.5**	**1,112,344**

To mitigate construction-related emissions, all construction equipment would be maintained in accordance with manufacturers' recommendations and engine idling time would be minimized. As required by federal regulations, construction equipment would combust diesel fuel with no more than 0.0015 percent sulfur, and vessels would combust fuel that complies with International Convention for the Prevention of Pollution from Ships and EPA standards for sulfur content. Additionally, Jordan Cove would implement the following measures to mitigate construction emissions from mobile and temporary stationary sources:

- reduce use, trips, and unnecessary idling of heavy equipment.
- maintain and tune engines per manufacturer's specifications to perform EPA certification levels, where applicable, and to perform at verified standards applicable to retrofit technologies. Employ periodic, unscheduled inspections to limit unnecessary idling and to ensure that construction equipment is properly maintained, tuned, and modified consistent with established specifications.
- prohibit any tampering with engines and require continuing adherence to manufacturer's recommendations.
- use construction equipment engines that incorporate modern pollution control technology. If practicable, lease new, clean equipment meeting the most stringent of applicable federal or state standards.

To mitigate fugitive dust emissions during construction, Jordan Cove would spray water or use dust suppressants on disturbed soil and access roads. The frequency and methodology of dust suppression would depend on the specific construction activities, terrain, soil conditions, and weather conditions. Additionally, Jordan Cove would implement the following measures to mitigate construction emissions due to fugitive dust:

- use of large off-road equipment for excavation and hauling operations to complete the work in the shortest time and least number of trips;
- stabilization of open storage piles and disturbed areas by covering and/or applying water or chemical/organic dust palliative where appropriate. This applies to both inactive and active sites, during workdays, weekends, holidays, and windy conditions. Installing wind fencing, and phase grading operations, where appropriate, and operate water trucks for stabilization of surfaces under windy conditions;

- pre-wetting of material before excavation in selected areas;
- use of wheel-washing stations to prevent trackout of materials onto public roads;
- use of street sweepers to clean any materials inadvertently tracked onto public roads near the project site; and
- when hauling material and operating non-earthmoving equipment, prevent spillage by covering loads, limiting fill height in trucks, and training operators in the proper hauling and loading of material.

The effect of construction emissions on ambient air quality would vary with time due to the construction schedule, the mobility of the sources, and the variety of emission sources. Fugitive dust and other emissions due to construction activities generally do not pose a significant increase in regional pollutant levels; however, local pollutant levels would increase during the construction period. Based on the duration and scope of construction activities, we determine that construction of the Project would impact local air quality. However, construction emissions would not have a long-term, permanent effect on air quality in the area.

Operational Air Quality Impacts

Operational emissions from the Project include those from the Jordan Cove LNG Project sources, fugitive emissions from evaporative losses, and emissions from the LNG carriers and tugboats (including emissions in the waterway). These emissions are summarized in table 4.12.1.3-2 for routine operation. Commissioning emissions are included in year 5 of the construction emissions in table 4.12.1.3-2.

TABLE 4.12.1.3-2

Estimated Emissions During Operation of the Jordan Cove LNG Project (tons per year)

Source	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$	HAP	GHG (as CO_2e)
Combustion Turbines	97.82	81.99	35.19	32.72	112.26	112.26	5.06	1,292,706
Combustion Turbines Startup/Shutdown	0.73	0.23	4.4E-03	0.10	0.11	0.11	6.2E-04	188
Thermal Oxidizer	38.50	63.25	19.84	1.08	3.85	3.85	0.96	622,154
Auxiliary Boiler	1.16	0.96	0.36	0.67	1.3	1.3	0.24	15,193
Firewater Pump Engines	0.80	1.59	2.1E-03	4.5E-02	9.0E-02	9.0E-02	3.6E-03	241
Backup Generator Engines	0.28	3.33	2.5E-03	0.04	0.04	0.04	4.1E-03	278
Black Start Generator Engines	0.21	1.49	8.8E-03	0.09	0.05	0.05	1.5E-02	1,002
Flares	3.90	0.86	3.9E-02	8.31	0.38	0.38	4.3E-02	2,177
Gas-Up	9.5	2.09	0.16	17.53	1.12	1.12	3.8E-02	4,351
Fugitive Emissions	0	0	0	7.98	0	0	1.77	13,116
Aggregate Insignificant Emissions	1.0	1.0	1.0	1.0	1.0	1.0	--	--
LNG Carriers a/	36.68	48.68	9.5	9.47	3.31	3.31	--	14,653
Tugs	17.68	9.51	2.6	1.00	0.32	0.32	--	3,736
Total	**208.26**	**214.98**	**68.71**	**80.04**	**123.83**	**123.83**	**8.13**	**1,969,795**

a/ Values are based on 120 vessel calls per year, assuming worst-case emissions (i.e., vessel type with the highest emissions) for each pollutant. Emissions estimated at 2.2 nautical miles from the Oregon coastline.

Commissioning and Start-Up Emissions: Commissioning of the Jordan Cove LNG Project is planned to occur during year 5 of construction. Table 4.12.1.3-2 includes estimated commissioning and operating emissions from all of the terminal stationary sources in year 5, including compressor turbines and duct burners, startup/shutdown emissions, auxiliary boiler, thermal oxidizer, flares, emergency engines, and fugitive emissions.

Routine Operation: The following sources are expected to operate continuously during routine operation:

- five combustion turbines for the refrigeration compressors;
- one thermal oxidizer;
- flare pilot flames for the enclosed marine flare and multipoint ground flare;
- two LNG storage tanks; and
- fugitive emission sources (valves, flanges, and other equipment).

Intermittent Operation: The following sources or activities would only operate intermittently. The auxiliary boiler would provide high-pressure steam if none of the LNG trains are operating, and the other intermittent sources would only operate during startup or shutdown events, planned maintenance, process upsets, readiness testing, or emergency situations:

- combustion turbine startup and shutdown events;
- one auxiliary boiler;
- one enclosed marine flare;
- one multipoint ground flare;
- two diesel black-start engines;
- two backup engines;
- three fire water pump engines; and
- up to 120 LNG carriers per year, with one tugboat attending each carrier.

The Jordan Cove LNG Project would remain below PSD major source thresholds for emissions of all criteria pollutants, HAP, and GHG, but would be a Title V major source for emissions of NO_x, CO, PM_{10}, and $PM_{2.5}$. As described above, a Type B state-only NSR application was submitted to ODEQ in September 2017.

For the criteria pollutants, dispersion modeling of the combined impacts of the terminal and LNG carriers/tugs was conducted using version 16216r of EPA's preferred dispersion model (AERMOD). Secondary formation of PM was also accounted for in accordance with EPA guidance, by adding the expected secondary formation of $PM_{2.5}$ from NO_x and SO_2 emissions to the modeled result for direct $PM_{2.5}$ impacts. For the permitting of just the stationary sources, regulations state that if worst-case impacts from worst-case project emissions are below the "significant" levels identified in OAR 240-200-0020 Table 1 (which are well below the NAAQS standards in table 4.12.1.2-1 and the PSD increments in 4.12.1.3-2), there is no need to quantitatively model impacts from other nearby sources as well. The ACDP permit application showed that 1-hour SO_2 impacts, as well as short-term and annual impacts for NO_2, $PM_{2.5}$, and PM_{10}, were above "significant" levels. Therefore, multisource modeling was conducted which incorporated emissions from eight other nearby facilities (RFP, Westrum Funeral Services, Bandon Concrete, Southport Forest Products, Allweather Wood, LTM Incorporated, Coastal Cremation and Funeral Services, and Georgia-Pacific Wood Products). The multisource modeling also included emissions from LNG carriers/tugs. Results are shown in table 4.12.1.3-3.

TABLE 4.12.1.3-3

Maximum Combined Impacts of Jordan Cove LNG Project, Marine Vessels, and Nearby Major Sources

Air Pollutant	Averaging Period	Maximum Cumulative Impact	Class II Increment	Maximum Cumulative Impact + Background	AAQS
SO_2 (µg/m^3)	1-Hour	30.1	NA	33.2	199
NO_2 (µg/m^3)	1-Hour	132.3	NA	148.3	188
	Annual	4.1	25.0	6.0	100
PM_{10} (µg/m^3)	24-Hour	9.3	30.0	44.3	150
	Annual	1.4	17.0	1.4	NA
$PM_{2.5}$ (µg/m^3)	24-Hour	8.3	9.0	18.2	35.0
	Annual	1.7	4.0	8.4	12.0

µg/m^3 = microgram per cubic meter

For all pollutants, the combined impacts at the points of highest concentration are below the applicable NAAQS and the PSD increments. Impacts on the distant Class I areas[187] are discussed in section 4.12.1.5. Therefore, we conclude that based on the maximum predicted impacts of the LNG terminal and LNG carriers, in addition to nearby major sources, there would be no significant impacts on regional air quality.

4.12.1.4 Pacific Connector Pipeline Project Impacts

Construction Air Quality Impacts

Construction of the pipeline and compressor station would result in a temporary increase in emissions due to the combustion of fuel in vehicles and equipment, dust generated from soil disturbance, and general construction activities (e.g., painting and welding). Pipeline construction spread activities would occur in sequence or in assembly-line fashion along the right-of-way with one crew following the next from clearing until final cleanup. Emissions from any given stage of construction would therefore be spread out along the construction corridor due to the sequence/assembly-line nature of the work, rather than being concentrated in a specific stationary location. As work proceeds, there are often small periods between job tasks when work at a specific location on the right-of-way is delayed such as between trenching and pipe stringing or pipe stringing and welding. As the work crews move along the corridor, the construction equipment would produce emissions and these emission sources would move along the corridor as work progresses. Local residents nearby to construction may notice a localized increase in dust (i.e., directly around the Project area) from construction activities; however, Pacific Connector would spray water on the right-of-way, and may use Dustlock®, in addition to water, for dust control. Pipeline construction crews would move quickly down the right-of-way in a linear fashion, and few locations would see sustained construction for significant lengths of time.

Pacific Connector estimated total pollutant emissions from the entire duration of construction activities, as detailed in table 4.12.1.4-1. Helicopters may be used during logging for right-of-way clearance; however, their use is uncertain and, due to the limited scope and duration of the activity, the associated emissions were not quantified.

[187] Areas designated as "Class I" include international parks and various national wilderness areas and parks above specified sizes.

TABLE 4.12.1.4-1

Estimated Emissions from Construction of the Klamath Compressor Station and Pacific Connector Pipeline (tons)

Source	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$	HAP	GHG (as CO_2e)
Compressor Station – Fugitive Dust on Unpaved Roads	0	0	0	0	4.67	0.47	0	0
Compressor Station – Fugitive Dust from Materials Handling	0	0	0	0	2.04	2.04	0	0
Compressor Station – Construction Equipment Exhaust	1.48	1.52	0.07	0.29	0.21	0.20	0.22	378
Pipeline – Fugitive Dust from Materials Handling	0	0	0	0	146.32	146.32	0	0
Pipeline – Fugitive Dust from Roads	0	0	0	0	123.45	12.55	0	0
Timber Removal – Fugitive Dust from Roads	0	0	0	0	30.92	3.22	0	0
Pipeline (Spread 1) – Construction Equipment Exhaust	12.96	35.39	2.39	4.40	4.36	4.23	3.66	14,342
Pipeline (Spread 2) – Construction Equipment Exhaust	12.60	32.82	2.18	4.06	3.99	3.87	3.37	13,099
Pipeline (Spread 3) – Construction Equipment Exhaust	10.58	25.77	1.64	3.10	3.02	2.93	2.56	9,784
Pipeline (Spread 4) – Construction Equipment Exhaust	9.10	23.56	1.52	2.79	2.82	2.73	2.34	9,082
Pipeline (Spread 5) – Construction Equipment Exhaust	8.06	20.11	1.33	2.50	2.46	2.39	2.09	8,003
Total	**54.78**	**139.17**	**9.13**	**17.14**	**324.26**	**180.95**	**14.24**	**54,688**

Emissions from construction equipment have been reduced over time as a result of the federal regulations for mobile engines and fuels, and measures would be taken by Pacific Connector to minimize fugitive dust. The predominant source of PM is fugitive dust (for which emissions estimation procedures have typically largely over-predicted emissions compared to what is seen in ambient measurements) (Watson and Chow 2000; Countess Environmental 2001). Pacific Connector would implement the following measures to mitigate the air emissions during pipeline construction:

Fugitive Dust Source Controls:

- Limit drop heights of soil excavation activities.
- Water the right-of-way, laydown areas, and temporary roads at least daily in areas of active construction, if necessary.
- Control project-related traffic speeds on dirt access roads and on linear facility rights-of-way.
- Ensure that speeds on the construction right-of-way would not exceed 15 mph where fugitive dust can be generated.
- Water gravel or dirt access roads in areas of heavy traffic, as determined necessary to control fugitive dust.
- Decrease speed limits when excessive winds prevail and where sensitive areas such as public roads may be adjacent to access roads or the right-of-way.
- Maintain speed limit signs for the duration of the construction activities and place them where access roads intersect the construction right-of-way.

- Water temporarily stockpiled soils to create a semi-hard protective layer to minimize wind erosion, if necessary.
- Ensure that wind erosion BMPs will be in place during forecasted high wind (greater than 25 mph) weather advisories (see the ECRP).

Mobile and Stationary Source Controls:

- Reduce use, trips, and unnecessary idling of heavy equipment.
- Maintain and tune engines per manufacturer's specifications to perform EPA certification levels, where applicable, and to perform at verified standards applicable to retrofit technologies. Employ periodic, unscheduled inspections to limit unnecessary idling and to ensure that construction equipment is properly maintained, tuned, and modified consistent with established specifications.
- Prohibit any tampering with engines and require continuing adherence to manufacturer's recommendations.
- Use construction equipment engines that incorporate modern pollution control technology. If practicable, lease new, clean equipment meeting the most stringent of applicable federal or state standards.

The impacts on ambient air quality from construction of the Klamath Compressor Station and Pacific Connector pipeline would vary with time due to the construction schedule, the mobility of the sources, and the variety of emission sources. Fugitive dust and other emissions due to construction activities generally do not pose a significant increase in regional pollutant levels; however, local pollutant levels would increase during the construction period. Based on the duration and scope of construction activities, we conclude that construction of the Project would impact local air quality. However, construction emissions would not have a long-term, permanent effect on air quality in areas adjacent to the construction corridor. In addition, emissions from pipeline construction would be distributed along the entire 229-mile-long construction corridor, greatly reducing localized impacts.

Operation Air Quality Impacts

Emissions of criteria pollutants from operation of the compressor station and pipeline are shown in table 4.12.1.4-2. Most of the emissions result from fuel combustion in the compressor station turbines, boiler, and standby generator. Fugitive emissions result from the normal leakage of small amounts of methane, VOC, and HAP compounds from valves, flanges, and other components in the compressor station piping, as well as meter stations or valve sites along the pipeline. Venting emissions result from infrequent process upsets and planned maintenance activities.

TABLE 4.12.1.4-2

Criteria Pollutant Emissions from Operation of Klamath Compressor Station and Pacific Connector Pipeline (tons per year)

Source	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$	HAPs	GHGs (as CO_2e)
Compressor Station Turbines a/	146.4	144.6	8.7	9.9	17.1	17.1	2.88	379,251
Compressor Station Fugitive Emissions	0	0	0	7.3	0	0	0.27	10,307
Boiler a/	2.7	1.6	0.02	0.18	0.25	0.25	0.06	3,912
Generator	0.6	0.3	0.00	0.2	0.01	0.00	0.04	88
Pipeline Fugitive and Venting Emissions	0	0	0	1.01	0	0	--	162
Total	**149.7**	**146.5**	**8.72**	**18.59**	**17.36**	**17.35**	**3.25**	**393,720**

a/ Based on maximum potential emissions for all three turbines and boiler operating continuously at their rated capacities, with the exception that turbine operation at temperatures below 0 degrees Fahrenheit is excluded. This value corresponds to the potential-to-emit (PTE) for the Project based on the permitted number of turbines.

Routine Operation: The following compressor station and pipeline sources are expected to operate continuously during routine operation:

- three combustion turbines for the compressor drives;
- one boiler;
- compressor station fugitive emission sources (condensate tank, valves, flanges, and other equipment); and
- pipeline fugitive emission sources (valves, flanges, and other equipment at three meter and regulator stations).

Intermittent Operation: The following sources or activities would only operate intermittently, during startup or shutdown events, planned maintenance, process upsets, readiness testing, or emergency situations:

- one standby generator engine; and
- periodic venting and blowdown events, estimated at three major blowdown events per year.

The compressor station would remain below PSD major source thresholds for emissions of all criteria pollutants, HAP, and GHG, but would be a Title V major source for emissions of NO_x and CO. Pacific Connector submitted a standard ACDP initial application to ODEQ in May 2015 and submitted a modification to its standard ACDP application in September 2017.

Potential emissions of HAP from the turbines, boiler, and generator are estimated to be just 1.3 TPY. Potential emissions of four pollutants at the Klamath Compressor Station (NO_x, CO, PM_{10}, and $PM_{2.5}$) exceed the Significant Emission Rate threshold at OAR 340-200-0020 and require a dispersion modeling analysis. Potential emissions of SO_2 are below the Significant Emission Rate, but modeling of SO_2 was also performed as requested by the FERC. A screening model (AERSCREEN) was used for all pollutants and averaging periods with the exception of 1-hour NO_2 and 24-hour $PM_{2.5}$, which were modeled twice, first with AERSCREEN and then with AERMOD. AERMOD is a more refined model that allows the use of hourly meteorological data and produces a less conservative result than AERSCREEN. Modeling results are presented in table 4.12.1.4-3. Pacific Connector filed an ACDP air permit application with ODEQ in 2015, and the modeling was performed in accordance with the modeling protocol that was approved by ODEQ at that time. ODEQ may request updates to that modeling protocol as part of the state air permitting process.

Based on the results of the screening analysis using AERSCREEN, and the refined AERMOD analysis for 1-hour NO_2 and 24-hour $PM_{2.5}$, we conclude that the Project would not have a significant impact on regional air quality.

TABLE 4.12.1.4-3

Screening-Level CO and NO_2 Impacts from Compressor Station Turbines

Air Pollutant	Averaging Period	Model	Maximum Impact	Background a/	Maximum Impact + Background	AAQS
NO_2 (µg/m^3)	1-Hour	AERMOD	96.4 b/	10.0	106.4	188
	Annual	AERSCREEN	29.6 b/	2.1	31.7	100
CO (µg/m^3)	1-Hour	AERSCREEN	433	993	1,426	40,000
	8-Hour	AERSCREEN	390	748	1,138	10,000
PM_{10} (µg/m^3)	24-Hour	AERSCREEN	32	32	64	150
$PM_{2.5}$ (µg/m^3)	24-Hour	AERMOD	4.2	17	21.2	35
	Annual	AERSCREEN	5.3	5.3	10.6	12
SO_2 (µg/m^3)	1-Hour	AERSCREEN	26.5	1.3	27.8	196
	3-Hour	AERSCREEN	26.5	1.3	27.8	1,300
	24-Hour	AERSCREEN	23.9	0.8	24.7	NA
	Annual	AERSCREEN	2.65	0.5	3.1	NA

a/ Background concentrations based on design values for 2009-2011 estimated using NW AIRQUEST.
b/ Based on an assumed in-stack NO_2 to NO_X ratio of 0.19.

4.12.1.5 Environmental Consequences on Federal Lands

A quantitative analysis of air quality impacts from potential stationary emissions sources at the Jordan Cove LNG Project (but not the marine vessels or other major sources that obtained permits since the baseline dates) was conducted for Class I areas within 200 kilometers (km) of the Project site. First, AERMOD was used to evaluate impacts at receptors placed at a radius of 50 km from the Project site (the farthest distance for which AERMOD is recommended for use). If modeled impacts at all of the 50 km receptors were below the significant impact level (SIL) for a given pollutant and averaging period, then it was presumed that impacts would also be below the SIL at each Class I area (ranging in distance from 110 to 178 km from the Project site).

However, if modeled impacts at 50 km were above a SIL, then further analysis was conducted to simulate what impacts would be at the nearest boundary of each Class I area. This simulation was performed by selecting the receptor along the 50-km radius that had the highest modeled concentration (i.e., impact) when averaged over five years, and then comparing that impact at 50 km to the five-year average impact at a receptor located just 1 km from the Project site, in the direction of the maximum-impact 50 km receptor. The results at the 1-km and 50-km receptors were then extrapolated (using an exponential decay function) to evaluate impacts at the distance of each Class I area.

The results of this analysis are shown in table 4.12.1.5-1 and indicate that impacts from the Jordan Cove LNG Project at all Class I areas would be well below the SILs.

TABLE 4.12.1.5-1

Maximum Impacts of Jordan Cove LNG Project at Class I Areas

Air Pollutant	Averaging Period	Maximum Impact at 50 km	Maximum Impact at Class I Area Boundary	Class I SIL a/
SO_2 (µg/m^3)	3-Hour	1.33	0.24	1.0
	24-Hour	0.35	0.023	0.2
	Annual	0.012	N/A	0.1
NO_2 (µg/m^3)	Annual	0.032	N/A	0.1
PM_{10} (µg/m^3)	24-Hour	0.854	0.061	0.3
	Annual	0.026	N/A	0.2
$PM_{2.5}$ (µg/m^3)	24-Hour	0.854	0.061	0.07
	Annual	0.026	N/A	0.06

a/ SILs are based on the first highest concentration at any one location.
µg/m^3 = microgram per cubic meter

In addition to the modeling analysis described above, a screening test was also performed for Air Quality Related Values (AQRV) at Class I areas. This screening test is used by federal land managers to determine whether a source more than 50 km from a Class I area is likely to have any adverse impact on an AQRV, such as visibility impairment. If the ratio of emissions in tons per year (Q) divided by the distance to a Class I area in km (D) is less than 10, then a source is considered not to cause or contribute to a visibility impairment. This screening calculation showed that the Q/D ratio for combined annual emissions of NO_x, SO_2, and PM from stationary sources at the Jordan Cove LNG Project was less than or equal to 10, indicating that no further Class I AQRV impact analyses are required.

Air pollution regulations treat other (Class II) federal lands in the same manner as non-federal Class II lands. The nearest federal lands in the vicinity of the Jordan Cove LNG Project include the ODNRA immediately north, and COE and BLM land on the North Spit. The pipeline route would cross various parcels of Class II areas administered by the BLM, Forest Service, and Reclamation. Dispersion modeling of terminal operations illustrated that impacts at the locations nearest the terminal would be less than the maximum Class II impacts identified above in section 4.12.1.3.

The closest Class I area to the Klamath Compressor Station is Lava Beds National Monument in California. This Class I area is approximately 37 km (about 23 miles) to the southwest of the compressor station site. A Class I AQRV screening analysis for potential impacts from compressor station operational emissions on Lava Beds National Monument shows that the Q/D ratio is much less than 10, indicating that no further Class AQRV impact analyses are required.

The pipeline route would pass closest to the Mountain Lakes Wilderness Class I area. The shortest distance between the Mountain Lakes Wilderness boundary and the pipeline is 4.5 miles (7.3 km), located at about MP 172.5. Pipeline construction spread 5 would operate between MPs 169.5 and 228.8, a total distance of 59.3 miles (95.4 km). Thus, emission sources for construction spread 5 would vary in distance from Mountain Lakes as the spread moves along the right-of-way. The potential air quality impact on Mountain Lakes would decrease as the distance between construction spread activity and Mountain Lakes increases (as the spread moves away from the closest point to Mountain Lakes). Pipeline construction would generally occur at a steady pace; therefore, it is reasonable to expect that these construction emissions for spread 5 would be evenly distributed throughout the spread 5 construction corridor (except for in areas where terrain or other factors slow the rate of construction). For the pollutants of highest concern, emissions expected per kilometer of pipeline route would only be 0.21 ton/km of NO_x, 0.01 ton/km of SO_2, and 1.56 ton/km of PM_{10}. Applying the Class I AQRV screening analysis mentioned above to these emissions again results in impacts far below the screening criteria.

Pacific Connector would consult with the federal land managers of Class I areas during the air permit process. For the Class II federal lands areas that are crossed by the pipeline, construction sources would have only a temporary impact on air quality and there are no operational sources of emissions located in those areas (i.e., the terminal and compressor station are not located on or near federal lands).

Terminal sources are distant from federal lands. The nearest Class I area is more than 100 km (about 62.1 miles) away, and a quantitative air quality impact analysis, as summarized in table 4.12.1.5-1, shows that impacts from the Jordan Cove LNG Project would not be significant on federal lands. About 71 miles of pipeline route would cross federal lands. Emissions associated with pipeline construction activities are very low; and these activities would be temporary and transient as crews move in a linear fashion along the right-of-way. Therefore, based on the analysis presented above, Pacific Connector's commitment to consult with federal land managers of Class I areas, and the temporary nature of construction emissions on Class II areas, we conclude that the Project would not adversely affect air quality on federal lands.

4.12.1.6 Conclusion

Constructing and operating the Project would result in sort and long-term impacts on air quality. However, based on the implementation of the required BMPs, the Project would not significantly affect air quality.

4.12.2 Noise and Vibration

Noise would affect the local environment during both the construction and operation of the Project. At any location, both the magnitude and frequency of environmental noise may vary considerably over the course of the day and throughout the week. For construction activities, this variation in noise levels is caused primarily by changes in equipment operations and activity locations. For operational noise conditions, this variation is caused in part by variations in operational activities, changing weather conditions, and the effects of seasonal vegetative cover. In this section of the EIS, analysis of potential noise impacts on human receptors are discussed, while noise impacts on wildlife are addressed in sections 4.5 and 4.6.

Noise can be measured and quantified using many different metrics. Some of the most commonly used metrics used by federal agencies and presented in subsequent sections of this EIS are the equivalent sound level (L_{eq}), day-night sound level (L_{dn}), and the maximum sound level (L_{max}). Conventionally expressed in dBA, the L_{eq} is the energy-averaged, A-weighted sound level for the complete time period. It is defined as the steady, continuous sound level over a specified time, which has the same total sound energy as the actual varying sound levels over the specified period. The L_{dn} measures the 24-hour average noise level at a given location. It was adopted by the EPA for developing criteria for the evaluation of community noise exposure and also by the FERC when assessing noise. The L_{dn} is calculated by averaging the 24-hour hourly L_{eq} levels at a given location after adding 10 dB to the nighttime period (10:00 p.m. to 7:00 a.m.) to account for the increased sensitivity of people to noises that occur at night. The L_{max} sound level can be used to quantify the maximum instantaneous sound pressure level over a given measurement period or maximum sound generated by a source. The human ear's threshold of perception for noise change is considered to be 3 dBA; 6 dBA is clearly noticeable to the human ear, and 10 dBA is perceived as a doubling of noise (Bies and Hansen 1988).

4.12.2.1 Regulatory Requirements for Noise

Federal Noise and Vibration Criteria

In 1974, the EPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (EPA 1974). This publication evaluates the effects of environmental noise with respect to health and safety. The document provides information for state and local governments to use in developing their own ambient noise standards. The EPA has determined that in order to protect the public from activity interference and annoyance outdoors in residential areas, noise levels should not exceed an L_{dn} of 55 dBA. The FERC has adopted this criterion for new compression and associated pipeline facilities, and it is used here to evaluate noise emissions from operation of the Project. An L_{dn} of 55 dBA is equivalent to a continuous noise level of 48.6 dBA L_{eq} for facilities that operate at a constant level of noise. Therefore, a constant sound level of less than 48.6 dBA L_{eq} would ensure compliance with the FERC requirement limiting the L_{dn} at the nearest NSAs to less than or equal to 55 dBA.

The Commission has regulations in 18 CFR 380.12k(4)(v)(B) that state that any new or modified facility may not result in an increase in perceived vibration. In addition, the American National Standards Institute (ANSI) published ANSI S12.2-2008 that identifies criteria for sound pressure levels that should not be exceeded to avoid moderately perceptible vibration and rattle inside a room. These criteria are 65 dB and 70 dB in the 31.5 hertz (Hz) and 63 Hz octave bands, respectively, and are used to assess vibration levels.

State Noise and Vibration Standards

The State of Oregon has established statewide noise limits for industrial and commercial noise sources (OAR, Chapter 340, Division 35). No statewide vibration limits have been established. The specified noise limits apply to either the property line location closest to the noise source or to locations 25 feet toward the noise source from the noise-sensitive building, whichever distance from the noise source is greater. Noise-sensitive property includes residences and other facilities normally used for sleeping, schools, churches, hospitals, and public libraries. The primary noise limits set by the Oregon regulations are based on the statistical distribution of varying noise levels during daytime and nighttime hours. Noise limits are specified in terms of three percentile levels: L_{50}, the noise level exceeded 50 percent of the time; L_{10}, the noise level exceeded 10 percent of the time, and L_{01}, the noise level exceeded 1 percent of the time. In addition to noise limits for noise-sensitive properties, Oregon noise regulations establish additional noise limits for industrial and commercial noise sources in or near designated quiet areas. Quiet areas are defined as land or facilities where the qualities of serenity, tranquility, and quiet are of extraordinary importance and serve a public need. The State of Oregon has not designated any quiet areas, but some local noise ordinances have done so (Beyer 2007). Noise limits established by the Oregon noise control regulations are summarized in table 4.12.2.1-1.

TABLE 4.12.2.1-1

Oregon Noise Limits For Industrial and Commercial Noise Sources

Percentile Noise Level In Any One Hour	Noise-Sensitive Properties Located Outside Designated Quiet Areas		Within Designated Quiet Areas at a Point 400 Feet or More from the Noise Source	
	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.
L_{50}	55 dBA	50 dBA	50 dBA	45 dBA
L_{10}	60 dBA	55 dBA	55 dBA	50 dBA
L_{01}	75 dBA	60 dBA	60 dBA	55 dBA

Notes: The noise limits in this table do not apply to noise from construction sites, agricultural or forestry operations, vehicle traffic, rail traffic, aircraft operations, and various other exempt sources.
Source: OAR 340-035-0035(1)(a), 340-035-0035(1)(b), and 340-035-0035(1)(c).

In addition to the overall dBA limits summarized in table 4.12.2.1-1, the Oregon noise regulations establish additional limits for discrete tones from industrial and commercial noise sources. These octave band noise limits are summarized in table 4.12.2.1-2.

TABLE 4.12.2.1-2

Octave Band Noise Limits For Industrial and Commercial Noise Sources

Center Frequency of Octave Band (Hertz)	Median Sound Pressure Level Limit a/	
	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.
31.5 Hz	68 dB	65 dB
63 Hz	65 dB	62 dB
125 Hz	61 dB	56 dB
250 Hz	55 dB	50 dB
500Hz	52 dB	46 dB
1,000 Hz	49 dB	43 dB
2,000 Hz	46 dB	40 dB
4,000 Hz	43 dB	37 dB
8,000 Hz	40 dB	34 dB

a/ The noise limits in this table do not apply to noise from construction sites, agricultural or forestry operations, vehicle traffic, rail traffic, aircraft operations, and various other exempt sources.
The noise limits in this table apply to either the property line location closest to the noise source or to locations 25 feet toward the noise source from the noise-sensitive building, whichever distance from the noise source is greater.
If noise levels for any 1/3 octave band exceeds the encompassing octave band limit by more than 10 dB, additional limitations may apply.
Source: OAR 340-035-0035(1)(f).

Oregon noise regulations also establish a numerical noise level increase standard for new industrial or commercial noise sources located on a previously unused site. The regulations limit the increase in hourly L_{10} and L_{50} noise levels as measured at noise-sensitive properties to 10 dBA above the ambient background L_{10} and L_{50} noise levels (OAR 340-035-0035(1)(b)(B)(i)). The 10 dBA operational noise increment standard does not apply to noise from construction activities, agricultural or forestry operations, vehicle traffic, rail traffic, aircraft operations, or various other exempt sources.

Local Noise Standards

The City of North Bend has a noise ordinance that prohibits the making of "unnecessary noise," but the ordinance does not establish specific numerical noise limits (North Bend City Code, Section 9.04.030). Daytime construction activity between the hours of 7 a.m. and 6 p.m. is exempt from the City of North Bend noise ordinance. The counties of Coos, Douglas, and Jackson, Oregon, do not have local noise ordinances. Klamath County cites compliance to occur when federal and/or state noise regulations are met (Klamath County 2010, Policy 5).

Underwater Noise Criteria

Potential underwater noise impacts on marine mammals and fish were also evaluated as part of the Project assessment. Applicable criteria are prescribed by NMFS and are provided in section 4.5.2.

Noise Levels

Existing noise levels are variable depending on location relative to the Project. Therefore, the existing sound environment is broken down by the Project area near the Jordan Cove LNG Project and areas near the Pacific Connector pipeline.

4.12.2.2 Existing Conditions

Jordan Cove LNG Project

The major existing anthropogenic noise sources in the vicinity of the Jordan Cove LNG Project include vehicle traffic on the Trans-Pacific Parkway and U.S. Highway 101, RV use in the ODNRA, and boat traffic on Coos Bay. Aircraft operations at the Southwest Oregon Regional Airport in North Bend are an additional intermittent anthropogenic noise source. Wind, birds, and insects contribute to natural background noise levels. There are no noise sensitive areas (NSAs) within 1 mile of the LNG terminal site.

Jordan Cove has conducted several baseline sound surveys in the vicinity of the Project including one in 2005, 2013 and one most recently in 2017 which collected data for approximately 30 minutes per measurement. All NSAs and distances to the LNG terminal are shown in figure M-1 in appendix M and are described below. The purple shaded area identifies the overall Project area. However, the Project facilities and majority of construction activities would occur in the western portion of the Project area. Noise generated from the eastern portions of the Project area would be minimal. The overall facility site plan is shown in figures 2.1-1 and 2.1-3 located in chapter 2.

- NSA 1 consists of single-family residences in a subdivision consisting of approximately 180 single-family residences located about 1.3 miles south of the LNG terminal noise-producing equipment in the city of North Bend along the south side of the bay adjacent to the airport. The subdivision is bordered on the north by Colorado Avenue and on the west by Arthur Street.
- NSA 2 is a group of approximately 50 single-family residences, located approximately 2.2 miles east on Russell Point. Noise levels at this location are influenced by highway traffic located along the Oregon Coast Highway.
- NSA 3 is the Horsfall campground, the closest campground to the Jordan Cove LNG Project, located approximately 1.2 miles northeast of the LNG terminal noise producing equipment.
- REC 1 is the recreation area located to the west and northwest of the LNG terminal noise-producing equipment. The recreation area does not incorporate campground facilities.

Jordan Cove monitored the ambient noise levels at those NSAs over a period of greater than 24 hours; the results are presented in table 4.12.2.2-1.

TABLE 4.12.2.2-1

Ambient Noise Levels for the Jordan Cove LNG Terminal Measured at Nearby NSAs a/

Receptor	Distance from LNG Terminal to Receptor (miles)	Direction	Daytime L_{eq}, dBA	Nighttime L_{eq}, dBA	Ambient L_{dn}, dBA b/
NSA 1	1.3	South	52	44	53
NSA 2	2.2	East	63	58	65
NSA 3	1.3	Northeast	58	40	56
REC 1	0.7	West	51	48	55

a/ Data collected during the 2017 sound survey
b/ The L_{dn} is calculated by averaging the actual daytime noise levels with the nighttime levels plus 10 dBA.

Ambient underwater sound levels were also considered. Ambient underwater noise levels range from about 74 dB to 100 dB re 1 µPa in the open ocean with no ship traffic nearby, to about 115 dB to 135 dB re 1 µPa in large marine inlets with some recreational boat traffic (CaDOT 2009). Since Coos Bay is fairly active with existing shipping traffic, ambient underwater noise levels are expected to correspond to the latter range in the presence of shipping but may be lower at times corresponding to reduced boat traffic activity.

Pacific Connector Pipeline Project

For the Pacific Connector pipeline, ambient sound level data were collected in the vicinity of the proposed Klamath Compressor Station in 2012. Background sound levels obtained in the 2012 survey are appropriate for continued use in this analysis because there have been no changes to the surrounding land uses and no development that would increase background noise levels since the 2012 survey. The GTN and Ruby meter facilities, farm animals and equipment, traffic on local roads, and an occasional aircraft overhead are the existing noise sources that were captured in the background noise monitoring study. All NSAs and distances to the LNG terminal are shown on figure M-6 in appendix M and are described as follows:

- NSA 1: 34545 Malin Loop Road (Subsequent to the 2012 noise survey, PCGP purchased this property);
- NSA 2: 33909 Malin Loop Road (Subsequent to the 2012 noise survey, PCGP purchased this property);
- NSA 3: 20933 Morelock Road;
- NSA 4: 33535 Malin Loop Road;
- NSA 5: 33770 Malin Loop Road;
- NSA 6: 34631 Malin Loop Road; and
- NSA 7: possible new home 1,230 feet north of station location.

Pacific Connector monitored the ambient noise levels at those NSAs over a period of greater than 24 hours, and the results are presented in table 4.12.2.2-2.

TABLE 4.12.2.2-2

Ambient Noise Levels for the Klamath Compressor Station Measured at Nearby NSAs

Receptor	Distance from Compressor Station, feet	Direction	Daytime L_{eq}, dBA	Nighttime L_{eq}, dBA	Ambient L_{dn}, dBA b/
NSA 1			Property owned by Pacific Connector		
NSA 2			Property owned by Pacific Connector		
NSA 3	1839	Northwest	35	32	39
NSA 4	2,820	Southwest	32	30	37
NSA 5	2,275	Southwest	54	36	52
NSA 6	1,500	Southeast	41	39	46
NSA 7 a/	1,230	North	39	37	43

a/ Residence to be built. Existing noise level based on level measured at NSA 1.
b/ The L_{dn} is calculated by averaging the actual daytime noise levels with the nighttime levels plus 10 dBA.

4.12.2.3 Jordan Cove LNG Project Impacts

Construction Noise Impacts

Construction of the Jordan Cove LNG Project would occur over a period of about four years. Major components would include berth facilities, buildings, LNG storage tanks, and mechanical/electrical equipment. Noise associated with construction activities would be intermittent because equipment is operated on an as-needed basis and mostly during daylight hours. During the site grading and filling operations, the equipment may be operated on two 10-hour shifts, 6 days per week, with the potential to increase to a 24/7 schedule if required. Construction would not result in generation of, or exposure of persons to, excessive noise or vibration levels. No blasting is anticipated to be required for construction as the entire site area consists of sand.

The most prevalent sound source during construction is anticipated to be the internal combustion engines used to provide mobility and operating power to construction equipment. The sound level at NSAs from construction operations would depend on the type of equipment used, the mode of operation of the equipment, the length of time the equipment is in use, the number of equipment used simultaneously, and the distance between the sound source and sensitive site. These factors would be constantly changing throughout the construction period, making it difficult to calculate an L_{dn} or L_{eq} sound level at any given location. However, construction noise was estimated using the Federal Highway Administration's Roadway Construction Noise Model. Table M-1 in appendix M shows a schedule of the equipment expected to potentially be in simultaneous operation, along with the maximum sound level, L_{max}, at 50 feet, the usage percentage, and the expected L_{eq} at 50 feet considering the usage percentage. Noise levels from the construction equipment are expected to range from 71 dBA L_{eq} to 81 dBA L_{eq} at 50 feet.

Noise modeling was conducted with the commercially available computer-aided noise abatement (CadnaA) noise prediction model. The software is standards based, and the International Organization for Standardization (ISO) 9613 Part 2 standard was used for air absorption and other noise propagation calculations. Standard atmospheric conditions were selected and all receptor locations were modeled with all sound sources assumed to be in operation simultaneously. The ground absorption coefficient for all water surfaces was set to highly acoustically reflective with the remaining surfaces set to partially acoustically absorptive.

Table 4.12.2.3-1 presents the predicted daytime and nighttime sound levels at NSAs associated with general construction activities based on planned equipment usage for the currently planned equipment allocation for each year of construction. Figure M-2 in appendix M also visually displays the sound generated during general construction activities throughout the Project area in the form of color-coded sound contours.

TABLE 4.12.2.3-1

Predicted Construction Noise Levels at NSAs (dBA)

Receptor	Ambient L_{dn}	Construction Noise Level, Daytime, L_d	Construction Noise Level, Nighttime, L_n	Construction Noise Level, L_{dn}	Future Combined Level, L_{dn}	Increase over Ambient, L_{dn}
NSA 1	53	49	44	52	56	3
NSA 2	65	39	34	41	65	<1
NSA 3	56	42	37	45	57	<1
REC 1	55	49	44	52	57	2

The loudest construction activity would be installation of the LNG carrier berth sheet pile wall and installation of the piles associated with the marine slip docks. Up to 14 concurrent diesel impact pile hammers would be used during construction of the facility to drive approximately 3,600 pipe piles in the plant facility area. Up to six vibratory hammers would be in use to install the sheet piles. The pipe pile diameters would range from 24 to 72 inches, and the maximum sound pressure level data were analyzed. Vibratory pile drivers were modeled using an L_{max} level of 101 dBA at a distance of 50 feet having applied a usage factor of 20 percent.

Table 4.12.2.3-2 presents the predicted sound levels associated with pile driving activities at NSAs having accounted for equipment operating during daytime or nighttime periods and accounting for two daytime and nighttime hours during which there are no planned pile-driving activities due to the crew shift change. Additionally, table 4.12.2.3-2 provides the predicted L_{max} values of pile driving activities. The L_{dn} is a useful metric when evaluating continuous noise sources; however, for impulsive sound sources, L_{max} better represents the sound impacts of short and intense noise sources. Figure M-3 in appendix M also visually displays the sound generated during pile driving throughout the Project area in the form of color-coded sound contours.

TABLE 4.12.2.3-2

Predicted Pile Driving Noise Levels at NSAs (dBA)

Receptor	Ambient L_{dn}	Pile Driving Noise Level, Daytime, L_d	Pile Driving Noise Level, Nighttime, L_n	Pile Driving Noise Level, L_{dn}	Future Combined Level, L_{dn}	Increase over Ambient, L_{dn}	Predicted Maximum Level, L_{max}
NSA 1	53	54	53	60	61	8	65
NSA 2	65	39	38	45	65	<1	55
NSA 3	56	42	42	48	57	1	60
REC 1	55	51	51	57	59	4	69

Based on the noise levels provided in table 4.12.2.3-2, it is predicted that pile-driving operations could result in an increase greater than 3 dB L_{dn} on the ambient noise level at two NSAs. Additionally, using the L_{max} values, pile-driving activities would result in noise impacts at all NSAs at or greater than our noise criterion of 48.6 dBA L_{eq}[188]. Pile-driving operations are

[188] note that a L_{dn} of 55 dBA is equivalent to a continuous noise level of 48.6 dBA L_{eq} for facilities that operate at a constant level of noise

currently proposed to occur 20 hours a day for construction of the Jordan Cove LNG Project for 2 years. Based on the large number of residents who live across Coos Bay on the south and the east, the impulsive (short, intense) noise impacts associated with pile-driving activities, the predicted and perceptible noise impacts on nearby NSAs, the duration of pile-driving activities, as well as the lack of noise mitigation measures proposed by Jordan Cove, **we recommend that:**

- **<u>Following the start of pile-driving activities</u>, Jordan Cove should monitor daytime pile-driving and file <u>weekly</u> noise data reports with the Secretary that identify the noise impact on the nearest NSAs. If any measured daytime noise impacts (L_{max}) at the nearest NSAs are greater than 10 dBA over the L_{eq} ambient levels, Jordan Cove should:**

  a. cease pile-driving activities and implement noise mitigation measures; and

  b. file with the Secretary evidence of noise mitigation installation and request written notification from the Director of OEP that pile driving may resume.

Given the proximity of residences to construction and the predicted noise levels associated with pile driving, we conclude that pile-driving activities, without further noise mitigation, should be concluded within reasonable working hours. Therefore, **we recommend that**:

- **Jordan Cove should conduct all pile-driving activities only between the hours of 7 a.m. and 7 p.m. <u>throughout the duration of construction</u>.**

Dredging would also take place during the first three years of the Project. Dredging is anticipated to occur on a 24-hour basis during construction, and its sound level is estimated to be 59 dBA at a distance of 500 feet. Open water dredging activities would occur in five separate work areas, with four work areas along the Federal Navigation Channel and one in the slip area of the Project. Sound was conservatively modeled assuming dredging would take place concurrently at each of the five separate work areas, with all equipment operating simultaneously. Table 4.12.2.3-3 presents the predicted sound levels at NSAs associated with dredging activities. An additional NSA, labeled NSA D1, was included in the dredging evaluation because it is the closest residential area to the Federal Navigation Channel dredging area. Figure M-4 in appendix M visually displays the sound generated during dredging throughout the Project area in the form of color-coded sound contours.

TABLE 4.12.2.3-3

Predicted Dredging Noise Levels at NSAs (dBA)

Receptor	Ambient L_{dn}	Predicted Sound Level, L_{eq}	Predicted Sound Level, L_{dn}	Future Combined Level, L_{dn}	Increase over Ambient, L_{dn}
NSA 1	53	36	42	53	<1
NSA 2	65	25	31	65	<1
NSA 3	56	22	28	56	<1
REC 1	55	28	34	55	<1
NSA D1 a/	53	45	51	55	2

a/ Ambient sound levels at NSA D1 are assumed to be the same as at NSA 1, a residence in the same neighborhood, and the same distance from the bay and ocean as NSA D1

Noise from a cutter suction dredge varies with the capacity of the dredger and the type of material being dredged. A smaller dredge with an anticipated sound power level of 157 dB would be used for the Project; however, a larger dredger was also considered to assess worst-case noise impacts. Noise associated with dredging is largely related to ship traffic. It is not anticipated that dredging noise would cause more severe effects on marine mammals or fish than behavioral disturbance (see section 4.5). The noise from dredging and vessel movements would be similar to existing noise levels due to existing dredging and vessel activity in the Coos Bay channel.

Operational Noise Impacts

Operational noise associated with the Jordan Cove Project was modeled using noise prediction software (CadnaA version 2017) in accordance with ISO 9613. The following major noise-producing equipment would normally be in operation at the Jordan Cove LNG Project and were included in the acoustic modeling analysis:

- Five refrigerant compressors, combustion turbines, heat recovery steam generators, and associated piping;
- Refrigerant compressor interstage and discharge aerial coolers;
- Three steam turbines and their associated air-cooled condensers;
- Two BOG compressors with interstage and discharge aerial coolers; and
- Various other smaller condensers, coolers, pumps and valves.

The model simulates the outdoor propagation of sound from each noise source and accounted for sound wave divergence, atmospheric and ground absorption, sound directivity, and shielding due to interceding barriers and terrain. A database was developed that specified the location, octave-band sound levels, and sound directivity of each noise source. The model calculates the A-weighted sound pressure levels from the Project at the NSA locations. Noise modeling was based on normal operation, which excludes intermittent activities such as start-up, shut down, and any other abnormal or upset operating conditions.

To assess compliance relative to the OAR anti-degradation standard, the increase in sound level was assessed relative to the measured nighttime 1-hour L_{eq}, which is used by Jordan Cove as a surrogate to the L_{50}. The results of the analysis (table 4.12.2.3-4) indicate that the predicted NSA sound levels are below the 55 dBA L_{dn} FERC noise criterion. In addition, the Project demonstrates compliance with the OAR anti-degradation standard as there are no expected increases greater than 10 dBA relative to the measured nighttime 1-hour L_{eq}/L_{50} sound level.

TABLE 4.12.2.3-4

Predicted Project Noise Emissions at NSAs compared to Regulatory Limits for Jordan Cove LNG Project (dBA)

Receptor	Predicted Project Sound Level (L_{eq})	2017 Nighttime Measured 1-hour L_{eq}/L_{50}	Increase Over Existing Ambient	Predicted Project Sound Level (L_{dn})	Existing Ambient L_{dn}	Future Level (Project + Ambient)	Increase Over Existing Ambient
NSA 1	45	44	1	51	53	55	2
NSA 2	37	58	0	43	65	65	<1
NSA 3	43	40	3	49	56	57	1
REC 1	49	48	1	55	55	58	3

As currently designed, Jordan Cove would not install additional noise mitigation measures such as acoustical enclosures, acoustical barriers, or custom silencers beyond mitigation inherent to the specified equipment analyzed.

As far as ground-borne and low frequency air-borne vibration, facility equipment is designed and balanced to minimize extraneous vibration to preserve and extend the service life of the equipment. Ground-borne and low-frequency airborne vibration resulting from the Jordan Cove LNG Project equipment is not expected at the NSAs.

In terms of environmental noise, an increase to the ambient sound level of 3 dB is generally considered barely detectable by the human ear. The expected increases in L_{dn} noise levels at the nearest NSAs due to normal operation are less than 3 dB; however, to ensure that the noise from operation of the Jordan Cove LNG Project would not be significant, **we recommend that:**

- **Jordan Cove should file a full power load noise survey with the Secretary for the LNG terminal <u>no later than 60 days after</u> each liquefaction train is placed into service. If the noise attributable to operation of the equipment at the LNG terminal exceeds an L_{dn} of 55 dBA at the nearest NSA, <u>within 60 days</u> Jordan Cove should modify operation of the liquefaction facilities or install additional noise controls until a noise level below an L_{dn} of 55 dBA at the NSA is achieved. Jordan Cove should confirm compliance with the above requirement by filing a second noise survey with the Secretary <u>no later than 60 days</u> after it installs the additional noise controls.**

- **Jordan Cove should file a full power load noise survey with the Secretary <u>no later than 60 days after placing the entire LNG terminal into service</u>. If a full load noise survey is not possible, Jordan Cove should file an interim survey at the maximum possible horsepower load <u>within 60 days</u> of placing the LNG terminal into service and file the full operational surveys <u>within 6 months</u>. If the noise attributable to the operation of all the equipment of the LNG terminal exceeds 55 dBA L_{dn} at any nearby NSAs, under interim or full load conditions, Jordan Cove should file a report on what changes are needed and install additional noise controls to meet the level <u>within 1 year</u> of the in-service date. Jordan Cove should confirm compliance with this requirement by filing a second full power noise survey with the Secretary <u>no later than 60 days</u> after it installs the additional noise controls.**

Flaring would generate noise; however, since it would occur very infrequently, it is not considered part of typical operations. Cold process flaring is expected to occur five times a year and last for approximately 30 minutes, and warm process flaring is expected to take place once every three years and last for approximately two hours. The marine flare is expected to be used four times a year and could last approximately 14 hours per event.

Noise associated with flaring was modeled using measurement data from another similar flare and/or engineering references, as appropriate. Table 4.12.2.3-5 presents the predicted sound levels at NSAs associated with flaring. Since flaring lasts for fewer than 24 hours, the predictions were adjusted to reflect actual operation time. Compliance with the FERC noise criterion and State of Oregon noise requirements was successfully demonstrated for all flaring scenarios. Figure M-5 in appendix M also visually displays the sound generated during flaring throughout the Project area in the form of color-coded sound contours. Though process and marine flaring are not expected to take place simultaneously, they were also modeled together to be conservative. As shown in table 4.12.2.3-5, process flaring is substantially louder than marine flaring and therefore dominates the combined case, with process flaring as the only even with an increase over ambient levels being greater than 1 L_{dn}.

TABLE 4.12.2.3-5

Predicted Process and Marine Flare Noise Levels at NSAs (dBA)

Receptor	Predicting Flaring Sound Level, L_{eq}	Predicting Flaring Sound Level (Adjusted for Event Duration), L_{eq}	2017 Nighttime Measured 1-hour L_{eq}/L_{50}	Increase Over Existing Ambient	Predicting Flaring Sound Level (Adjusted for Event Duration), L_{dn}	Ambient L_{dn}	Future Combined Level, L_{dn}	Increase over Ambient, L_{dn}
Process Flare								
NSA 1	47	38	44	<1	44	53	53	1
NSA 2	40	31	58	<1	37	65	65	<1
NSA 3	46	37	40	<1	43	56	57	<1
REC 1	60	51	48	<1	57	55	59	4
Marine Flare								
NSA 1	25	25	44	<1	31	53	53	<1
NSA 2	16	16	58	<1	22	65	65	<1
NSA 3	12	12	40	<1	18	56	56	<1
REC 1	28	28	48	<1	34	55	55	<1
Combined Process and Marine Flares								
NSA 1	47	38	44	<1	44	53	53	1
NSA 2	40	31	58	<1	37	65	65	<1
NSA 3	46	37	40	<1	43	56	57	<1
REC 1	47	38	48	<1	44	55	53	1

During operation of the Jordan Cove LNG Project, the primary underwater sound sources would consist of LNG ships and tug boats. The Jordan Cove LNG Project would add about 110-120 LNG carriers on an annual basis to the existing 50 deep draft vessels per year operating in the area.

Noise from large vessels can range up to 188 dB re 1 µPa at 1 meter. Noise from vessels varies depending on size, power, propulsion system loading, and vessel speed. Typical transit speed for vessels within Coos Bay navigation channel is 7 knots. JASCO Research (2006) states that broadband noise from LNG carriers at half speed is expected to be around 175 re 1 µPa at 1 meter. Noise from tug boats is less speed dependent and, in fact, tugs under load can be noisier than larger vessels.

In accordance with the NMFS (2016) technical guidance, a cumulative assessment was conducted for vessel-related noise. The results showed that the noise from transiting vessels and tugs does not represent a potential risk of PTS to any of the identified marine mammal species. When tugs are operating semi-stationary under full power near the facility, individual harbor porpoises would need to remain within about 1 mile of the tug for 1 hour for there to be a potential for PTS. Killer whales would need to remain within about 100 feet of the tug for 1 hour for there to be potential for PTS.

4.12.2.4 Pacific Connector Pipeline Project Impacts

Construction Noise Impacts

Construction activities at the Klamath Compressor Station are expected to last between 12 and 18 months and would involve clearing and grading, placement of fill, excavation for foundations for the compressor unit packages, other equipment settings, ancillary equipment, associated unit housing, piping, and structures. Table M-2 in appendix M presents typical noise emission levels at various distances for the noise producing equipment that would be operating during the construction of the station.

Construction of the Klamath Compressor Station would cause temporary increases in ambient noise levels in the immediate vicinity of the construction site. Pacific Connector's standard construction operating hours are 7:00 a.m. to 7:00 p.m., Monday through Saturday. OAR 340-035-0035(5)(g) provides an exemption for construction noise from compliance with noise standards.

During construction of the Pacific Connector pipeline, construction noise would be audible to NSAs near the construction right-of-way. Some of the land crossed by the pipeline is categorized for residential, commercial, or industrial use. Over 100 structures are within 150 feet of the pipeline right-of-way or TEWAs, and several residences are within 50 feet of the pipeline construction right-of-way or TEWAs. See section 4.7 of this EIS for more information on land use. Due to the assembly-line nature of pipeline construction, activities in any area could occur intermittently over a period lasting from several weeks to a few months.

Construction equipment would be operated on an as-needed basis. Phase 6 includes rock blasting and represents the highest sound levels associated with pipeline construction. A blasting plan has been prepared within the POD that details mitigation measures for blasting activities. For this phase, sound levels at 50 feet are predicted to be 95 dBA L_{eq} and would attenuate to 87 dBA L_{eq} and 74 dBA L_{eq} at 100 feet and 300 feet, respectively. Noise would diminish rapidly as the distance from the noise source increases.

Access roads would be used by construction equipment to reach the right-of-way. There may be areas where access roads are limited in width, grade, or availability. Helicopters may be used during logging for right-of-way clearance. Helicopters that may be used for the Project are assumed to be at most 115 dBA at 50 feet (Michael Minor & Associates 2008), 112 dBA at 100 feet, and 98 dBA at 300 feet. The primary sources of wideband acoustic energy from helicopters are the main and tail rotor. Helicopters generally fly at low altitudes; therefore, potential temporary increases to ambient sound levels would occur in the area where helicopters are operating as well as along their flight path.

In addition to temporary disturbance near residences or other noise-sensitive land uses, construction noise would have localized but temporary effects on wildlife. In general, temporary noise from construction activities would result in some wildlife movements away from the pipeline corridor. See additional discussion of potential pipeline construction noise effects on wildlife in sections 4.5 and 4.6 of this EIS.

The majority of pipeline construction would occur during daytime hours only, with the exception of HDD operations. Other activities often conducted at night include operation of pumps at dry-ditch waterbody crossings; hydrostatic testing; and tie-ins. Pacific Connector may opt to perform these additional construction activities at night. The following mitigation measures would be implemented, as necessary, during construction of the pipeline and/or the Klamath Compressor Station:

- ensure that all equipment has sound control devices no less effective than those provided by the manufacturer;
- ensure that equipment would have muffled exhausts; and
- to the extent feasible, the construction site would be configured in a manner that keeps noisier equipment and activities as far as possible from noise sensitive locations.

If necessary, for greater noise reduction, moveable paneled noise shields, barriers, or enclosures adjacent to or around noisy equipment would be installed where required to meet applicable Project noise limits. If properly installed, temporary barriers can result in a noise reduction of up to 10 dBA at the receptor.

Horizontal Directional Drilling and Direct Pipe Crossings

Pacific Connector proposes to use HDD technology to cross under six waterbodies and a powerline/steep slope location at six sites. Some portions of HDD operations would occur as 12-hour work shifts, while other activities would normally occur as 24-hour-per-day operations. The overall duration of HDD operations is site-specific and would be determined by the drilling contractor. HDD operations are expected to last up to 4 weeks at each site.

The equipment would consist of an HDD drilling rig and auxiliary support equipment including electric mud pumps, a crane, mud mixing and cleaning equipment, and a shale shaker. Most significant noise sources would be at the entry and noise levels from the exit locations would be less than the entry noise levels. Table M-4 in appendix M provides sound power level data for the proposed HDD equipment by octave band.

Using a methodology consistent with ambient data collection for other portions of the Project, a measurement survey was conducted near each HDD crossing. The results of that survey are presented in table 4.12.2.4-1.

TABLE 4.12.2.4-1

Ambient Noise Levels for the Pacific Connector HDD Sites Measured at Nearby NSAs

Crossing	Measurement Location	Daytime L_{eq}, dBA	Nighttime L_{eq}, dBA	Ambient L_{dn}, dBA
Coos Bay East and West Entry	Measurement Site #1	63	46	61
	Measurement Site #2	65	46	63
MP25 (BPA Powerline Corridor)	NSA #1	54	49	56
	NSA #2	43	45	51
Coos River	NSA #1	65	35	63
	NSA #2	65	38	63
	NSA #3	60	41	58
	NSA #4	60	37	58
South Umpqua	NSA #1	53	50	57
	NSA #2	63	59	66
	NSA #3	57	51	59
	NSA #4	62	53	63

TABLE 4.12.2.4-1 (continued)

Ambient Noise Levels for the Pacific Connector HDD Sites Measured at Nearby NSAs

Crossing	Measurement Location	Daytime L_{eq}, dBA	Nighttime L_{eq}, dBA	Ambient L_{dn}, dBA
Rogue River	NSA #1	46	35	46
	NSA #2	46	35	46
	NSA #3	46	35	46
	NSA #4	46	35	46
	NSA #5	54	35	52
	NSA #6	36	35	42
	NSA #7	45	35	45
Klamath River	NSA #1	62	46	61
	NSA #2	57	47	57
	NSA #3	53	43	53

Sound levels at the NSAs due to HDD construction were modeled assuming two scenarios: no noise mitigation and with noise mitigation, if necessary. The noise mitigation options considered were a barrier wall and two types of acoustic tents. The 20-foot-high barrier wall would wrap around the entire HDD site. The tents include a vinyl acoustic tent installed over the entire drilling site. The tent would be approximately 190 feet long by 90 feet wide by 35 feet high and would contain all equipment on the site and an additional special fabric acoustic tent installed over the entire drilling site. Table 4.12.2.4-2 shows the existing ambient sound level, expected drilling noise including mitigation (if necessary), future combined sound level and net increase in sound level above ambient, presented in terms of L_{eq} sound levels. In most cases, the HDD noise produced adheres to the FERC noise criterion of 55 dBA L_{dn} (or 48.6 dBA L_{eq}); however, there are a few instances where exceedances are predicted at the Coos Bay West and East crossings. At the Coos Bay West crossing, NSA#1 is expected to experience received sound levels above 48.6 dBA L_{eq}; however, during daytime hours, existing ambient sound levels are such that the increase in sound level due to HDD would be negligible. During nighttime hours, HDD activity would result in a net increase in sound level of approximately 7 dBA above nighttime ambient sound levels. At the Coos Bay East crossing, NSA #2 would experience an exceedance of the FERC noise criterion during nighttime hours and HDD activity would result in a net increase in sound level of approximately 7 dBA above nighttime ambient sound levels. We conclude that the noise from the HDD operations, especially during nighttime operations, should be mitigated. Therefore, **we recommend that:**

- **<u>Prior to drilling activities at HDD sites</u>, Pacific Connector should file a site-specific nighttime noise mitigation plan with the Secretary for review and written approval by the Director of OEP. During any drilling operations, Pacific Connector should implement the approved plan, monitor noise levels, and file in its biweekly reports documentation that the noise levels attributable to the drilling operations at NSAs does not exceed 55 L_{dn} dBA.**

Figures M-7 through M-13 in appendix M depict the HDD locations, predicted sound levels for HDD activity, and the location of the nearest NSAs.

TABLE 4.12.2.4-2

Summary of HDD Acoustic Modeling Results

Crossing	NSA	Distance (ft) / Direction from HDD a/	Ambient Sound Level L_{dn}, dBA	HDD Noise, L_{dn}, dBA	Future Combined Sound Level, L_{dn}, dBA	Net Increase, dBA
Coos Bay West (20’ Barrier Wall)	NSA #1	1,469 / South	61	51	61	<1
	NSA #2	1,652 / Southeast	61	46	61	<1
	NSA #3	4,493 / North	61	39	61	<1
	NSA #4	2,058 / Southeast	61	45	61	<1
Coos Bay East (20’ Barrier Wall)	NSA #1	1,193 / Southwest	61	41	61	<1
	NSA #2	490 / South	61	51	61	<1
	NSA #3	4,431 / North	61	40	61	<1
	NSA #4	873 / Southeast	61	44	61	<1
MP25 - BPA Powerline Corridor (No Mitigation)	NSA #1	9,842 / Northwest	56	37	56	<1
	NSA #2	4,104 / Southeast	51	48	53	2
Coos River (20’ Barrier Wall)	NSA #1	1,232 / South	63	38	63	<1
	NSA #2	1,258 / South	63	36	63	<1
	NSA #3	479 / Southeast	58	51	59	1
	NSA #4	375 / Southwest	58	53	59	1
S Umpqua (20’ Barrier Wall)	NSA #1	2,025 / South	57	33	57	<1
	NSA #2	818 / East	66	46	66	<1
	NSA #3	1,325 / Northeast	59	50	60	1
	NSA #4	2,345 / Southeast	63	50	63	<1
Rogue River East Entry (Special Acoustic Tent)	NSA #1	464 / North	46	51	52	6
	NSA #2	1,000 / East	46	43	48	2
	NSA #3	800 / South	46	47	50	4
	NSA #4	490 / Southwest	46	52	53	7
Rogue River East Entry (20’ Barrier Wall)	NSA #5	1,300 / West	52	48	53	1
	NSA #6	>1,300 b/	42	55	55	13
	NSA #7	>1,300 b/	45	45	48	3
Klamath River East Entry (Special Acoustic Tent)	NSA #1	650 / Northeast	61	53	62	1
	NSA #2	>1,500 b/	57	43	57	<1
	NSA #3	1,500 / South	53	44	54	1
Klamath River East Entry (20’ Barrier Wall)	NSA #1	650 / Northeast	61	51	61	<1
	NSA #2	>1,500 b/	57	51	58	1
	NSA #3	1,500 / South	53	53	56	3

a/ Distances and direction were estimated from the figures in appendix M.
b/ NSA was not shown in the figures. It is assumed that these NSA’s are at a greater distance from the HDD than the NSA shown on the figure.

The DP method is another trenchless construction methods that would be used to cross some waterbodies by Pacific Connector (see section 2), which is similar to HDD but is also combined with the process of microtunneling. Compared to HDD, a much larger cutterhead is used, eliminating the reaming process. Excavation and hole boring are performed with a microtunneling machine and cutterhead. Generally, completing a DP crossing takes less time than an HDD crossing and is considered less noisy since the majority of equipment is located at the crossing entry point, as opposed to both entry and exit points. Therefore, it is expected that the assessment of potential noise impacts using HDD technology is a conservative approach in comparison to use of the DP method.

Operational Noise Impacts

Compressor Station Operation

Operational noise associated with the Klamath Compressor Station was evaluated using manufacturers' noise emission data for the anticipated compressors, associated noise producing equipment, and typical noise control applications. The Klamath Compressor Station detailed design has not been completed; therefore, estimates of compressor station operational noise levels are based on best available information. Primary noise sources from equipment at the compressor station, along with corresponding estimated noise emission data and noise control equipment reduction values, were derived from measurements of similar equipment at other similar facilities (see table M-5 in appendix M).

Operational noise levels for the Klamath Compressor Station were estimated using CadnaA, as previously discussed, and noise prediction techniques consistent with ISO 9613 for sound propagation outdoor. These techniques take into account the noise generation of individual equipment items, shielding by buildings and barriers, spreading losses, ground and atmospheric effects, and reflections from surfaces. The modeling conservatively predicted the noise contribution during the operation of all three compressor units operating under full load conditions. The modeling included effects of the hillside excavated to form a partial noise barrier to the east.

During development of the detailed design, best practices applicable to noise reduction would be incorporated. Best design practices routinely incorporated in gas turbine stations are low noise air intakes; exhaust silencers; blow down silencers; gas cooler fans; and sound insulated buildings, housings, and piping. In rare cases, if necessary for compliance with noise limits, noise barriers may be installed. Insertion loss values of the noise mitigation measures incorporated into the acoustic modeling analysis are presented in table M-6 in appendix M.

The results of the operational acoustic modeling analysis are shown in table 4.12.2.4-3. FERC regulations require that during operation, compressor station noise increments not exceed an L_{dn} of 55 dBA (equivalent to a continuous noise level of 48.6 dBA L_{eq}) at the nearest NSA. Oregon noise regulations require that operational noise from new commercial or industrial facilities must not increase ambient L_{50} noise levels by more than 10 dBA. For a facility that operates continuously at a steady level, the L_{50} is often very similar to the L_{eq} level; therefore, predictions of compressor station sound levels are in L_{eq} but are comparable to L_{50} baseline sound levels. The results indicate that, having incorporated the indicated noise mitigation measures, the received sound levels at NSAs would be in compliance with the 55 dBA L_{dn} FERC noise criterion and the

Oregon noise regulations. In addition, figure M-14 in appendix M shows the sound contours associated with the operation of the Klamath Compressor Station.

TABLE 4.12.2.4-3

Predicted Operational Noise Levels of the Klamath Compressor Station

Receptor Location	Distance (feet) and Direction	Existing L_{50} (dBA)	Predicted L_{eq} (dBA)	Predicted Increase Over Existing L_{50} (dBA)	Existing L_{dn} (dBA)	Predicted L_{dn} (dBA)	Combined Existing plus Predicted L_{dn}, dBA	Predicted Increase Over Existing L_{dn} (dBA)
NSA 1	Property Purchased by Pacific Connector							
NSA 2	Property Purchased by Pacific Connector							
NSA 3	1,839/Northwest	32	40	9	39	46	47	8
NSA 4	2,820/Southwest	30	35	6	37	41	42	6
NSA 5	2,275/Southwest	36	37	4	52	43	43	1
NSA 6	1,500/Southeast	39	41	4	49	47	47	2
NSA 7	1,230/North	37	43	7	43	50	50	8

Pacific Connector has committed to implementing the following noise mitigation measures for the facility:

- The turbine intake and/or exhaust systems should be equipped with silencers having greater insertion losses than the standard Solar Titan 130 silencers in order to reduce the noise contribution at the nearest NSA (NSA 1) to a level below L_{dn} 55 dBA.
- The turbine exhaust duct located between the compressor building wall and the silencer should be acoustically insulated.
- The turbine lube oil coolers should have noise levels approximately equal to Solar's 85 dBA cooler. The cooler noise level at a horizontal distance of 50 feet from the center of each cooler would be about 54 dBA.
- The gas after-coolers should be designed so that the noise levels at a horizontal distance of 50 feet from the center of each cooler would be about 60 dBA.
- Outdoor aboveground gas piping should be inserted underground soon after exiting the compressor building.
- The compressor building should be acoustically insulated with 6 inches of 8 pounds/cubic feet density mineral wool insulation. The building shell should have 22-gauge metal outer sheeting in the walls and roof and a 26-gauge perforated metal liner.
- The compressor building roll-up door should have a minimum noise reduction rating of STC-28 through the door (this may require a double door).
- Personnel doors should be standard insulated doors with an STC-26 noise reduction rating.
- The compressor building ventilation system has not yet been designed. The building ventilation openings should be acoustically designed so that they are compatible with the silencing in the rest of the station.
- The compressor impeller wheels have not yet been selected and the unit piping noise levels could not be evaluated. It is expected that the unit piping would require acoustic insulation.

As shown in table 4.12.2.4-3, operation of the Klamath Compressor Station would result in clearly noticeable increases in noise levels at three of the five NSAs. However, the station's contribution would be less than the FERC requirement of L_{dn} 55 dBA. Although the Klamath Compressor Station is anticipated to operate in compliance with the applicable noise requirements to ensure that actual operational noise is at or below the FERC-recommended limits, and that there would be no significant effects on noise quality at the nearest NSAs, **we recommend that:**

- **Pacific Connector should file a noise survey with the Secretary <u>no later than 60 days after placing the Klamath Compressor Station in service</u>. If a full load condition noise survey is not possible, Pacific Connector should provide an interim survey at the maximum possible horsepower load and provide the full load survey <u>within six months</u>. If the noise attributable to the operation of all of the equipment at the Klamath Compressor Station under interim or full horsepower load conditions exceeds an L_{dn} of 55 dBA at any nearby NSAs, Pacific Connector should file a report on what changes are needed and should install the additional noise controls to meet the level <u>within one year</u> of the in-service date. Pacific Connector should confirm compliance with the above requirement by filing a second noise survey with the Secretary <u>no later than 60 days</u> after it installs the additional noise controls.**

<u>Venting/Blowdown Events</u>

These events are a venting of gas for safety purposes to relieve pressure in a pipeline component or at a compressor station prior to performing maintenance work (anticipated to occur on an annual basis). A venting or blowdown event at individual MLV locations is a rare and infrequent event. A blowdown vent with a silencer results in a sound power level of approximately 83 dBA. Noise levels at various distances based on that sound power level expected for routine blowdown events are given in table 4.12.2.4-4.

TABLE 4.12.2.4-4

Blowdown Valve Sound Pressure Level at Various Distances

	Distance (feet)/ Received Sound Level (dBA)			
Sound Source	**50**	**100**	**300**	**1,000**
Blowdown Valve with Silencer	48	42	33	22

Acoustic modeling was conducted to determine received sound levels associated with routine blowdowns at the closest NSAs to the block valve locations (table 4.12.2.4-5). Modeling results indicate compliance with applicable noise requirements prescribed by the FERC and the State of Oregon.

TABLE 4.12.2.4-5

Summary of Blowdown Acoustic Modeling Results

Receptor	County	Distance (Feet)	Sound Pressure Level, L_{eq} (dBA)	Sound Pressure Level, L_{dn} (dBA)
02 - AGF 15.69 (BVA #2)	Coos	72	25	31
05 - AGF 59.58 (BVA #5)	Douglas	1,224	21	27
06 - AGF 71.46 (BVA #6)	Douglas	1,096	21	27
08 - AGF 94.66 (BVA #8)	Douglas	20	36	42
10 - AGF 122.18 (BVA #10)	Jackson	89	23	29
15 - AGF 197.77 (BVA #15)	Klamath	1,092	21	27
16 - AGF 214.28 (BVA #16)	Klamath	60	27	33
17 - AGF 228.13 (Klamath Compressor Station, BVA #17)	Klamath	74	25	31

MLV blowdowns, if scheduled for maintenance activities during the life of the pipeline, would be communicated to the surrounding landowners in writing (e.g., letters and “door-hangers”) in advance of the event. These events are conducted during daylight hours only. Such transient events are of very short duration and do not represent continuous or routine noise or disturbance to NSAs. Based on the infrequent and short duration of blowdowns, these events would not have significant adverse noise impacts on nearby NSAs.

Metering Station Noise

One meter station would be located very close to the Jordan Cove LNG terminal (at the gas gate), and two meter stations would be located within the Klamath Compressor Station fenceline. Noise may be generated by gas flow in the pipe used for measurement at the meter stations. However, noise generated by operation of the Jordan Cove LNG Project would dominate over the meter station near the terminal; similarly, noise generated by operation of the compressor station would dominate over the meter stations at the compressor station. Noise would not be expected to be audible beyond the edge of the meter station sites or pipeline right-of-way. Additionally, our recommendation that Pacific Connector and Jordan Cove complete noise surveys at both the compressor station and the LNG terminal would be inclusive of noise generated by the meter stations in and near these respective facilities; therefore, we do not believe that noise impacts due to operation of the meter stations would result in significant impacts on nearby NSAs.

4.12.2.5 Environmental Consequences on Federal Lands

The southern boundary of the ODNRA is less than 0.7 mile northwest of the Jordan Cove LNG Project. As shown on the noise contour maps in figure 4.12-3, estimated noise from general Jordan Cove LNG Project construction is expected to remain below an L_{dn} of 55 dBA (i.e., the noise level used by the EPA and FERC to protect the public from activity interference and annoyance outdoors in residential areas); however, during pile driving for installation of berth facilities at the Jordan Cove marine slip, predicted noise levels at the ODNRA are expected to exceed the FERC noise criterion (figure 4.12-4). In addition, predicted noise levels at the BLM boat ramp located about 1 mile southwest of the terminal site would exceed 55 dBA (figureM-4 in appendix M). Noise from pile driving would be noticeable to users of the ODNRA and BLM boat ramp during construction. This impact would be a temporary annoyance to users of the ODNRA and boat ramp. Due to the noise-generating activities associated with the ODNRA and BLM boat ramp, these locations are not considered to be an NSA.

During operation and flaring, predicted noise generated from the Jordan Cove LNG Project may also exceed the 55 dBA L_{dn} FERC noise criterion at the ODNRA and BLM boat ramp. During operation of the Jordan Cove LNG Project, BLM and COE lands near the Coos Bay navigation channel would receive limited noise impacts from LNG carriers arriving at and departing from the terminal. An estimated 110-120 ships per year would call on the Jordan Cove LNG Project. Noise levels during ship movements are estimated to be about 63 dBA at a distance of 300 feet during each passby event, which would be similar to noise generated from deep-draft cargo ships that currently traverse the Coos Bay navigation channel. Because the Coast Guard would impose a moving safety zone around LNG carriers, only one large vessel would be traversing any one location along the channel at any point in time. Current ship traffic at the Port is about 50 deep-draft commercial ship calls per year. The increase in the number of vessel calls at the Port resulting from operation of the Jordan Cove LNG Project would be less than one ship movement per day. Noise from LNG carriers would not be expected to create a noticeable change in overall noise levels at BLM and COE lands along the Coos Bay navigation channel.

During construction of the Pacific Connector pipeline, there would be temporary noise impacts on federal lands crossed by the pipeline or crossed by construction access roads. Construction noise could have localized and temporary effects on recreational users and wildlife on federal lands. Pipeline construction would proceed in a linear fashion along the right-of-way, and equipment would be operated on an as-needed basis; therefore, exact noise at a particular point cannot be determined. However, we can estimate noise levels as a function of the distance of the receptor from the equipment. Table M-3 in appendix M provides predicted construction noise levels at 50 feet, 100 feet, and 300 feet for pipeline construction. Noise would diminish rapidly as the distance from the noise source increases.

During operation of the pipeline, there would be no noise generated from the buried pipeline. Aboveground MLVs would be located within BLM lands. During operation, sound is sometimes detectable within several feet of MLVs; however, any noise impact during operation of the MLVs, with the exception of blowdown events discussed previously, would not be humanly perceptible beyond the operational right-of-way for the pipeline. The main source of noise from operation of the Pacific Connector would be from the Klamath Compressor Station, which would be located on private land, with no federal land adjacent or nearby. We conclude that construction and operation of the Pacific Connector Pipeline Project would not have significant adverse noise impacts on users of federal lands.

4.12.2.6 Conclusion

Constructing and operating the Project would result in noise-related impacts. However, based on the implementation of the proposed BMPs as well as inclusion of the recommendations made in this EIS, the Project would not cause significant noise-related impacts.

4.13 RELIABILITY AND SAFETY

4.13.1 Jordan Cove LNG Project

4.13.1.1 LNG Facility Reliability, Safety, and Security Regulatory Oversight

LNG facilities handle flammable and sometimes toxic materials that can pose a risk to the public if not properly managed. These risks are managed by the companies owning the facilities, through selecting the site location and plant layout as well as through suitable design, engineering, construction, and operation of the LNG facilities. Multiple federal agencies share regulatory authority over the LNG facilities and the operator's approach to risk management. The safety, security, and reliability of the Jordan Cove LNG Project would be regulated by the USDOT, the Coast Guard, and the FERC.

In February 2004, the USDOT, the Coast Guard, and the FERC entered into an Interagency Agreement to ensure greater coordination among these three agencies in addressing the full range of safety and security issues at LNG terminals and LNG marine vessel operations, and maximizing the exchange of information related to the safety and security aspects of LNG facilities and related marine operations. Under the Interagency Agreement, the FERC is the lead federal agency responsible for the preparation of the analysis required under NEPA for impacts associated with terminal construction and operation. The USDOT and the Coast Guard participate as cooperating agencies but remain responsible for enforcing their regulations covering LNG facility siting, design, construction, operation, and maintenance. All three agencies have some oversight and responsibility for the inspection and compliance during the LNG facility's operation.

The USDOT establishes and has the authority to enforce the federal safety standards for the location, design, installation, construction, inspection, testing, operation, and maintenance of onshore LNG facilities under the Natural Gas Pipeline Safety Act (49 U.S.C. 1671 et seq.). The USDOT's LNG safety regulations are codified in 49 CFR 193, which prescribes safety standards for LNG facilities used in the transportation of gas by pipeline that are subject to federal pipeline safety laws (49 U.S.C. 60101 et seq.), and 49 CFR 192. On August 31, 2018, USDOT and FERC signed a memorandum of understanding (MOU) regarding methods to improve coordination throughout the LNG permit application process for FERC jurisdictional LNG facilities. In the MOU, USDOT agreed to issue a Letter of Determination (LOD) stating whether a proposed LNG facility would be capable of complying with location criteria and design standards contained in Subpart B of Part 193. The Commission committed to rely upon the USDOT determination in conducting its review of whether the facilities would be consistent in the public interest. The issuance of the LOD does not abrogate USDOT's continuing authority and responsibility over a proposed project's compliance with Part 193 during construction and future operation of the facility. The USDOT's conclusion on the siting and hazard analysis required by Part 193 is based on preliminary design information which may be revised as the engineering design progresses to final design. USDOT regulations also contain requirements for the design, construction, installation, inspection, testing, operation, maintenance, qualifications and training of personnel, fire protection, and security for LNG facilities as defined in 49 CFR 193, which would be completed during later stages of the Project. If the Project is authorized and constructed, LNG facilities as defined in 49 CFR 193, would be subject to the USDOT's inspection and enforcement programs to ensure compliance with the requirements of 49 CFR 193.

The Coast Guard has authority over the safety of an LNG terminal's marine transfer area and LNG marine vessel traffic, as well as over security plans for the waterfront facilities handling LNG and LNG marine vessel traffic. The Coast Guard regulations for waterfront facilities handling LNG are codified in 33 CFR 105 and 33 CFR 127. As a cooperating agency, the Coast Guard assists the FERC staff in evaluating whether an applicant's proposed waterway would be suitable for LNG marine vessel traffic and whether the waterfront facilities handling LNG would be operated in accordance with 33 CFR 105 and 33 CFR 127. If the facilities are constructed and become operational, the facilities would be subject to the Coast Guard inspection program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

The FERC authorizes the siting and construction of LNG terminals under the NGA and delegated authority from the DOE. The FERC requires standard information to be submitted to perform safety and reliability engineering reviews. FERC's filing regulations are codified in 18 CFR 380.12 (m) and (o), and requires each applicant to identify how its proposed design would comply with the USDOT's siting requirements of 49 CFR 193 Subpart B. The level of detail necessary for this submittal requires the applicant to perform substantial front-end engineering of the complete project. The design information is required to be site-specific and developed to the extent that further detailed design would not result in significant changes to the siting considerations, basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs. As part of the review required for a FERC order, we use this information from the applicant to assess whether the proposed facilities would have a public safety impact and to suggest additional mitigation measures for the Commission to consider for incorporation as conditions in the order. If the facilities are approved and the suggested mitigation measures are incorporated into the order as conditions, FERC staff would review material filed to satisfy the conditions of the order and conduct periodic inspections throughout construction and operation.

In addition, the Energy Policy Act of 2005 requires FERC to coordinate and consult with the Department of Defense (DOD) on the siting, construction, expansion, and operation of LNG terminals that would affect the military. On November 21, 2007, the FERC and the DOD entered into a MOU formalizing this process.[189] On January 29, 2019, the FERC received a response letter from the DOD Siting Clearinghouse stating that Jordan Cove LNG Project would have a minimal impact on military training and operations conducted in the area.

4.13.1.2 USDOT Siting Requirements and 49 CFR Part 193 Subpart B Determination

Siting LNG facilities, as defined in 49 CFR 193, with regard to ensuring that the proposed site selection and location would not pose an unacceptable level or risk to public safety is required by USDOT's regulations in 49 CFR 193 Subpart B. The Commission's regulations under 18 CFR 380.12 (o) (14) require Jordan Cove to identify how the proposed design complies with the siting requirements in USDOT's regulations under 49 CFR 193 Subpart B. The scope of USDOT's siting authority under 49 CFR 193 applies to LNG facilities used in the transportation of gas by pipeline subject to the federal pipeline safety laws and 49 CFR 192.[190]

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[189] http://www.ferc.gov/legal/mou/mou-dod.pdf

[190] 49 CFR 193.2001 (b) (3), Scope of part, excludes any matter other than siting provisions pertaining to marine cargo transfer systems between the LNG marine vessel and the last manifold (or in the absence of a manifold, the last valve) located immediately before a storage tank.

The requirements in 49 CFR 193 Subpart B, state that an operator or government agency must exercise legal control over the activities as long the facility is in operation that can occur within an "exclusion zone," defined as the area around an LNG facility that could be exposed to specified levels of thermal radiation or flammable vapor in the event of a release of LNG or ignition of LNG vapor. Approved mathematical models must be used to calculate the dimensions of these exclusion zones. The siting requirements specified in NFPA 59A (2001), an industry consensus standard for LNG facilities, are incorporated into 49 CFR 193 Subpart B by reference, with regulatory preemption in the event of conflict. The following sections of 49 CFR 193 Subpart B specifically address siting requirements:

- Section 193.2051, Scope, states that each LNG facility designed, replaced, relocated or significantly altered after March 31, 2000, must be provided with siting requirements in accordance with Subpart B and NFPA 59A (2001). In the event of a conflict with NFPA 59A (2001), the regulatory requirements in Part 193 prevail.
- Section 193.2057, Thermal radiation protection, requires that each LNG container and LNG transfer system have thermal exclusion zones in accordance with section 2.2.3.2 of NFPA 59A (2001).
- Section 193.2059, Flammable vapor-gas dispersion protection, requires that each LNG container and LNG transfer system have a dispersion exclusion zone in accordance with sections 2.2.3.3 and 2.2.3.4 of NFPA 59A (2001).
- Section 193.2067, Wind forces, requires that shop fabricated containers of LNG or other hazardous fluids less than 70,000 gallons must be designed to withstand wind forces based on the applicable wind load data in American Society of Civil Engineers (ASCE) 7 (2005). All other LNG facilities must be designed for a sustained wind velocity of not less than 150 mph unless the USDOT Administrator finds a lower wind speed is justified or the most critical combination of wind velocity and duration for a 10,000-year mean return interval.

As stated in 49 CFR 193.2051, LNG facilities must meet the siting requirements of NFPA 59A (2001), Chapter 2, and include but may not be limited to:

- NFPA 59A (2001) section 2.1.1 (c) requires consideration of protection against forces of nature.
- NFPA 59A (2001) section 2.1.1 (d) requires that other factors applicable to the specific site that have a bearing on the safety of plant personnel and surrounding public be considered, including an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility.
- NFPA 59A (2001) section 2.2.3.2 requires provisions to minimize the damaging effects of fire from reaching beyond a property line, and requires provisions to prevent a radiant heat flux level of 1,600 British thermal units per square foot per hour (Btu/ft^2-hr) from reaching beyond a property line that can be built upon. The distance to this flux level is to be calculated with LNGFIRE3 or with models that have been validated by experimental test data appropriate for the hazard to be evaluated and that have been approved by USDOT.
- NFPA 59A (2001) section 2.2.3.4 requires provisions to minimize the possibility of any flammable mixture of vapors from a design spill from reaching a property line that can be built upon and that would result in a distinct hazard. Determination of the distance that the

flammable vapors extend is to be determined with DEGADIS or approved alternative models that take into account physical factors influencing LNG vapor dispersion.[191]

Taken together, 49 CFR 193 Subpart B, and NFPA 59A (2001) require that flammable LNG vapors from design spills do not extend beyond areas in which the operator or a government agency legally controls all activities. Furthermore, consideration of other hazards which may affect the public or plant personnel must be evaluated as prescribed in NFPA 59A (2001), section 2.1.1 (d).

Title 49 CFR 193 Subpart B, and NFPA 59A (2001) also specify three radiant heat flux levels which must be considered for LNG storage tank spills for as long as the facility is in operation:

- 1,600 Btu/ft^2-hr - This level can extend beyond the plant property line that can be built upon but cannot include areas that are used for outdoor assembly by groups of 50 or more persons;[192]
- 3,000 Btu/ft^2-hr - This level can extend beyond the plant property line that can be built upon but cannot include areas that contain assembly, educational, health care, detention or residential buildings or structures;[193] and
- 10,000 Btu/ft^2-hr - This level cannot extend beyond the plant property line that can be built upon.[194]

The requirements for design spills from process or transfer areas are more stringent. For LNG spills, the 1,600 Btu/ft^2-hr flux level cannot extend beyond the plant property line onto a property that can be built upon. In addition, section 2.1.1 of NFPA 59A (2001) requires that factors applicable to the specific site with a bearing on the safety of plant personnel and the surrounding public must be considered, including an evaluation of potential incidents and safety measures incorporated into the design or operation of the facility. USDOT has indicated that potential incidents, such as vapor cloud explosions and toxic releases should be considered to comply with Part 193 Subpart B.[195]

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[191] USDOT has approved two additional models for the determination of vapor dispersion exclusion zones in accordance with 49 CFR 193.2059: FLACS 9.1 Release 2 (Oct. 7, 2011) and PHAST-UDM Version 6.6 and 6.7 (Oct. 7, 2011).

[192] The 1,600 Btu/ft^2-hr flux level is associated with producing pain in less than 15 seconds, first degree burns in 20 seconds, second degree burns in approximately 30 to 40 seconds, 1 percent mortality in approximately 120 seconds, and 100 percent mortality in approximately 400 seconds, assuming no shielding from the heat, and is typically the maximum allowable intensity for emergency operations with appropriate clothing based on average 10 minute exposure.

[193] The 3,000 Btu/ft^2-hr flux level is associated with producing pain in less than 5 seconds, first degree burns in 5 seconds, second degree burns in approximately 10 to 15 seconds, 1 percent mortality in approximately 50 seconds, and 100 percent mortality in approximately 180 seconds, assuming no shielding from the heat, and is typically the critical heat flux for piloted ignition of common building materials (e.g., wood, PVC, fiberglass, etc.) with prolonged exposures.

[194] The 10,000 Btu/ft^2-hr flux level is associated with producing pain in less than 1 seconds, first degree burns in 1 seconds, second degree burns in approximately 3 seconds, 1 percent mortality in approximately 10 seconds, and 100 percent mortality in approximately 35 seconds, assuming no shielding from the heat, and is typically the critical heat flux for unpiloted ignition of common building materials (e.g., wood, PVC, fiberglass) and degradation of unprotected process equipment after approximate 10 minute exposure and to reinforced concrete after prolonged exposure.

[195] The USDOT PHMSA's "LNG Plant Requirements: Frequently Asked Questions" item H1, https://www.phmsa.dot.gov/pipeline/liquified-natural-gas/lng-plant-requirements-frequently-asked-questions, accessed Aug. 2018.

In accordance with the August 31, 2018 MOU, USDOT will issue a LOD to the Commission after USDOT completes its analysis of whether the proposed facilities would meet the USDOT siting standards. The LOD will evaluate the hazard modeling results and endpoints used to establish exclusion zones, as well as Jordan Cove's evaluation on potential incidents and safety measures incorporated in the design or operation of the facility specific to the site that have a bearing on the safety of plant personnel and surrounding public. The LOD will serve as one of the considerations for the Commission to deliberate in its decision to authorize or deny an application.

4.13.1.3 Coast Guard Safety Regulatory Requirements and Letter of Recommendation

LNG Marine Vessel Historical Record

Since 1959, marine vessels have transported LNG without a major release of cargo or a major accident involving an LNG marine vessel. There are more than 370 LNG marine vessels in operation routinely transporting LNG between more than 100 import/export terminals currently in operation worldwide. Since U.S. LNG terminals first began operating under FERC jurisdiction in the 1970s, there have been thousands of individual LNG marine vessel arrivals at terminals in the U.S. For more than 40 years, LNG shipping operations have been safely conducted in U.S. ports and waterways.

A review of the history of LNG maritime transportation indicates that there has not been a serious accident at sea or in a port which resulted in a spill due to rupturing of the cargo tanks. However, insurance records, industry sources, and public websites identify a number of incidents involving LNG marine vessels, including minor collisions with other marine vessels of all sizes, groundings, minor LNG releases during cargo unloading operations, and mechanical/equipment failures typical of large vessels. Some of the more significant occurrences, representing the range of incidents experienced by the worldwide LNG marine vessel fleet, are described below:

- **El Paso Paul Kayser** grounded on a rock in June 1979 in the Straits of Gibraltar during a loaded voyage from Algeria to the United States. Extensive bottom damage to the ballast tanks resulted; however, no cargo was released because no damage was done to the cargo tanks. The entire cargo of LNG was subsequently transferred to another LNG marine vessel and delivered to its U.S. destination.
- **Tellier** was blown by severe winds from its docking berth at Skikda, Algeria in February 1989 causing damage to the loading arms and the LNG marine vessel and shore piping. The cargo loading had been secured just before the wind struck, but the loading arms had not been drained. Consequently, the LNG remaining in the loading arms spilled onto the deck, causing fracture of some plating.
- **Mostefa Ben Boulaid** had an electrical fire in the engine control room during unloading at Everett, Massachusetts on February 5, 1996. The LNG marine vessel crew extinguished the fire and the ship completed unloading.
- **Khannur** had a cargo tank overfill into the LNG marine vessel's vapor handling system on September 10, 2001, during unloading at Everett, Massachusetts. Approximately 100 gallons of LNG were vented and sprayed onto the protective decking over the cargo tank dome, resulting in several cracks. After inspection by the Coast Guard, the Khannur was allowed to discharge its LNG cargo.

- **Mostefa Ben Boulaid** had LNG spill onto its deck during loading operations in Algeria in 2002. The spill, which is believed to have been caused by overflow rather than a mechanical failure, caused significant brittle fracturing of the steelwork. The LNG marine vessel was required to discharge its cargo, after which it proceeded to dock for repair.
- **Norman Lady** was struck by the USS Oklahoma City nuclear submarine while the submarine was rising to periscope depth near the Strait of Gibraltar in November 2002. The 87,000 m^3 LNG marine vessel, which had just unloaded its cargo at Barcelona, Spain, sustained only minor damage to the outer layer of its double hull but no damage to its cargo tanks.
- **Tenaga Lima** grounded on rocks while proceeding to open sea east of Mopko, South Korea due to strong current in November 2004. The shell plating was torn open and fractured over an approximate area of 20 by 80 feet, and internal breaches allowed water to enter the insulation space between the primary and secondary membranes. The LNG marine vessel was refloated, repaired, and returned to service.
- **Golar Freeze** moved away from its docking berth during unloading on March 14, 2006, in Savannah, Georgia. The powered emergency release couplings on the unloading arms activated as designed, and transfer operations were shut down.
- **Catalunya Spirit** lost propulsion and became adrift 35 miles east of Chatham, Massachusetts on February 11, 2008. Four tugs towed the LNG marine vessel to a safe anchorage for repairs. The Catalunya Spirit was repaired and taken to port to discharge its cargo.
- **Al Gharrafa** collided with a container ship, Hanjin Italy, in the Malacca Strait off Singapore on December 19, 2013. The bow of the Al Gharrafa and the middle of the starboard side of the Hanjin were damaged. Both ships were safely anchored after the incident. No loss of LNG was reported.
- **Al Oraiq** collided with a freight carrier, Flinterstar, near Zeebrugge, Belgium on October 6, 2015. The freight carrier sank, but the Al Oraiq was reported to have sustained only minor damage to its bow and no damage to the LNG cargo tanks. According to reports, the Al Oraiq took on a little water but was towed to the Zeebrugge LNG terminal where its cargo was unloaded using normal procedures. No loss of LNG was reported.
- **Al Khattiya** suffered damage after a collision with an oil tanker off the Port of Fujairah on February 23, 2017. Al Khattiya had discharged its cargo and was anchored at the time of the incident. A small amount of LNG was retained within the LNG marine vessel to keep the cargo tanks cool. The collision damaged the hull and two ballast tanks on the Al Khattiya, but did not cause any injury or water pollution. No loss of LNG was reported.

LNG Marine Vessel Safety Regulatory Oversight

The Coast Guard exercises regulatory authority over LNG marine vessels under 46 CFR 154, which contains the United States safety standards for self-propelled LNG marine vessels transporting bulk liquefied gases. The LNG marine vessels visiting the proposed facility would also be constructed and operated in accordance with the IMO *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk and the International Convention for the Safety of Life at Sea*. All LNG marine vessels entering U.S. waters are required to possess a valid

IMO Certificate of Fitness and either a Coast Guard Certificate of Inspection (for U.S. flag vessels) or a Coast Guard Certificate of Compliance (for foreign flag vessels). These documents certify that the LNG marine vessel is designed and operating in accordance with both international standards and the U.S. regulations for bulk LNG marine vessels under 46 CFR 154.

The LNG marine vessels that would deliver or receive LNG to or from the proposed facility would also need to comply with various U.S. and international security requirements. The IMO adopted the *International Ship and Port Facility Security Code* in 2002. This code requires both ships and ports to conduct vulnerability assessments and to develop security plans. The purpose of the code is to prevent and suppress terrorism against ships; improve security aboard ships and ashore; and reduce the risk to passengers, crew, and port personnel on board ships and in port areas. All LNG marine vessels, as well as other cargo vessels (e.g., 500 gross tons and larger), and ports servicing those regulated vessels, must adhere to the IMO standards. Some of the IMO requirements for ships are as follows:

- marine vessels must develop security plans and have a Vessel Security Officer;
- marine vessels must have a ship security alert system to transmit ship-to-shore security alerts identifying the ship, its location, and indication that the security of the ship is under threat or has been compromised;
- marine vessels must have a comprehensive security plan for international port facilities, focusing on areas having direct contact with ships; and
- marine vessels may have equipment onboard to help maintain or enhance the physical security of the ship.

In 2002, the Maritime Transportation Security Act (MTSA) was enacted by the U.S. Congress and aligned domestic regulations with the maritime security standards of the *International Ship and Port Facility Security Code and the Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk and the International Convention for the Safety of Life at Sea*. The Coast Guard's regulations in 33 CFR 104 require marine vessels to conduct a vessel security assessment and develop a vessel security plan that addresses each vulnerability identified in the vessel security assessments. All LNG marine vessels servicing the facility would have to comply with the MTSA requirements and associated regulations while in U.S. waters.

The Coast Guard also exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under EO 10173; the Magnuson Act (50 U.S.C. section 191); the Ports and Waterways Safety Act of 1972, as amended (33 U.S.C. section 1221, et seq.); and the MTSA of 2002 (46 U.S.C. section 701). The Coast Guard is responsible for matters related to navigation safety, LNG marine vessel engineering and safety standards, and all matters pertaining to the safety of facilities or equipment located in or adjacent to navigable waters up to the last valve immediately before the receiving tanks. The Coast Guard also has authority for LNG facility security plan review, approval, and compliance verification as provided in 33 CFR 105.

The Coast Guard regulations in 33 CFR 127 apply to the marine transfer area of waterfront facilities between the LNG marine vessel and the last manifold or valve immediately before the receiving tanks. Title 33 CFR 127 applies to the marine transfer area for LNG of each new waterfront facility handling LNG and to new construction in the marine transfer areas for LNG of each existing waterfront facility handling LNG. The scope of the regulations includes the design, construction, equipment, operations, inspections, maintenance, testing, personnel training, firefighting, and security of the marine transfer area of LNG waterfront facilities. The safety systems, including communications, emergency shutdown, gas detection, and fire protection, must comply with the regulations in 33 CFR 127. Under 33 CFR 127.019, Jordan Covewould be required to submit two copies of its Operations and Emergency Manuals to the Coast Guard Captain of the Port (COTP) for examination.

Both the Coast Guard regulations under 33 CFR 127 and FERC regulations under 18 CFR 157.21, require an applicant who intends to build an LNG terminal facility to submit a Letter of Intent (LOI) to the Coast Guard no later than the date that the owner/operator initiates pre-filing with FERC, but, in all cases, at least 1 year prior to the start of construction. In addition, the applicant must submit a Preliminary WSA to the COTP with the LOI.

The Preliminary WSA provides an initial explanation of the port community and the proposed facility and transit routes. It provides an overview of the expected impacts LNG operations may have on the port and the waterway. Generally, the Preliminary WSA does not contain detailed studies or conclusions. This document is used by the COTP to begin his or her evaluation of the suitability of the waterway for LNG marine traffic. The Preliminary WSA must provide an initial explanation of the following:

- port characterization;
- characterization of the LNG facility and the LNG marine vessel route;
- risk assessment for maritime safety and security;
- risk management strategies; and
- resource needs for maritime safety, security, and response.

A Follow-On WSA must be provided no later than the date the owner/operator files an application with FERC, but in all cases at least 180 days prior to transferring LNG. The Follow-on WSA must provide a detailed and accurate characterization of the waterfront facilities handling LNG, the LNG marine vessel route, and the port area. The Follow-on WSA provides a complete analysis of the topics outlined in the Preliminary WSA. It should identify credible security threats and navigational safety hazards for the LNG marine vessel traffic, along with appropriate risk management measures and the resources (i.e., federal, state, local, and private sector) needed to carry out those measures. Until a facility begins operation, applicants must also annually review their WSAs and submit a report to the COTP as to whether changes are required. This document is reviewed and validated by the Coast Guard and forms the basis for the agency's Letter of Recommendation (LOR) to the FERC.

In order to provide the Coast Guard COTPs/Federal Maritime Security Coordinators, members of the LNG industry, and port stakeholders with guidance on assessing the suitability of a waterway for LNG marine traffic, the Coast Guard has published a Navigation and Vessel Inspection Circular – *Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic* (NVIC 01-11).

NVIC 01-11 directs the use of the three concentric Zones of Concern, based on LNG marine vessels with a cargo carrying capacity up to 265,000 m^3, used to assess the maritime safety and security risks of LNG marine traffic. The Zones of Concern are:

- Zone 1 – impacts on structures and organisms are expected to be significant within 500 meters (1,640 feet). The outer perimeter of Zone 1 is approximately the distance to thermal hazards of 37.5 kilowatts per square meter (kW/m^2) (12,000 Btu/ft^2-hr) from a pool fire.
- Zone 2 – impacts would be significant but reduced, and damage from radiant heat levels are expected to transition from severe to minimal between 500 and 1,600 meters (1,640 and 5,250 feet). The outer perimeter of Zone 2 is approximately the distance to thermal hazards of 5 kW/m^2 (1,600 Btu/ft^2-hr) from a pool fire.
- Zone 3 – impacts on people and property from a pool fire or an un-ignited LNG spill are expected to be minimal between 1,600 meters (5,250 feet) and a conservative maximum distance of 3,500 meters (11,500 feet or 2.2 miles). The outer perimeter of Zone 3 should be considered the vapor cloud dispersion distance to the lower flammability limit from a worst case un-ignited release. Impacts to people and property could be significant if the vapor cloud reaches an ignition source and burns back to the source.

Once the applicant submits a complete Follow-On WSA, the Coast Guard reviews the document to determine if it presents a realistic and credible analysis of the public safety and security implications from LNG marine traffic both in the waterway and when in port. As required by its regulations (33 CFR 127.009), the Coast Guard is responsible for issuing a LOR to the FERC regarding the suitability of the waterway for LNG marine traffic with respect to the following items:

- physical location and description of the facility;
- the LNG marine vessel's characteristics and the frequency of LNG shipments to or from the facility;
- waterway channels and commercial, industrial, environmentally sensitive, and residential areas in and adjacent to the waterway used by LNG marine vessels en route to the facility, within 25 kilometers (15.5 miles) of the facility;
- density and character of marine traffic in the waterway;
- locks, bridges, or other manmade obstructions in the waterway;
- depth of water;
- tidal range;
- protection from high seas;
- natural hazards, including reefs, rocks, and sandbars;
- underwater pipes and cables; and
- distance of berthed LNG marine vessels from the channel and the width of the channel.

The Coast Guard may also prepare an LOR Analysis, which serves as a record of review of the LOR and contains detailed information along with the rationale used in assessing the suitability of the waterway for LNG marine traffic.

Jordan Cove LNG Project's Waterway Suitability Assessment

On January 9, 2017, Jordan Cove submitted a LOI and a Preliminary WSA to the COTP, Sector Colombia River, to notify the Coast Guard that it proposed to construct an LNG export terminal. The Preliminary WSA was based on a WSA dated April 10, 2006 that was previously submitted to the Coast Guard and was updated on December 29, 2012 for export operations. In addition, Jordan Cove has submitted annual WSA updates to the Coast Guard since the 2012 WSA update. On January 23, 2017, the Coast Guard accepted the Project's existing WSA as it relates to the new proposed project and stated that a new Follow-On WSA is not required.

LNG Marine Vessel Routes and Hazard Analysis

An LNG marine vessel's transit to the terminal would begin when it reaches the entrance of Coos Bay from the Pacific Ocean. Once inside the entrance, the marine vessel would turn north at the City of Charleston, Oregon and would transit to the Jordan Cove LNG Project marine berth. After reaching the turning basin near the Project site, the LNG marine vessel would turn to the right and back into the eastern side of the marine slip. The total inbound transit distance to the Jordan Cove LNG Project marine berth would be approximately 8.0 miles from the entrance of Coos Bay. The route would be reversed for outbound LNG marine vessel transits.

Pilotage is compulsory for foreign marine vessels and U.S. marine vessels under registry in foreign trade when in U.S. waters. All deep draft marine vessels currently entering the shared waterway would employ a U.S. pilot. The National Vessel Movement Center in the U.S. would require a 96-hour advance notice of arrival for deep draft marine vessels calling on U.S. ports. During transit, LNG marine vessels would be required to maintain voice contact with controllers and check in on designated frequencies at established way points.

NVIC 01-11 references the "Zones of Concern" for assisting in a risk assessment of the waterway. As LNG marine vessels proceed along the intended transit route, the estimated zones of concern would extend over resources such as residential and industrial areas, military installations, and also non-residential areas accessible to the public such as parks. Hazard Zone 1 would remain almost entirely over the water and would encompass coastal areas in Charleston and Coos Bay. Commercial vessels, recreational vessels, fishing vessels, Cape Arago Dock, I.C.I. Marine Industrical Park, North Bay Marine Industrial Park, and Roseburg Forest Products Facility would also fall within Zone 1. Zone 2 would cover a wider swath of coastal areas along Charleston, Coos Bay, Barview, and North Bend and would include multiple residential buildings, commercial buildings, industrial buildings, numerous Recreational Vehicle hook-up Parks, numerous recreational areas and boat launch ramps, Marine Research Center, Charleston Marina, South Slough Bridge, Coast Guard Sector Charleston, Charleston Fire District Stations 1 and 3, Madison Elementary School, Sunset Middle School, Coos Bay Fire Department Station 2, and the Southwestern Oregon Regional Airport. Zone 3 would span larger portions of Charleston, Coos Bay, Barview, and North Bend and would include Coast Guard Group North Bend, Railroad Bridge, Oregon Dunes Recreational Park, Southwestern Oregon Community College.

The areas impacted by the three different hazard zones are illustrated for accidental and intentional events in figures 4.13-1 and 4.13-2, respectively.

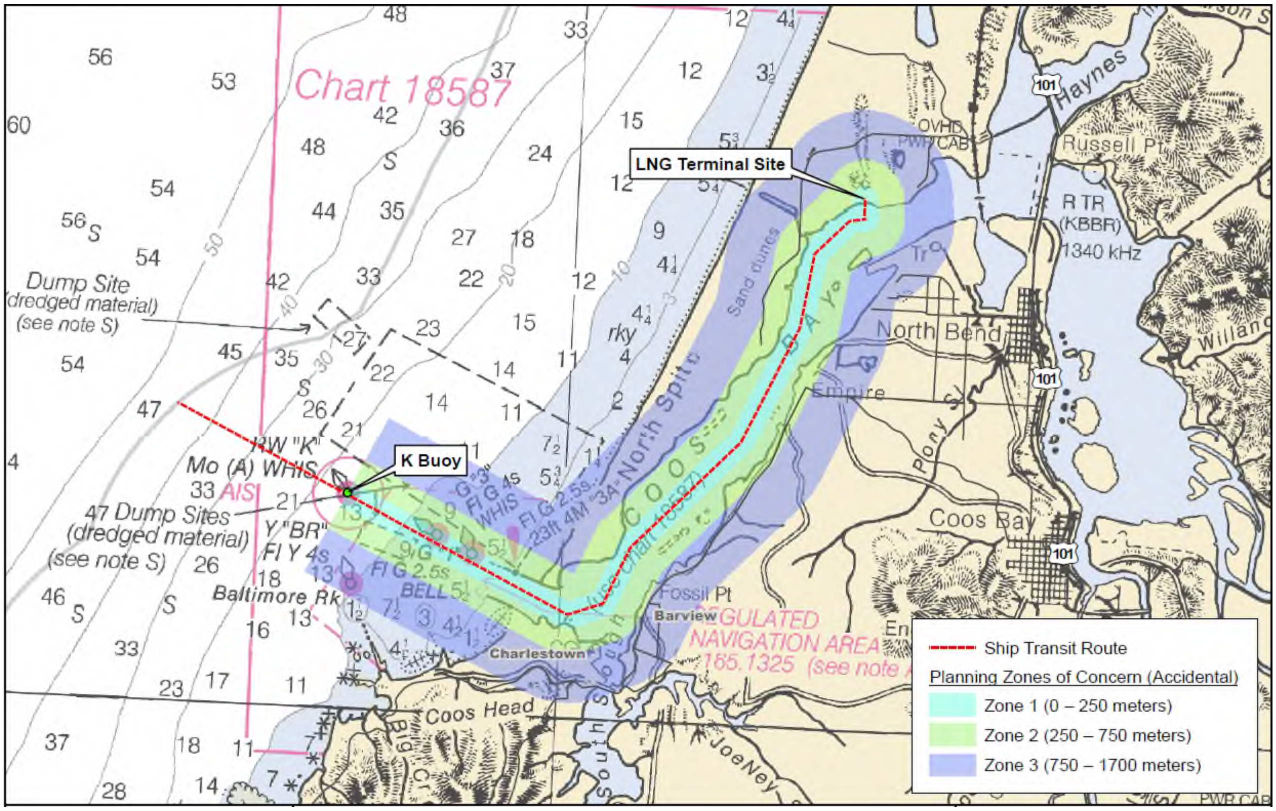

Figure 4.13-1 Accidental Hazard Zones along LNG Marine Vessel Route

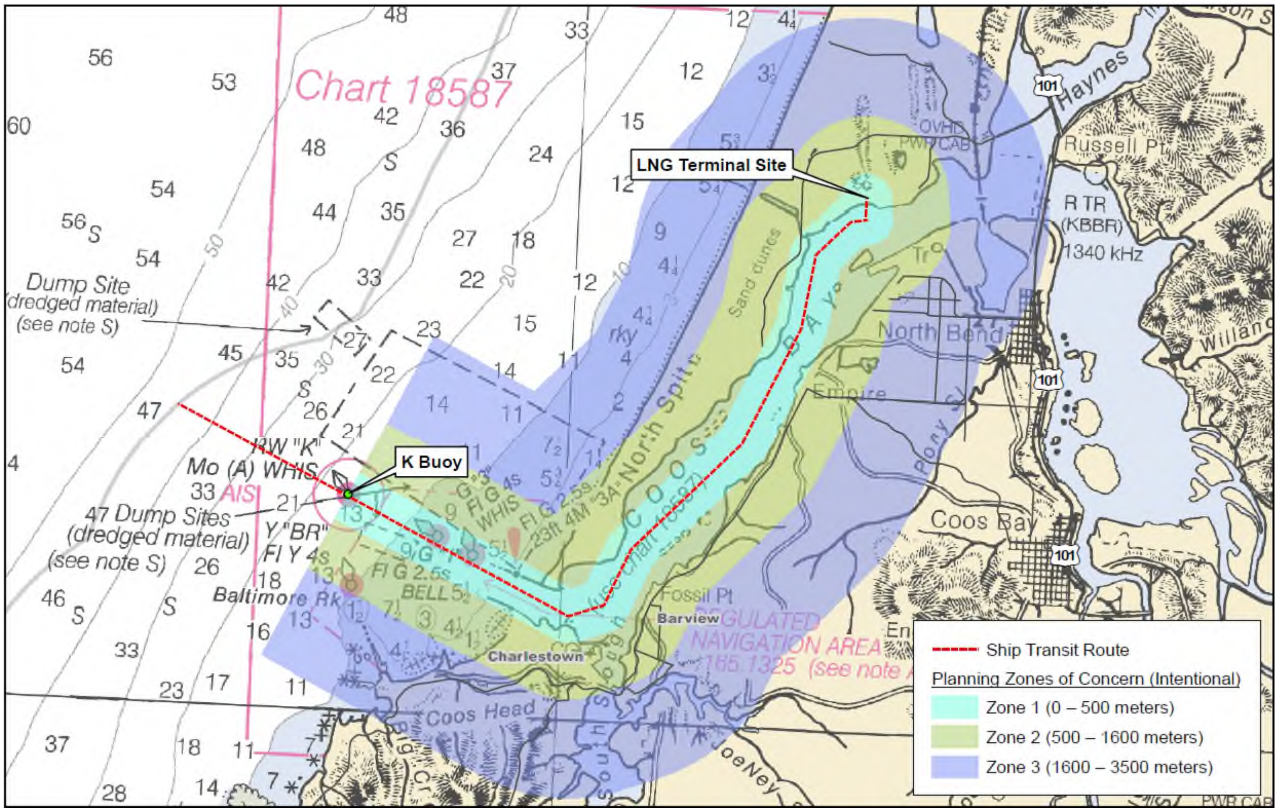

Figure 4.13-2. Intentional Hazard Zones along LNG Marine Vessel Route

U.S. Coast Guard Letter of Recommendation and Analysis

In a letter dated May 10, 2018, the Coast Guard issued an LOR and LOR Analysis to FERC stating that the Coos Bay Channel would be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this Project. As part of its assessment of the safety and security aspects of this Project, the COTP Sector Columbia River consulted a variety of stakeholders including the Area Maritime Security Committees, Harbor Safety Committees, state representatives, pilot organizations, and local emergency responders. The LOR was based on full implementation of the strategies and risk management measures identified by the Coast Guard to Jordan Cove in its WSA.

Although Jordan Cove has suggested mitigation measures for responsibly managing the maritime safety and security risks associated with LNG marine traffic, the necessary vessel traffic and/or facility control measures may change depending on changes in conditions along the waterway. The Coast Guard regulations in 33 CFR 127 require that applicants annually review WSAs until a facility begins operation and submit a report to the Coast Guard identifying any changes in conditions, such as changes to the port environment, the LNG facility, or the LNG marine vessel route, that would affect the suitability of the waterway for LNG marine traffic.

The Coast Guard's LOR is a recommendation, regarding the current status of the waterway, to the FERC, the lead agency responsible for siting the on-shore LNG facility. Neither the Coast Guard nor the FERC has authority to require waterway resources of anyone other than the applicant under any statutory authority or under the Emergency Response Plan (ERP) or the Cost Sharing Plan.

As stated in the LOR, the Coast Guard would assess each transit on a case by case basis to identify what, if any, safety and security measures would be necessary to safeguard the public health and welfare, critical infrastructure and key resources, the port, the marine environment, and the LNG marine vessel.

Under the Ports and Waterways Safety Act, the Magnuson Act, the MTSA, and the Security and Accountability For Every (SAFE) Port Act, the COTP has the authority to prohibit LNG transfer or LNG marine vessel movements within his or her area of responsibility if he or she determines that such action is necessary to protect the waterway, port, or marine environment. If this Project is approved and if appropriate resources are not in place prior to LNG marine vessel movement along the waterway, then the COTP would consider at that time what, if any, vessel traffic and/or facility control measures would be appropriate to adequately address navigational safety and maritime security considerations.

4.13.1.4 LNG Facility Security Regulatory Requirements

The security requirements for the proposed project are governed by 33 CFR 105, 33 CFR 127, and 49 CFR 193 Subpart J - Security. Title 33 CFR 105, as authorized by the MTSA, requires all terminal owners and operators to submit a Facility Security Assessment (FSA) and a Facility Security Plan (FSP) to the Coast Guard for review and approval before commencement of operations of the proposed Project facilities. Jordan Cove would also be required to control and restrict access, patrol and monitor the plant, detect unauthorized access, and respond to security threats or breaches under 33 CFR 105. Some of the responsibilities of the applicant include, but are not limited to:

- designating a Facility Security Officer with a general knowledge of current security threats and patterns, security assessment methodology, vessel and facility operations, conditions, security measures, emergency preparedness, response, and contingency plans, who would be responsible for implementing the FSA and FSP and performing an annual audit for the life of the Project;
- conducting an FSA to identify site vulnerabilities, possible security threats and consequences of an attack, and facility protective measures; developing a FSP based on the FSA, with procedures for: responding to transportation security incidents; notification and coordination with federal, state, and local authorities; prevention of unauthorized access; measures to prevent or deter entrance with dangerous substances or devices; training; and evacuation;
- defining the security organizational structure with facility personnel with knowledge or training in current security threats and patterns; recognition and detection of dangerous substances and devices, recognition of characteristics and behavioral patterns of persons who are likely to threaten security; techniques to circumvent security measures; emergency procedures and contingency plans; operation, testing, calibration, and maintenance of security equipment; and inspection, control, monitoring, and screening techniques;
- implementing scalable security measures to provide increasing levels of security at increasing maritime security levels for facility access control, restricted areas, cargo handling, LNG marine vessel stores and bunkers, and monitoring; ensuring that the Transportation Worker Identification Credential (TWIC) program is properly implemented;

- ensuring coordination of shore leave for LNG marine vessel personnel or crew change out as well as access through the facility for visitors to the LNG marine vessel;
- conducting drills and exercises to test the proficiency of security and facility personnel on a quarterly and annual basis; and
- reporting all breaches of security and transportation security incidents to the National Response Center.

Title 33 CFR 127 has requirements for access controls, lighting, security systems, security personnel, protective enclosures, communications, and emergency power. In addition, an LNG facility regulated under 33 CFR 105 and 33 CFR 127 would be subject to the TWIC Reader Requirements Rule issued by the Coast Guard on August 23, 2016. This rule requires owners and operators of certain vessels and facilities regulated by the Coast Guard to conduct electronic inspections of TWICs (e.g., readers with biometric fingerprint authentication) as an access control measure. The final rule would also include recordkeeping requirements and security plan amendments that would incorporate these TWIC requirements. The implementation of the rule was first proposed to be in effect August 23, 2018. In a subsequent notice issued on June 22, 2018, the Coast Guard indicated delaying the effective date for certain facilities by three years, until August 23, 2021. On August 2, 2018, the President of the United States signed into law the Transportation Worker Identification Credential Accountability Act of 2018 (H.R. 5729). This law prohibits the Coast Guard from implementing the rule requiring electronic inspections of TWICs until after the Department of Homeland Security (DHS) has submitted a report to the Congress. Although the implementation of this rule has been postponed for certain facilities, the company should to consider the rule when developing access control and security plan provisions for the facility.

Title 49 CFR 193 Subpart J also specifies security requirements for the onshore components of LNG terminals, including requirements for conducting security inspections and patrols, liaison with local law enforcement officials, design and construction of protective enclosures, lighting, monitoring, alternative power sources, and warning signs. If the Project is authorized and constructed, compliance with the security requirements of 33 CFR 105, 33 CFR 127, and 49 CFR 193 Subpart J would be subject to the respective Coast Guard and USDOT inspection and enforcement programs.

Jordan Cove provided preliminary information as well as data request responses on these security features and indicated additional details would be completed in the final design. The Project site would install an impervious vapor barriers of heights ranging from 20 feet to 100 feet around portions of the property boundary. However, details of intrusion detection on the barriers would not be finalized until final design. We recommend in section 4.13.1.6 that Jordan Cove provide final design details on these security features for review and approval, including: lighting coverage drawings that illustrate photometric analyses demonstrating the lux levels at the interior of the terminal are in accordance with API 540, and other federal regulations for lighting along the perimeter fence line and along paths/roads of access and egress; camera coverage drawings that illustrate coverage areas of each camera such that the entire perimeter of the plant is covered with redundancy and the interior of plant is covered, including a camera be provided at the top of each LNG storage tank, within pretreatment areas, within liquefaction areas, within truck transfer areas, within marine transfer areas, and buildings; fencing drawings that demonstrate a fence would deter or mitigate entry along the perimeter of the entire facility and is set back from exterior structures and vegetation, and from interior hazardous piping and equipment by at least 10 feet; vehicle barrier and controlled access point drawings that demonstrate crash-rated barriers are provided to prevent uncontrolled access, inadvertent entry, and impacts to components containing hazardous fluids from vehicles. Furthermore, in accordance with the February 2004 Interagency Agreement among FERC, USDOT, and Coast Guard, FERC staff would collaborate with the Coast Guard and USDOT on the Project's security features.

4.13.1.5 FERC Engineering and Technical Review of the Preliminary Engineering Designs

LNG Facility Historical Record

The operating history of the U.S. LNG industry has been free of safety-related incidents resulting in adverse effects on the public or the environment with the exception of the October 20, 1944, failure at an LNG plant in Cleveland, Ohio. The 1944 incident in Cleveland led to a fire that killed 128 people and injured 200 to 400 more people.[196] The failure of the LNG storage tank was due to the use of materials not suited for cryogenic temperatures. LNG migrated through streets and into underground sewers due to inadequate spill impoundments at the site. Current regulatory requirements ensure that proper materials suited for cryogenic temperatures are used in the design and that spill impoundments are designed and constructed properly to contain a spill at the site. To ensure that this potential hazard would be addressed for proposed LNG facilities, we evaluate the preliminary and final specifications for suitable materials of construction and for the design of spill containment systems that would properly contain a spill at the site.

Another operational accident occurred in 1979 at the Cove Point LNG plant in Lusby, Maryland. A pump electrical seal located on a submerged electrical motor LNG pump leaked causing flammable gas vapors to enter an electrical conduit and settle in a confined space. When a worker switched off a circuit breaker, the flammable gas ignited, causing severe damage to the building and a worker fatality. With the participation of the FERC, lessons learned from the 1979 Cove Point accident led to changes in the national fire codes to better ensure that the situation would not occur again. To ensure that this potential hazard would be addressed for proposed facilities that have electrical seal interfaces, we evaluated the preliminary designs and recommend in section 4.13.1.6 that Jordan Cove provide, for review and approval, the final design details of the electrical seal design at the interface between flammable fluids and the electrical conduit or wiring system, details of the electrical seal leak detection system, and the details of a downstream physical break (i.e. air gap) in the electrical conduit to prevent the migration of flammable vapors.

On January 19, 2004, a blast occurred at Sonatrach's Skikda, Algeria, LNG liquefaction plant that killed 27 and injured 56 workers. No members of the public were injured. Findings of the accident investigation suggested that a cold hydrocarbon leak occurred at Liquefaction Train 40 and was introduced into a high-pressure steam boiler by the combustion air fan. An explosion developed inside the boiler firebox, which subsequently triggered a larger explosion of the hydrocarbon vapors in the immediate vicinity. The resulting fire damaged the adjacent liquefaction process and liquid petroleum gas separation equipment of Train 40, and spread to Trains 20 and 30. Although Trains 10, 20, and 30 had been modernized in 1998 and 1999, Train 40 had been operating with

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[196] For a description of the incident and the findings of the investigation, see "U.S. Bureau of Mines, Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944," dated February 1946.

its original equipment since start-up in 1981. To ensure that this potential hazard would be addressed for proposed facilities, we evaluated the preliminary design for mitigation of flammable vapor dispersion and ignition in buildings and combustion equipment to ensure they would be adequately covered by hazard detection equipment that could isolate and deactivate any combustion equipment whose continued operation could add to or sustain an emergency. We also recommend in section 4.13.1.6 that Jordan Cove provide, for review and approval, the final design details of hazard detection equipment, including the location and elevation of all detection equipment, instrument tag numbers, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment.

On March 31, 2014, a detonation occurred within a gas heater at Northwest Pipeline Corporation's LNG peak-shaving plant in Plymouth, Washington.[197] This internal detonation subsequently caused the failure of pressurized equipment, resulting in high velocity projectiles. The plant was immediately shut down, and emergency procedures were activated, which included notifying local authorities and evacuating all plant personnel. No members of the public were injured, but one worker was sent to the hospital for injuries. As a result of the incident, the liquefaction trains and a compressor station located onsite were rendered inoperable. Projectiles from the incident also damaged the control building that was located near pre-treatment facilities and penetrated the outer shell of one of the LNG storage tanks. All damaged facilities were ultimately taken out of service for repair. The accident investigation showed that an inadequate purge after maintenance activities resulted in a fuel-air mixture remaining in the system. The fuel-air mixture auto-ignited during startup after it passed through the gas heater at full operating pressure and temperature. To ensure that this potential hazard would be addressed for proposed facilities, we recommend in section 4.13.1.6 that Jordan Cove provide a plan for purging, for review and approval, which addresses the requirements of the American Gas Association Purging Principles and Practice and to provide justification if not using an inert or non-flammable gas for purging. In evaluating such plans, we would assess whether the purging could be done safely based on review of other plans and lessons learned from this and other past incidents. If a plan proposes the use of flammable mediums for cleaning, dry-out or other activities, we would evaluate the plans against other recommended and generally accepted good engineering practices, such as NFPA 56, Standard for Fire and Explosion Prevention during Cleaning and Purging of Flammable Gas Piping Systems.

We also recommend in section 4.13.1.6 that Jordan Cove provide, for review and approval, operating and maintenance plans, including safety procedures, prior to commissioning. In evaluating such plans, we would assess whether the plans cover all standard operations, including purging activities associated with startup and shutdown. Also, in order to prevent other sources of projectiles from affecting occupied buildings and storage tanks, we recommend in section 4.13.1.6 that Jordan Cove incorporate mitigation into their final design with supportive information, for review and approval, that demonstrates it would mitigate the risk of a pressure vessel burst or boiling liquid expanding vapor explosion (BLEVE) from occurring.

FERC Preliminary Engineering Review

FERC requires an applicant to provide safety, reliability, and engineering design information as part of its application, including hazard identification studies and front-end-engineering-design (FEED) information for its proposed Project. FERC staff evaluates this information with a focus

[197] For a description of the incident and the findings of the investigation, see Root Cause Failure Analysis, Plymouth LNG Plant Incident Investigation under CP14-515.

on potential hazards from within and nearby the site, including external events, which may have the potential to cause damage or failure to the Project facilities, and the engineering design and safety and reliability concepts of the various protection layers to mitigate the risks of potential hazards.

The primary concerns are those events that could lead to a hazardous release of sufficient magnitude to create an offsite hazard or interruption of service. Furthermore, the potential hazards are dictated by the site location and the engineering details. In general, FERC staff considers an acceptable design to include various layers of protection or safeguards to reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public. These layers of protection are generally independent of one another so that any one layer would perform its function regardless of the initiating event or failure of any other protection layer. Such design features and safeguards typically include:

- a facility design that prevents hazardous events, including the use of inherently safer designs; suitable materials of construction; adequate design margins from operating limits for process piping, process vessels, and storage tanks; adequate design for wind, flood, seismic, and other outside hazards;
- control systems, including monitoring systems and process alarms, remotely-operated control and isolation valves, and operating procedures to ensure that the facility stays within the established operating and design limits;
- safety instrumented prevention systems, such as safety control valves and emergency shutdown systems, to prevent a release if operating and design limits are exceeded;
- physical protection systems, such as appropriate electrical area classification, proper equipment and building spacing, pressure relief valves, spill containment, and cryogenic, overpressure, and fire structural protection, to prevent escalation to a more severe event;
- site security measures for controlling access to the plant, including security inspections and patrols, response procedures to any breach of security, and liaison with local law enforcement officials; and
- onsite and offsite emergency response, including hazard detection and control equipment, firewater systems, and coordination with local first responders, to mitigate the consequences of a release and prevent it from escalating to an event that could impact the public.

The inclusion of such protection systems or safeguards in a plant design can minimize the potential for an initiating event to develop into an incident that could impact the safety of the offsite public. The review of the engineering design for these layers of protection are initiated in the application process and carried through to the next phase of the proposed project in final design if authorization is granted by the Commission.

The reliability of these layers of protection is informed by occurrence and likelihood of root causes and the potential severity of consequences based on past incidents and validated hazard modeling. As a result of the continuous engineering review, we recommend mitigation measures and continuous oversight to the Commission for consideration to include as conditions in the order. If a facility is authorized and recommendations are adopted as conditions to the order, FERC staff would continue its engineering review through final design, construction, commissioning, and operation.

Process Design

In order to liquefy natural gas, most liquefaction technologies require that the feed gas stream be pre-treated to remove components that could freeze out and clog the liquefaction equipment or would otherwise be incompatible with the liquefaction process or equipment, including mercury, H_2S, CO_2, water, and heavy hydrocarbons. For example, mercury is typically limited to concentrations of less than 0.01 micrograms per normal cubic meter because it can induce embrittlement and corrosion resulting in a catastrophic failure of equipment.

The inlet gas would be conditioned to remove solids and water droplets prior to entering feed gas pretreatment processes. Once the inlet gas is conditioned, the feed gas would enter the mercury removal system to reduce the mercury concentration in the feed gas. After mercury removal, the feed gas would contact an amine-based solvent solution in the amine contactor column to remove the H_2S and CO_2 (i.e., acid gas) present in the feed gas. Once the acid gas components accumulate in the amine solution, the amine solution is routed to an amine regenerator column that utilizes a reboiler to create hot amine vapor. Contact with the hot amine vapor would regenerate the amine solution by using heat to release the acid gas. The regenerated amine solution would be recycled back to the amine contactor column and the removed acid gas would be sent through a sulfur removal unit to remove H_2S. The acid gas stream is then routed to a thermal oxidizer, where CO_2, trace amounts of H_2S not removed in the sulfur removal unit, and trace amounts of hydrocarbons would be incinerated. The feed gas exiting the amine contactor column enters a knock out drum where bulk water would be recovered and recycled back to the amine contactor column. After the knock out drum, any remaining water in the feed gas would be removed using regenerative molecular sieve beds. Water collected during the molecular sieve regeneration process would be routed back to the amine contactor column. After water removal, the treated dry gas would flow to the liquefaction unit.

Heavy hydrocarbon removal would be integrated into the liquefaction process. The first pass through the refrigeration process would be used to remove heavy hydrocarbons at intermediate temperatures. The feed gas would flow into deethanizer to remove the liquids. The vapor portion would reenter the refrigeration process and would be sub-cooled into LNG. The liquid portion from the deethanizer would flow into the deethanizer reboiler stabilizer to further separate the heavier hydrocarbons from the lighter hydrocarbons. The heavier hydrocarbons exiting the deethanizer reboiler would be sent to the fuel gas system and the lighter hydrocarbons would be returned to the deethanizer for further processing. The LNG exiting the refrigeration process would flow to an LNG expander to reduce pressure, then into an LNG flash vessel before being pumped to two full containment LNG storage tanks.

In order to achieve the cryogenic temperatures needed to liquefy the natural gas stream in the above process, the gas would be cooled by a thermal exchange process driven by a closed loop refrigeration system using mixed refrigerants comprised of a mixture of nitrogen, methane, ethylene, propane, and isopentane. Methane would be provided from the treated dry feed gas stream entering the refrigeration process and the other refrigerants required for the liquefaction process would be delivered by truck and stored onsite for initial filling and use, as needed, for make-up. Truck unloading facilities would be provided to unload make-up refrigerants.

During export operations, LNG stored within the LNG storage tanks would be sent out through multiple in-tank pumps (the pump discharge piping would penetrate through the roof and is an inherently safer design when compared to penetrating the side of an LNG storage tank) and would be routed through a marine transfer line and multiple liquid marine transfer arms connected to an LNG marine vessel. In order to keep the marine transfer line cold between LNG export cargoes, an LNG recirculation line would keep the marine transfer line cold and avoid cool down prior to every LNG marine vessel loading operation. The LNG transferred to the LNG marine vessel would displace vapors from the marine vessel, which would be sent back through a vapor marine transfer arm, a vapor return line, and into the boil-off gas (BOG) header. Once loaded, the LNG marine vessel would be disconnected and leave for export. Low pressure BOG generated from stored LNG (LNG is continuously boiling), vapors returned during LNG marine vessel filling operations, and flash gas from the LNG flash vessel would be compressed and would be routed to the fuel gas system. The closed BOG system would prevent the release of BOG to the atmosphere and would be in accordance with NFPA 59A. This would be an inherently safer design when compared to allowing the BOG to vent to the atmosphere.

The Project would include many utilities and associated auxiliary equipment. The major auxiliary systems required for the operation of the liquefaction facility include BOG, fuel gas, flares, instrument and utility air supply, water supply, demineralized water, steam, aqueous ammonia, nitrogen, diesel, and backup power. Three flare systems would be designed to handle and control the vent gases from the process areas. The warm and cold flare would be routed to a common ground flare and the marine flare would be routed to a dedicated enclosed cylindrical ground flare. High pressure steam created using refrigerant compressor driver exhaust gas waste heat would generate electricity for the facility via the Steam Turbine Generators and would also supply heat to the Regeneration Gas Heater. Low pressure steam would provide heat to the Feed Inlet Heater, Amine Reboiler, Sulfur Scavenger Inlet Heater, Fuel Gas Superheater, and the Defrost Heater. An auxiliary steam boiler would be provided to generate steam when the refrigerant compressors are not in operation. A diesel storage tank would be provided to supply two standby diesel generators that would support the black start and power backup capability. The diesel storage tank would also supply three diesel firewater pumps. Trucks would fill a liquid nitrogen storage tank and vaporizers would supply gaseous nitrogen for refrigerant make-up. Site generated nitrogen would be used for compressor seals, purging activities, and utility stations as well as for pre-commissioning and start-up activities. In addition, aqueous ammonia would be used for pH adjustment in the steam system and to reduce nitrogen oxide emissions from the refrigerant compressor drivers.

The failure of process equipment could pose potential harm if not properly safeguarded through the use of appropriate engineering controls and operation. Jordan Cove would install process control valves and instrumentation to safely operate and monitor the facilities. Alarms would have visual and audible notification in the control room to warn operators that process conditions may be approaching design limits. Jordan Cove would design their control systems and human machine interfaces to the International Society for Automation (ISA) Standards 5.3, 5.5, 60.1, 60.3, 60.4, and 60.6, and other standards and recommended practices. Jordan Cove indicates that an alarm management program in accordance with ISA Standard 18.2 would be in place to ensure the effectiveness of the alarms. We recommend in section 4.13.1.6 that Jordan Cove develop and implement the alarm management program prior to introduction of hazardous fluids.

Operators would have the capability to take action from the control room to mitigate an upset. Jordan Cove would develop facility operation procedures after completion of the final design; this timing is fully consistent with accepted industry practice. We recommend in section 4.13.1.6 that Jordan Cove provide more information, for review and approval, on the operating and maintenance procedures, including safety procedures, hot work procedures and permits, abnormal operating conditions procedures, and personnel training prior to commissioning. We would evaluate these procedures to ensure that an operator can operate and maintain all systems safely, based on benchmarking against other operating and maintenance plans and comparing against recommended and generally accepted good engineering practices, such as American Institute of Chemical Engineers (AIChE) Center for Chemical Process Safety (CCPS), *Guidelines for Writing Effective Operating and Maintenance Procedures*, AIChE CCPS, *Guidelines for Management of Change for Process Safety*, AIChE CCPS, *Guidelines for Effective Pre-Startup Safety Reviews, AGA*, *Purging Principles and Practices*, and NFPA 51B, *Standards for Fire Prevention During Welding, Cutting, and Other Hot Work*. In addition, we recommend in section 4.13.1.6 that Jordan Cove tag and label instrumentation and valves, piping, and equipment and provide car-seals/locks to address human factor considerations and improve facility safety and prevent incidents.

In the event of a process deviation, emergency shutdown (ESD) valves and instrumentation would be installed to monitor, alarm, shutdown, and isolate equipment and piping during process upsets or emergency conditions. The Project would also have a plant-wide emergency shutdown system to initiate closure of valves and shutdown of the process during emergency situations as well as the ability to shutdown specific areas to address local emergency conditions. Safety-instrumented systems would comply with ISA Standard 84.00.01 and other recommended and generally accepted good engineering practices. We also recommend in section 4.13.1.6 that Jordan Cove file information, for review and approval, on the final design, installation, and commissioning of instrumentation and emergency shutdown equipment to ensure appropriate cause-and-effect alarm or shutdown logic and enhanced representation of the emergency shutdown system in the plant control room and throughout the plant.

In developing the FEED, Jordan Cove conducted a Hazard Identification (HAZID) review project's preliminary design based on the proposed process flow diagrams and the plot plans. In addition, the Jordan Cove performed two Hazard and Operability and Layer of Protection Analysis (HAZOP and LOPA) Studies. Each HAZOP was used to identify and analyze the potential hazards within the design that might pose an unacceptable risk to people, the environment, and assets and was based on the piping and instrumentation diagrams. Each LOPA was used to analyze selected scenarios of high risk to personnel, the environment, or assets, as identified in the HAZOP, to assure the appropriate risk level reduction, based on risk reduction factors for the hazard.

A more detailed hazard and operability review (HAZOP) analysis would be performed by Jordan Cove during the final design to identify the major process hazards that may occur during the operation of the facilities. The HAZOP study would be intended to address hazards of the process, engineering, and administrative controls and would provide a qualitative evaluation of a range of possible safety, health, and environmental consequences that may result from the process hazard, and identify whether there are adequate safeguards (e.g., engineering and administrative controls) to prevent or mitigate the risk from such events. Where insufficient engineering or administrative controls were identified, recommendations to prevent or minimize these hazards would be generated from the results of the HAZOP review. We recommend in section 4.13.1.6 that Jordan Cove file the HAZOP study on the completed final design for review and approval. We would evaluate the HAZOP to ensure all systems and process deviations are addressed appropriately based on likelihood, severity, and risk values with commensurate layers of protection in accordance with recommended and generally accepted good engineering practices, such as American Institute of Chemical Engineers, Guidelines for Hazard Evaluation Procedures. We also recommend in section 4.13.1.6 that Jordan Cove file the resolutions of the recommendations generated by the HAZOP review be provided for review and approval by FERC staff. Once the design has been subjected to a HAZOP review, the design development team would track, manage, and keep records of changes in the facility design, construction, operations, documentation, and personnel. Jordan Cove would evaluate these changes to ensure that the safety, health, and environmental risks arising from these changes are addressed and controlled based on its management of change procedures. If our recommendations are adopted into the order, resolutions of the recommendations generated by the HAZOP review would be monitored by FERC staff. We also recommend in section 4.13.1.6 that Jordan Cove file all changes to their FEED for review and approval by FERC staff. However, major modifications could require an amendment or new proceeding.

If the Project is authorized and constructed, Jordan Cove would install equipment in accordance with its design. We recommend in section 4.13.1.6 that Project facilities be subject to construction inspections and that Jordan Cove provide, for review and approval, commissioning plans, procedures and commissioning demonstration tests that would verify the performance of equipment. In addition, we recommend in section 4.13.1.6 that Jordan Cove provide semi-annual reports that include abnormal operating conditions and planned facility modifications. Furthermore, we recommend in section 4.13.1.6 that the Project facilities be subject to regular inspections throughout the life of the facilities to verify that equipment is being properly maintained and to verify basis of design conditions, such as feed gas and sendout conditions, do not exceed the original basis of design.

Mechanical Design

Jordan Cove provided codes and standards for the design, fabrication, construction, and installation of piping and equipment and specifications for the facility. The design specifies materials of construction and ratings suited to the pressure and temperature conditions of the process design. Piping would be designed, fabricated, assembled, erected, inspected, examined, and tested in accordance with the American Society of Mechanical Engineers (ASME) Standards B31.3, B36.10, and B36.19. Valves and fittings would be designed to standards and recommended practices such as API Standards 594, 598, 600, 602, 603, 607, 608, 609, and 623; ASME Standards B16.5, B16.9, B16.10, B16.20, B16.21, B16.25, B16.34, B16.36 and B16.47; and ISA Standards 75.01.01, 75.05.01, 75.08.01, and 75.08.05. Portions of the facility regulated under 33 CFR 127 for the marine transfer system, including piping, hoses, and loading arms should also be tested in accordance with 33 CFR 127.407.

Pressure vessels must be designed, fabricated, inspected, examined, and tested in accordance with ASME Boiler and Pressure Vessel Code (BPVC) Section VIII and per 49 CFR 193 Subparts C, D, and E and NFPA 59A (2001). LNG storage tanks must be designed, fabricated, tested, and inspected in accordance with 49 CFR 193 Subpart D, NFPA 59A (2001 and 2006), and API Standard 620. In addition, Jordan Cove would design, fabricate, test, and inspect the LNG storage tanks in accordance with API Standard 625 and American Concrete Institute (ACI) 376. Other low-pressure storage tanks such as the amine storage tank would be designed, inspected, and maintained in accordance with the API Standards 650 and 653. All LNG storage tanks would also include boil-off gas compression to prevent the release of boil-off to the atmosphere in accordance with NFPA 59A (2001) for an inherently safer design. The Heat exchangers would be designed to ASME BPVC Section VIII standards; API Standards 660 and 661; the Tubular Exchanger Manufacturers Association (TEMA) standards; and Aluminum Plate-Fin Heat Exchanger Manufacturer's Association (ALPEMA) guidelines. Rotating equipment would be designed to standards and recommended practices, such as API Standards 610, 613, 614, 617, 618, 619, 670, 672, 674, 675, 676, and 682; and ASME Standards B73.1 and B73.2. Fired heaters would be specified and designed to standards and recommended practices, such as API Standards 530, 556 and 560, and NFPA 85.

Pressure and vacuum safety relief valves, a vent stack, and flares would be installed to protect the storage containers, pressure vessels, process equipment, and piping from an unexpected or uncontrolled pressure excursion. The safety relief valves would be designed to handle process upsets and thermal expansion within piping, per NFPA 59A (2001) and ASME Section VIII; and would be designed in accordance with API Standards 520, 521, 526, 527, 537, and 2000; ASME Standards B31.3; and other recommended and generally accepted good engineering practices. In addition, the operator should verify the set pressure of the pressure relief valves meet the requirements in 33 CFR 127.407. We recommend in section 4.13.1.6 Jordan Cove provide final design information on pressure and vacuum relief devices, vent stack, and flares, for review and approval, to ensure that the final sizing, design, and installation of these components are adequate and in accordance with the standards reference and other recommended and generally accepted good engineering practices.

Although many of the codes and standards were listed as ones the project would meet, Jordan Cove did not make reference to all codes and standards required by regulations or are recommended and generally accepted good engineering practices. Therefore, we recommend in section 4.13.1.6 that Jordan Cove provide the final specifications for all equipment and a summarized list of all referenced codes and standards for review and approval. If the Project is authorized and constructed, Jordan Cove would install equipment in accordance with its specifications and design, and FERC staff would verify equipment nameplates to ensure equipment is being installed based on approved design. In addition, FERC staff would conduct construction inspections including reviewing quality assurance and quality control plans to ensure construction work is being performed according to proposed Project specifications, procedures, codes, and standards. We recommend in section 4.13.1.6 Jordan Cove provide semi-annual reports that include equipment malfunctions and abnormal maintenance activities. In addition, we recommend in section 4.13.1.6 that the Project facilities be subject to inspections to verify that the equipment is being properly maintained during the life of the facility.

Hazard Mitigation Design

If operational control of the facilities were lost and operational controls and emergency shutdown systems failed to maintain the Project within the design limits of the piping, containers, and safety relief valves, a release could potentially occur. FERC regulations under 18 CFR 380.12 (o) (1) through (4) require applicants to provide information on spill containment, spacing and plant layout, hazard detection, hazard control, and firewater systems. In addition, 18 CFR 380.12 (o) (7) require applicants to provide engineering studies on the design approach and 18 CFR 380.12 (o) (14) requires applicants to demonstrate how they comply with 49 CFR 193 and NFPA 59A.

As required by 49 CFR 193 Subpart I and by incorporation section 9.1.2 of NFPA 59A (2001), fire protection must be provided for all USDOT regulated LNG facilities based on an evaluation of sound fire protection engineering principles, analysis of local conditions, hazards within the facility, and exposure to or from other property. NFPA 59A (2001) also requires the evaluation on the type, quantity, and location of hazard detection and hazard control, passive fire protection, emergency shutdown and depressurizing systems, and emergency response equipment, training, and qualifications. If authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 Subpart I and would be subject to USDOT's inspection and enforcement programs. However, NFPA 59A (2001) also indicates the wide range in size, design, and location of LNG facilities precludes the inclusion of detailed fire protection provisions that apply to all facilities comprehensively and includes subjective performance-based language on where ESD systems and hazard control are required and does not provide any additional guidance on placement or selection of hazard detection equipment and provides minimal requirements on firewater. Also, the project marine facilities would be subject to 33 CFR 127, which incorporates sections of NFPA 59A (1994), which have similar performance-based guidance. Therefore, FERC staff evaluated the proposed spill containment and spacing, hazard detection, emergency shutdown and depressurization systems, hazard control, firewater coverage, structural protection, and onsite and offsite emergency response to ensure they would provide adequate protection of the LNG facilities as described below.

Jordan Cove performed a preliminary fire protection evaluation to ensure that adequate mitigation would be in place, including spill containment and spacing, hazard detection, emergency shutdown and depressurization systems, hazard control, firewater coverage, structural protection, and onsite and offsite emergency response. We recommend in section 4.13.1.6 that Jordan Cove provide a final fire protection evaluation that evaluates the type, quantity, and location of hazard detection and hazard control, passive fire protection, emergency shutdown and depressurizing systems, and emergency response equipment, training, and qualifications in accordance with NFPA 59A (2001), and to provide more information on the final design, installation, and commissioning of spill containment, hazard detection, hazard control, firewater systems, structural fire protection, and onsite and offsite emergency response procedures for review and approval.

Spill Containment

In the event of a release, sloped areas at the base of storage and process facilities would direct a spill away from equipment and into the impoundment system. This arrangement would minimize the dispersion of flammable vapors into confined, occupied, or public areas and minimize the potential for heat from a fire to impact adjacent equipment, occupied buildings, or public areas if ignition were to occur.

Title 49 CFR 193.2181 Subpart C specifies that each impounding system serving an LNG storage tank must have a minimum volumetric liquid capacity of 110 percent of the LNG tank's maximum design liquid capacity for an impoundment serving a single tank, unless surge is accounted for in the impoundment design. If authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 Subpart C and would be subject to USDOT's inspection and enforcement programs. For full containment LNG tanks, we also consider it prudent to provide a barrier to prevent liquid from flowing to an unintended area (i.e., outside the plant property). The purpose of the barrier is to prevent liquid from flowing off the plant property and does not define containment or an impounding area for thermal radiation or flammable vapor exclusion zone calculations or other code requirements already met by sumps and impoundments throughout the site. Jordan Cove proposes two full-containment LNG storage tanks for which the outer tank wall would serve as the impoundment system. FERC staff verified that the LNG storage tank's outer concrete wall would have a liquid capacity of at least 110 percent of the inner LNG tank's maximum liquid capacity. In addition, Jordan Cove would also install a berm around the LNG storage tank area to prevent liquid in the storage tank area from flowing off-site in the event of an outer tank impoundment failure.

Jordan Cove proposes to install curbing, paving, and trenches to direct potential LNG, refrigerant, and heavy hydrocarbon liquid releases to the Process/Tank Impoundment Basin. LNG releases from ship loading piping would be directed to either the Process/Tank Impoundment Basin or the Marine Impoundment Basin. Releases in the refrigerant storage area or from refrigerant delivery trucks would be collected in curbed areas and directed via a trench to the Refrigerant Storage Impoundment Basin. This basin would be sized to be greater than the largest refrigerant storage tank. Jordan Cove would also include local containment walls around the Amine Make-up Storage Tank, Liquid Nitrogen Storage Tank, Ammonia Storage Tank, and Diesel Storage Tank which would have a volumetric capacity of greater than 110 percent of the maximum liquid volume in each storage tank. The design would also include curbed areas in the acid gas removal area to contain amine releases. However, Jordan Cove did not propose a spill containment system to collect liquid releases from the Warm Flare Knockout Drum. Therefore we recommend in section 4.13.1.6 that Jordan Cove specify a spill containment system around the Warm Flare Knockout Drum.

Under NFPA 59A (2001), section 2.2.2.2, the capacity of impounding areas for vaporization, process, or LNG transfer areas must equal the greatest volume that can be discharged from any single accidental leakage source during a 10-minute period or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the USDOT. If authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 Subpart C and would be subject to USDOT's inspection and enforcement programs. The impoundment system design for the marine facilities would be subject to the Coast Guard's 33 CFR 127, which does not specify a spill or duration for impoundment sizing. However, we evaluate whether all hazardous liquids are provided with spill containment based on the largest flow capacity from a single pipe for 10 minutes accounting for de-inventory or the liquid capacity of the largest vessel (or total of impounded vessels) served, whichever is greater and whether providing spill containment reduces consequences from a release. We recommend in section 4.13.1.6 that Jordan Cove provide additional information on the final design of the impoundment systems for review and approval.

Jordan Cove indicated that all piping, hoses, and equipment that could produce a hazardous liquid spill would be provided with spill collection and/or spill conveyance systems. Furthermore, Jordan Cove indicates that the stormwater pumps would be automatically operated by level control and interlocked using redundant low temperature detectors to prevent pumps from operating if LNG is present within the LNG spill basins. Although stormwater removal pumps would be proposed for the large impoundment basins, Jordan Cove proposes to install normally-closed valves on local curbed areas and within bund walls to allow analysis of stormwater prior to routing it to the drainage channels. Jordan Cove is consulting with USDOT on the use of normally-closed valves instead of stormwater removal pumps required in 49 CFR 193 Subpart C. Therefore we recommend in section 4.13.1.6 that Jordan Cove provide correspondence from USDOT on the use of normally closed valves to remove stormwater from curbed areas. In addition, low temperature detectors would not stop the stormwater removal pumps from operating in the event a relatively warm heavy hydrocarbon release reaches the impoundment basins. Therefore, Jordan Cove indicated that gas detectors would be provided to prevent the stormwater removal pumps from operating if warm refrigerant or heavy hydrocarbon releases could reach an impoundment basin. If the facilities are approved and constructed, final compliance with the requirements of 49 CFR 193 Subpart C, would be subject to USDOT's inspection and enforcement programs.

If a project is authorized and constructed, Jordan Cove would install spill impoundments in accordance with its design and FERC staff would verify during construction inspections that the spill containment system including dimensions, and slopes of curbing and trenches, and volumetric capacity matches final design information. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facility to verify that impoundments are being properly maintained.

Spacing and Plant Layout

The spacing of vessels and equipment between each other, from ignition sources, and to the property line must meet the requirements of 49 CFR 193 Subparts C, D, and E, which incorporate NFPA 59A (2001). NFPA 59A (2001) includes spacing and plant layout requirements and further references NFPA 30, NFPA 58, and NFPA 59 for additional spacing and plant layout requirements. If authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to USDOT's inspection and enforcement programs.

In addition, FERC staff evaluated the spacing to determine if there could be cascading damage and to inform what fire protection measures may be necessary to reduce the risk of cascading damage. If spacing to mitigate the potential for cascading damage was not practical, we evaluated whether other mitigation measures were in place and evaluated those systems in further detail as discussed in subsequent sections in section 4.13.5.5. We evaluated the spacing of buildings in line with AIChE CCPS *Guidelines for Evaluating Process Plant Buildings for External Explosions and Fires* and API 752, which provide guidance on identifying and evaluating explosion and fire impacts to plant buildings and occupants resulting from events external to the buildings. Jordan Cove submitted a building siting analysis based on API 752 and also indicated it would meet ASCE 59 to determine explosion impacts to plant buildings. In addition, FERC staff evaluated other hazards associated with releases and whether any damage would likely occur at buildings or would result in cascading damage.

To minimize the risk of cryogenic spills causing structural supports and equipment from cooling below their minimum design metal temperature, Jordan Cove would generally locate cryogenic equipment away from process areas and would have spill containment systems for cryogenic spills that would direct them to a remote impoundment. In addition, Jordan Cove would protect equipment and structural steel against cold shocks through selection of suitable materials of construction or by the application of cold spill protection. We recommend in section 4.13.1.6 that Jordan Cove file drawings and specifications for structural passive protection systems to protect equipment and supports that could be exposed to cryogenic releases.

To minimize risk for flammable or toxic vapor ingress into buildings and from reaching areas that could result in cascading damage from explosions, Jordan Cove would generally locate buildings away from process areas and would locate fired equipment and ignition sources away from process areas. In addition, the LNG storage tanks are generally located away from process equipment and process facilities are relatively unconfined and uncongested. Therefore, we recommend in section 4.13.1.6 that Jordan Cove conduct a technical review of facility, for review and approval, identifying all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and verify that these areas would be adequately covered by hazard detection devices that would isolate or shut down any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency. In addition, we recommend in section 4.13.1.6 that Jordan Cove demonstrate adequate ventilation and detection in the battery rooms to mitigate hydrogen build up from battery off-gas. We also recommend in section 4.13.1.6 that Project facilities be subject to periodic inspections during construction to verify flammable/toxic gas detection equipment is installed in heating, ventilation, and air condition intakes of buildings at appropriate locations. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facilities to continue to verify that flammable/toxic gas detection equipment installed in building air intakes function as designed and are being maintained and calibrated.

To minimize overpressures from vapor cloud explosions, we evaluated how flammable vapors would be prevented from accumulating within confined areas. Jordan Cove would design for overpressures in accordance with API 753, ASCE 41088, and other recommended and generally accepted good engineering practices. In addition, explosions in process areas were evaluated and demonstrated to produce less than 1 psi side on overpressure at the LNG storage tanks. However, vapor dispersion could disperse underneath the LNG storage tanks. Therefore, we recommend in section 4.13.1.6 that Jordan Cove file an analysis for review and approval that demonstrates the flammable vapor dispersion from design spills would be prevented from dispersing underneath the elevated LNG storage tanks or detail how the LNG storage tanks would be able to withstand an overpressure due to ignition of the flammable vapors that disperse underneath the elevated LNG storage tanks.

To minimize the risk of pool fires from causing cascading damage, Jordan Cove located the spill impoundments such that the radiant heats would have a minimal impact on most areas of the plant. Fires within the process impoundments would be spaced such that there would not be high radiant heats on any equipment. A fire from the LNG storage tank outer containment walls would result in radiant heats over 10,000 Btu/ft^2-hr at the adjacent LNG storage tank. Therefore, we recommend in section 4.13.1.6 that Jordan Cove file an analysis for review and approval demonstrating the tanks can withstand the radiant heat from adjacent LNG storage tank fires. In addition, a fire from the tank outer walls would result in less than 4,000 Btu/ft^2-hr in most other areas of the plant with the exception of the LNG Flash Drum and the Auxiliary Boiler. Jordan Cove would install fixed water spray systems that would cover the LNG Flash Drum and Auxiliary Boiler. In addition, the LNG Flash Drum would be insulated for cryogenic service which would shield the equipment from the radiant heat.

To minimize the risk of jet fires from causing cascading damage that could exacerbate the initial hazard, Jordan Cove would shroud the LNG transfer piping and LNG product header and would locate flammable and combustible containing piping and equipment away from buildings and process areas that do not handle flammable and combustible materials. Jordan Cove would also install emergency shutdown systems that would limit the duration of a jet fire event, depressurization systems that would reduce the pressure in equipment, and would install firewater systems to cool equipment and structures as described in subsequent sections in section 4.13.5.5. In addition, we recommend in section 4.13.1.6 that Jordan Cove file drawings of the passive structural fire protection for review and approval for structural supports and equipment.

In addition, FERC staff evaluated the spacing to determine if there could be cascading damage and to inform what fire protection measures may be necessary to reduce the risk of cascading damage. Thermal radiation levels from an LNG tank roof top fire and other impoundments could potentially impact process equipment, process vessels, and piperacks located within the pretreatment area, liquefaction trains, BOG compressor area, the utility area, and at the Marine Flare. To mitigate against a LNG tank roof top fire, impoundment fires, and jet fires within the plant, Jordan Cove proposes thermal radiation mitigation measures to prevent cascading events in the design, including thermal protection insulation, fire-retardant insulation materials, emergency depressurization, flame, combustible gas and low temperature detectors, fire proofing of structural steel columns supporting critical equipment, fixed automatic firewater spray system, high expansion foam system, and firewater monitors and hydrants. However, details of these systems would be done in final design. Therefore, we recommend in section 4.13.1.6 that Jordan Cove provide the final design of these thermal mitigation measures, for review and approval, to demonstrate cascading events would be mitigated.

If the project is authorized, Jordan Cove would finalize the plot plan, and we recommend in section 4.13.1.6 that Jordan Cove provide any changes for review and approval to ensure capacities and setbacks are maintained. If the facilities are constructed, Jordan Cove would install equipment in accordance with the spacing indicated on the plot plans. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to periodic inspections during construction to verify equipment is installed in appropriate locations and the spacing is met in the field. We also recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facilities to continue to verify that equipment setbacks from other equipment and ignition sources are being maintained during operations.

Ignition Controls

Jordan Cove LNG Project's plant areas would be designated with a hazardous electrical classification and process seals commensurate with the risk of the hazardous fluids being handled in accordance with NFPA 59A (2001), 70, 497, and API RP 500. If authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to USDOT's inspection and enforcement programs, which require compliance, by incorporation by reference, with NFPA 59A (2001) and NFPA 70 (1999). The marine facilities must comply with similar electrical area classification requirements of NFPA 59A (1994) and NFPA 70 (1993), which are incorporated by reference into the Coast Guard regulations in 33 CFR 127. Depending on the risk level, these areas would either be unclassified or classified as Class 1 Division 1, or Class 1 Division 2. Electrical equipment located in these areas would be designed such that in the event a flammable vapor is present, the equipment would have a minimal risk of igniting the vapor. We evaluated Jordan Cove's electrical area classification drawings to determine whether Jordan Cove would meet these electrical area classification requirements and good engineering practices in NFPA 59A, 70, 497, and API RP 500. We recognize that Jordan Cove appears to meet NFPA 59A (1994 and 2001), NFPA 70 (1993 and 1999), and most of NFPA 497 and API 500, and recommend in section 4.13.1.6 that Jordan Cove provide final electrical area classification drawings for review and approval.

If the project is authorized, Jordan Cove would finalize the electrical area classification drawings and would describe changes made from the FEED design. We recommend in section 4.13.1.6 that Jordan Cove file the final design of the electrical area classification drawings for review and approval. If facilities are constructed, Jordan Cove would install appropriately classed electrical equipment, and we recommend in section 4.13.1.6 that Project facilities be subject to periodic inspections during construction for FERC staff to spot check electrical equipment and verify equipment is installed per classification and are properly bonded or grounded in accordance with NFPA 70. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facility to ensure electrical equipment is maintained (e.g., bolts on explosion proof equipment properly installed and maintained, panels provided with purge, etc.), and electrical equipment are appropriately de-energized and locked out and tagged out when being serviced.

In addition, submerged pumps and instrumentation must be equipped with electrical process seals, and instrumentation in accordance with NFPA 59A (2001) and NFPA 70. We recommend in section 4.13.1.6 that Jordan Cove provide, for review and approval, final design drawings showing process seals installed at the interface between a flammable fluid system and an electrical conduit or wiring system that meet the requirements of NFPA 59A (2001) and NFPA 70. In addition, we recommend in section 4.13.1.6 that Jordan Cove file, for review and approval, details of an air gap or vent equipped with a leak detection device that should continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facility to ensure electrical process seals for submerged pumps continue to conform to NFPA 59A and NFPA 70 and that air gaps are being properly maintained.

Hazard Detection, Emergency Shutdown, and Depressurization Systems

Jordan Cove would also install hazard detection systems to detect cryogenic spills, flammable and toxic vapors, and fires. The hazard detection systems would alarm and notify personnel in the area and control room to initiate an emergency shutdown, depressurization, or initiate appropriate procedures, and would meet NFPA 72, ISA Standard 12.13, and other recommended and generally accepted good engineering practices. In addition, we recommend in section 4.13.1.6 that Jordan Cove provide specifications, for review and approval, for the final design of fire safety specifications, including hazard detection, hazard control, and firewater systems.

FERC staff also evaluated the adequacy of the general hazard detection type, location, and layout to ensure adequate coverage to detect cryogenic spills, flammable and toxic vapors, and fires near potential release sources (i.e., pumps, compressors, sumps, trenches, flanges, and instrument and valve connections). We recommend in section 4.13.1.6 that Jordan Cove file a hazard detection study to evaluate the effectiveness of their flammable and combustible gas detection and flame and heat detection systems in accordance with ISA 84.00.07 or equivalent methodologies. This evaluation would need to demonstrate that 90 percent or more of releases (unignited and ignited) that could result in an off-site or cascading impact would be detected by two or more detectors and result in isolation and de-inventory within 10 minutes. The analysis should take into account the set points, voting logic, wind speeds, and wind directions. FERC staff also reviewed the fire and gas cause and effect matrices to evaluate the detectors that would initiate an alarm, shutdown, depressurization, or other action based on the FEED. Jordan Cove did not provide the fire and gas system cause and effect matrices that indicate how each detector would initiate an alarm, shutdown, depressurization, or conduct other action. Therefore, we recommend in section 4.13.1.6 that Jordan Cove provide, for review and approval, the cause and effect matrices for process instrumentation, fire and gas detection system, and emergency shutdown system.

In addition, Jordan Cove specified low oxygen detectors at the liquid nitrogen storage tanks, but did not denote the location of the low oxygen detectors in the Project drawings. Therefore, we recommend in section 4.13.1.6 that Jordan Cove provide additional information, for review and approval, on the final design of all hazard detection systems (e.g., manufacturer and model, elevations, etc.) and hazard detection layout drawings. If the project is authorized and constructed, Jordan Cove would install hazard detectors according to its final specifications and drawings, and we recommend in section 4.13.1.6 that Project facilities be subject to periodic inspections during construction to verify hazard detectors and ESD pushbuttons are appropriately installed per approved design and functional based on cause and effect matrixes prior to introduction of hazardous fluids. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facility to verify hazard detector coverage and functionality is being maintained and are not being bypassed without appropriate precautions.

Hazard Control

If ignition of flammable vapors occurred, hazard control devices would be installed to extinguish or control incipient fires and releases, and would meet NFPA 59A; NFPA 10, 12, 17, and 2001; API Standard 2510A; and other recommended and generally accepted good engineering practices. We evaluated the adequacy of the number and availability of handheld, wheeled, and fixed fire extinguishing devices throughout the site based on the FEED. FERC staff also evaluated whether the spacing of the fire extinguishers would meet NFPA 10 and agent type and capacities meet NFPA 59A (2009 and later editions). The hazard control plans appeared to meet NFPA 10 travel distances to most components containing flammable or combustible fluids (Class B) for handheld fire extinguishers (30 to 50 feet) and wheeled extinguishers (100 feet) and NFPA 10 travel distance to most other components that could pose an ordinary combustible hazard (Class A) or associated electrical (Class C) hazard for handheld extinguishers (75 feet). Buildings also appear to be provided with handheld extinguishers that appear to satisfy NFPA 10 requirements, including placement at each entry/exit. The agent type (potassium bicarbonate) and agent storage capacities for wheeled (minimum 125 pounds [lb]) and for handheld extinguishers (minimum 20 lb) also appear to meet NFPA 59A requirements. In addition, travel distances, installation heights, visibility, flow rate capacities, and other requirements should be confirmed in final design and in the field where design details, such as manufacturer, obstructions, and elevations, would be better known. Therefore, we recommend in section 4.13.1.6 that Jordan Cove files the final design of these systems, for review and approval, where details are yet to be determined (e.g., manufacturer and model, elevations, flowrate, capacities, etc.) and where the final design could change as a result of these details or other changes in the final design of the Project.

In addition, we evaluated whether clean agent systems would be installed in all instrumentation buildings in accordance with NFPA 2001. Jordan Cove would install clean agent fire suppression systems in accordance with NFPA 2001 in buildings that house electrical and control equipment such as the Control Room, power distribution equipment rooms, and power generation houses. Jordan Cove also indicated that CO2 extinguishers as well as dry chemical extinguishers would be provided in the electrical powerhouses. In addition, Jordan Cove would provide a carbon dioxide extinguishing system for the refrigerant compressors turbines in accordance with NFPA 12.

If the Project is authorized and constructed, Jordan Cove would install hazard control equipment, and we recommend in section 4.13.1.6 that Project facilities be subject to periodic inspections during construction to verify hazard control equipment is installed in the field and functional prior to introduction of hazardous fluids. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facility to verify in the field that hazard control coverage and is being properly maintained and inspected.

Passive Cryogenic and Fire Protection

If cryogenic releases or fires could not be mitigated from impacting facility components to insignificant levels, passive protection (e.g., fireproofing structural steel, cryogenic protection, etc.) should be provided to prevent failure of structural supports of equipment and pipe racks. The structural fire protection would comply with NFPA 59A (2001) and other recommended and generally accepted good engineering practices. NFPA 59A (2001) section 6.4.1 requires pipe supports, including any insulation systems used to support pipe whose stability is essential to plant safety, to be resistant to or protected against fire exposure, escaping cold liquid, or both, if they are subject to such exposure. However, NFPA 59A (2001) does not provide the criteria for determining if they are subject to such exposure or the level of protection needed to protect the pipe supports against such exposures. In addition, NFPA 59A does not address cryogenic or structural protection of pressure vessels or other equipment.

Therefore, FERC staff evaluated whether passive cryogenic and fire protection would be applied to pressure vessels and structural supports to facilities that could be exposed to cryogenic liquids or radiant heats of 4,000 Btu/ft^2-hr or greater from fires with durations that could result in failures[198] and that they are specified in accordance with recommended and generally accepted good engineering practices with a fire protection rating commensurate to the exposure. The structural fire protection would comply with NFPA 59A (2001); API RP 2218; Association of the Wall and Ceiling Industry Technical Paper 12-A; International Organization for Standardization (ISO) 12944 and 22899; Underwriters Laboratories (UL) 1709; and other recommended and generally accepted good engineering practices.

To minimize the risk of cryogenic spills causing structural supports and equipment from cooling below their minimum design metal temperature, Jordan Cove would protect equipment and structural steel against cold shocks through selection of suitable materials of construction or by the application of coldproofing. In addition, Jordan Cove would have spill containment systems surrounding cryogenic equipment and would generally locate cryogenic equipment away from process areas that do not handle cryogenic materials. Cryogenic protection would comply with NFPA 59A (2001), ISO 20088, and other recommended and generally accepted good engineering practices. In addition, Jordan Cove would install a firewall between the refrigerant storage tanks and the Refrigerant Storage Impoundment Basin to prevent cascading damage from radiant heats in excess of 4,000 Btu/ft^2-hr. We recommend in section 4.13.1.6 that Jordan Cove file drawings and specifications of the final design, for review and approval, for the structural passive protection systems to protect equipment and supports from cryogenic releases.

[198] Pool fires from impoundments are generally mitigated through use of emergency shutdowns, depressurization systems, structural fire protection, and firewater, while jet fires are primarily mitigated through the use of emergency shutdowns, depressurization systems, and firewater with or without structural fire protection.

To minimize the risk of a pool or jet fire from causing cascading damage, Jordan Cove would generally locate flammable and combustible containing piping, equipment, and impoundments away from buildings and other process areas that do not handle flammable and combustible materials. Jordan Cove demonstrated that the radiant heats from pool fires from the LNG storage tank outer containment walls and impoundments would have a minimal impact on most areas of the plant. A pool fire from the outer tank wall would result in less than 4,000 Btu/ft^2-hr in most other areas of the plant with the exception of the LNG Flash Drum and Auxiliary Boiler. Fires within the other impoundments would be spaced such that there would be less than 4,000 Btu/ft^2-hr on any equipment.

In addition, we recommend in section 4.13.1.6 that Jordan Cove demonstrate that passive protection is provided in areas where jet fires may result in failure of structural supports. Jordan Cove would need to file drawings of the passive structural fire protection for review and approval for structural supports and equipment that could result in a failure when exposed to a jet fire. In addition, we recommend in section 4.13.1.6 that Jordan Cove provide additional information on final design of these systems, for review and approval, where details are yet to be determined (e.g., calculation of structural fire protection materials, thicknesses, etc.) and where the final design could change as a result of these details or other changes in the final design of the Project.

We also note that it was unclear whether Jordan Cove would install fire walls in transformer areas, which would be required for certain transformers. Therefore, we recommend in section 4.13.1.6 that Jordan Cove separate or provide fire walls for transformer in accordance with NFPA 850 or equivalent that would prevent cascading damage.

If the Project is authorized and constructed, Jordan Cove would install structural cryogenic and fire protection according to its design, and we recommend in section 4.13.1.6 that Project facilities be subject to periodic inspections during construction to verify structural cryogenic and fire protection is properly installed in the field as designed prior to introduction of hazardous fluids. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facility to continue to verify that passive protection is being properly maintained.

Firewater Systems

Jordan Cove would also provide firewater systems, including remotely operated firewater monitors, sprinkler systems, fixed water spray systems, and firewater hydrants and hoses for use during an emergency to cool the surface of storage vessels, piping, and equipment exposed to heat from a fire. These firewater systems would be designed, tested, and maintained to meet NFPA 59A (2001), 13, 14, 15, 20, 22, 24, and 25 requirements. Jordan Cove would also provide high expansion foam for each LNG spill impoundment basin to reduce vaporization rates from LNG pools and would meet NFPA 59A (2001) and NFPA 11. FERC staff evaluated the adequacy of the general firewater or foam system coverage and verified the appropriateness of the associated firewater demands of those systems and worst-case fire scenarios to size the firewater and foam systems. Jordan Cove provided firewater coverage drawings for the firewater monitors and fire hydrants, however, where coverage circles intersect pipe racks, large vessels or process equipment, the firewater coverage could be blocked, and the coverage circles should be modified to account for obstructions during the final design. Additionally, not all areas of the gas pretreatment are adequately covered. We recommended in section 4.13.1.6 that Jordan Cove provide adequate firewater coverage for all of the pretreatment equipment. We recommend in section 4.13.1.6 that Jordan Cove file additional information on the final design of these systems, for review and approval, where details are yet to be determined (e.g., manufacturer and model, nozzle types, etc.) and where the final design could change as a result of these details or other changes in the final design of the Project.

FERC staff also assessed whether the reliability of the firewater pumps, firewater source, and onsite storage volume would be appropriate. Jordan Cove would provide a primary and backup firewater pump with different drivers per NFPA 20. Jordan Cove also states that the firewater tanks would meet NFPA 22 and API Standard 650. However, the firewater tank data sheet denotes that the firewater tanks would be designed to API Standard 650 and does not make reference to NFPA 22. Therefore, we recommend in section 4.13.1.6 that Jordan Cove design the firewater tanks in accordance with NFPA 22 or justify how API Standard 650 provides an equivant or better level of safety. Furthermore, Jordan Cove would provide a fully staffed fire department adjacent to the firewater tanks that would meet NFPA 600.

We also recommend in section 4.13.1.6 that Jordan Cove should specify that the firewater flow test meter is equipped with a transmitter and that a pressure transmitter is installed upstream of the flow transmitter, which should both be connected to the DCS and recorded to keep a history of flow test data. In addition, we recommend in section 4.13.1.6 that the largest firewater pump or component be able to be removed for maintenance from the firewater pump shelter. If the Project is authorized and constructed, Jordan Cove would install the firewater and foam systems as designed, and we recommend in section 4.13.1.6 that Project facilities be subject to periodic inspections during construction and that companies provide results of commissioning tests to verify the firewater and foam systems are installed and functional as designed prior to introduction of hazardous fluids. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facility to ensure firewater and foam systems are being properly maintained and tested.

Geotechnical and Structural Design

Jordan Cove provided geotechnical and structural design information for its facilities to demonstrate the site preparation and foundation designs would be appropriate for the underlying soil characteristics and to ensure the structural design of the Project facilities would be in accordance with federal regulations, standards, and recommended and generally accepted good engineering practices. The application focuses on the resilience of the Project facilities against natural hazards, including extreme geological, meteorological, and hydrological events, such as earthquakes, tsunamis, seiche, hurricanes, tornadoes, floods, rain, ice, snow, regional subsidence, sea level rise, landslides, wildfires, volcanic activity, and geomagnetism.

Geotechnical Evaluation

FERC regulations under 18 CFR 380.12 (h) (3) require geotechnical investigations to be provided. In addition, FERC regulations under 18 CFR 380.12 (o) (14) require an applicant demonstrate compliance with regulations under 49 CFR 193 and NFPA 59A. If authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to USDOT's inspection and enforcement programs. USDOT regulations incorporate by reference NFPA 59A (2001). NFPA 59A (2001) section 2.1.4 requires soil and general investigations of the site to determine the design basis for the facility. However, no additional requirements are set out in 49 CFR 193 or NFPA 59A on minimum requirements for evaluating existing soil site conditions or evaluating the adequacy of the foundations, therefore FERC staff evaluated the existing site conditions, geotechnical report, and proposed foundations to ensure they are adequate for the LNG facilities as described below.

The Project would be located within the Pacific Border Physiographic province at the western edge of the coastal headlands of the Central Coast Mountain Range, on the North Spit of Coos Bay. The North Spit of Coos Bay marks the southern edge of the Holocene Epoch Coos Bay dune sheet (Peterson et al. 2006). The Project would be located near the eastern edge of the Cascadia Subduction Zone (CSZ), where the North American Plate is overriding the Explorer, Juan de Fuca, and Gorda tectonic plates (Wells et al. 2016). The converging tectonic plates have resulted in the accumulation of marine deltaic sediments and volcanic seamounts, referred to as the Siletzia Terrance, along the western edge of the North American tectonic plate (Heller and Ryberg 1983). The plates have also created a deformation zone along the western edge of the accumulation wedge complex, strike-slip and thrust/reverse faulting in the North American tectonic place, and a zone of bedrock folding extending from the coast eastward. The major tectonic elements associated with the subduction zone include the accumulation wedge complex, a deformed forearc basin consisting of the Coast Range and Willamette Valley, a volcanic arc complex consisting of the Cascade Mountain Range, and a backarc in eastern Oregon and Washington. The Project would be located at the junction of the accumulation wedge complex and the forearc basin. Local bedrock structures reflect east-west compressional deformation resulting from ongoing oblique subduction of the CSZ that has occurred since the late-middle Miocene Epoch (Wells and Peck 1961), and includes the megathrust itself, north-south trending folds, north-south trending reverse and thrust faults, and west-northwest trending oblique strike-slip faults (Black and Madin 1995; Madin et al. 1995; Goldfinger et al. 1992). The location and extent of local fold and fault structures have been inferred from stratigraphic, geomorphic, and geophysical evidence. Geologic structures south of the site include the South Slough Syncline, the Westport Arc (anticline), and the eastern and the western forks on the Westport Arc (Allen and Baldwin 1944).

Jordan Cove contracted KBJ (a joint venture consisting of Kiewit, Black & Veath, and JGC) and its subconsultants to conduct geotechnical investigations and report to evaluate existing soil site conditions and proposed foundation design for the Project. During the investigation, the facility was subdivided into three primary areas: Ingram Yard area, Access and Utility Corridor area and South Dunes area. The LNG liquefaction trains, LNG storage tanks, and marine facilities would be located in the Ingram Yard area. The average elevation of the existing grade in Ingram Yard area ranged from +20 to +125 feet North American Vertical Datum 1988 (NAVD 88), the Access and Utility Corridor area ranged from +20 to +135 feet NAVD 88, and the South Dune area was less variable and was approximately +15 feet NAVD 88. KBJ indicated that the geologic profile consists primarily of sand overlying sand and silt, and then overlies clayey silt. Below elevation −30 feet NAVD 88, the subsurface material is relatively consistent and generally dense. Above elevation −30 feet, the material is more variable, with organics, clay, and fill present in the upper near surface profile in portions of the Project site. The Project site would be demolished, cleared, relocated, grubbed, and prepared using standard earthmoving and compaction equipment. Site preparation would result in a final grade elevation from +46 to +70 feet NAVD 88 with varying amounts of fill/cut that cross the site. Exceptions include the LNG storage tanks and water-dependent facilities such as the marine terminal and the Material Offloading Facility (MOF). The LNG storage tank basins would have an elevation of approximately +27 feet NAVD 88 that would be surrounded by a tertiary protective berm with a crest elevation of no less than +46 feet NAVD

88. Jordan Cove indicated that the parts of the marine facilities that would be normally occupied or operational would typically be at an elevation of +34.5 feet or greater, whereas normally unoccupied/non-operational parts of the marine facilities may be at a lower elevation.

KBJ conducted subsurface investigations work including mud-rotary borings with standard penetration tests (SPTs), cone penetration test (CPT) soundings, test pits, electrical resistivity testing, measurement of shear and compression wave velocities, pressuremeter testing, infiltrometer testing, pump testing, geophysical surveys, and laboratory testing. The borings and shear wave velocity logging on the Project site were completed to depths of approximately 300 feet. Geotechnical laboratory testing was completed on representative samples of the soil obtained from the explorations for the purpose of determining its physical characteristics and engineering properties. Approximately 132 borings to depths ranging from 14 to 300 feet below existing grade, approximately 90 cone penetration tests (CPTs) to depths ranging from 16 to 80 feet (or to refusal) below existing grade, 21 temporary piezometers to measure groundwater levels, and over 5 different tests on recovered soil samples, including classification tests (water content, Atterberg liquid and plastic limits, sieve tests), compression tests, corrosion potential tests (pH, sulfate, chloride, electrical resistivity) in general accordance with pertinent American Society for Testing and Materials (ASTM) standards. Based on the results of analytical laboratory testing, the exposure of concrete and steel to the soil would not require special considerations. The results for sulfate in the groundwater tested indicate that no special considerations would be required to protect the concrete for the existing groundwater conditions. The electrical resistivity test results indicate a corrosion specialist should be consulted. In addition, Coos Bay is a salt water environment; therefore, materials in contact with the surface water in Coos Bay or in the immediate vicinity of Coos Bay should be protected from exposure to salt water. Currently the groundwater below the site is fresh water; however, if the marine slip is authorized and dredged, it is unclear how much water from Coos Bay would infiltrate into the dredged sands and increase the chloride content. Therefore, it is standard practice that the chloride content of the dredged sand be tested as dredging is performed. If the chloride contents are oberserved to increase during dredging, then any necessary corrosion protection should be implemented.

Based on the test borings conducted, a number of design profiles were developed for the Project site. At Ingram Yard area: the subsurface conditions are relatively consistent below EL −30 feet. The existing sands above EL −30 feet consists of either existing sand fill or native dune or estuary sand deposits. In the area of the dune on the eastern portion of the Ingram Yard area, the sands are native starting at the ground surface. Below EL −30 feet, the native sands is predominantly fine-grained, with occasional shells and silt zones. A sand-silt unit is present beneath the native sand at elevations ranging from −110 feet to −140 feet. Investigation borings completed near the south LNG storage tank in the Ingram Yard area encountered hard clayey silt that was classified as poorly indurated silty shale at a depth of approximately −252 feet. Another boring drilled about 480 feet north, did not encounter the poorly indurated silty shale when terminated at a depth of about −280 feet. At the Access and Utility Corridor area, the subsurface conditions are generally similar to Ingram Yard. Below EL −30 feet, the conditions are similar to the Ingram Yard area. Above EL −30 feet, the soil consists primarily of sand with both fill and native sand encountered. Organics and peat were encountered only in the western end of the Access and Utility Corridor between EL −11 feet and EL −10.5 feet. At the South Dune area, as at Ingram Yard and along the Access Utility Corridor, the subsurface conditions at the South Dunes area are relatively constant below EL −30 feet. The conditions above EL −30 feet vary mainly because of variation in the sands and the presence or absence of peat/organics. Peat/organics were encountered in several areas of the South Dunes area at elevations ranging from 4 to 9 feet. The existing sand above EL −30 feet consists of fill, and native dune and estuary sand deposits. In the northeast quadrant of the South Dunes a layer of clay was encountered from EL 6 to 3.5 feet. The clay thickness varies from 0.3 foot to 2.5 feet and the material is very soft to soft with high plasticity. In the east central portion of the South Dunes, the driftwood was estimated to extend not more than 10 feet below ground surface. Below elevation −30 feet, the South Dunes subsurface conditions are fairly consistent. The native sand is predominantly fine grained, with occasional shells and silt zones. A deep boring at the South Dunes indicates that the native sand extends to elevation −151 feet. Below EL −151 feet, dark gray, very stiff to very hard, moist, and high plasticity clayey silt with sand and cementation was encountered that extended to an elevation of at least −223 feet.

The subsurface data from geotechnical soil borings and CPT soundings indicate that the subsurface conditions are relatively consistent across the site. Generally, the profile consists of existing sand fill from the ground surface near EL 20 feet to EL 9.5 feet. Near approximately EL 9.5 feet, an up to 2 feet thick layer of peat is present in many locations across the site. Beneath the peat layer is medium dense, native sand that extends to EL −30 feet. The medium dense, native sand would be improved by vibro-compaction to mitigate potentially liquefiable soils prior to construction of the LNG storage tanks. The peat layer would be removed and replaced prior to the ground improvement for soil liquefaction mitigation. Below EL −30 feet is dense to very dense, native sand that extends to about EL −135 feet. From EL −135 feet to below EL −260 feet. A clayey silt material identified as poorly indurated silty shale was found below about EL −235 feet.

FERC staff evaluated the geotechnical investigation to ensure the adequacy in the number, coverage, and types of the geotechnical borings, CPTs, SCPTs, and other tests, and found them to adequately cover major facilities, including the marine facilities, liquefaction areas, pretreatment areas, flare system, buildings, power generation, storage tanks, and berms at the site. Jordan Cove states that additional investigation would be performed to support final final design, including borings, CPTs, PMTs, and geophysical testing. FERC staff will continue its review of the results of the geotechnical investigation to ensure foundation designs are appropriate prior to construction of final design and throughout the life of the facilities.

Measured groundwater elevations have varied from a high of approximately 18 feet to 1 foot NAVD 88 below grade. Groundwater elevations increase with distance to the north away from Coos Bay. Considering the subsurface conditions for the LNG facility, Jordan Cove is proposing to support the LNG storage tanks and most of the facility structures on shallow isolated foundations, raft foundations, or deep foundations placed on improved ground. The recommended deep foundations to support large loads proposed would be either drilled piers or open-ended steel pipe piles. KBJ indicated the estimated depth of frost penetration for the site is approximately 1 foot below ground surface, therefore, the bottom of the foundations should be located at minimum depth of 1 foot below finished grade. The subsurface conditions at the site require soil improvement before any structures can be built for the LNG facilities. These conditions include peat, clay, buried driftwood, and liquefiable soil. KBJ provided considerations for ground improvement techniques including vibro-compaction; sand compaction; dry excavation and removal; wet excavation and removal and soil mixing. In areas where ground improvement would be utilized, Jordan Cove proposes to utilize vibro-compaction and deep soil mixing ranging in depth from the groundwater table to a maximum of approximately EL −30 feet NAVD 88, depending on the foundation loading and soil suitability for ground improvement, to bring foundations capacities and settlements within acceptable limits. Deep soil mixing would consist of installing overlapping (secant) soil mixed columns to create shear walls that reinforce the liquefiable soil mass. The deep soil mixed shear walls would be installed. KBJ performed settlement analysis for the Project site. At Ingram Yard, the potential total settlement was estimated to be none to approximately 11.5 inches. Along the Access and Utility Corridor, the potential total settlement was estimated to be approximately 0.8 to 9.5 inches. At the South Dunes, the potential total settlement was estimated to be approximately 0.5 inch up to 7 inches. KBJ stated that the ground improvement, vibro compaction method was proposed to reduce the settlement to 3 inch or less. KBJ stated that the preliminary estimates of LNG storage tank settlement based on the available ground investigation data and proposed ground improvement indicate that differential settlements would be in line with the requirements of ACI 376. The influence of soil structure interaction on local settlement gradients near the LNG storage tank edge would be evaluated with more detailed analysis and models in the detailed design phase, together with the limits that can be absorbed by the tank components. Due to the wide range of settlement values, we recommend in section 4.13.1.6 that Jordan Cove file an upper limit for total settlement for large flexible foundations and the maximum total edge settlement for equipment and structures consistent with applicable codes, including but not limited to API 620, API 625, API 653, and ACI 376.

Dredging would be required for the LNG marine vessels to traverse to the terminal as well as for the construction of the marine facilities. The existing shoreline would be excavated, dredged, and sloped during construction. To prevent slumping of the dredged slope, maintain the berthing line position, and provide structural integrity support to the landside facilities, the excavated shoreline would be protected from scour and erosion using stone or cement based rip-rap armoring. The Project basin shoreline would be protected from scour and erosion using stone or a cement based rip rap. The North Slope would be protected against scour from the toe to above the water line. Above the waterline, alternative scour (and wind/rain erosion) protection systems for less frequent events would be provided using any number of potential techniques including; concrete cellular mattresses, grout-injected geotextile fabric mattresses (fabriform) and/or geotextile reinforced vegetative planting. The proposed rip-rap armoring would minimize the potential for erosion where the shoreline would be excavated.

The results of Jordan Cove's geotechnical investigation at the Project site indicate that subsurface conditions are suitable for the proposed facilities, if proposed site preparation, foundation design, and construction methods are implemented in addition to the satisfaction of proposed recommendations.

Structural and Natural Hazard Evaluation

FERC regulations under 18 CFR 380.12 (m) requires applicants address the potential hazard to the public from failure of facility components resulting from accidents or natural catastrophes, evaluate how these events would affect reliability, and describe what design features and procedures that would be used to reduce potential hazards. In addition, 18 CFR 380.12 (o) (14) require an applicant to demonstrate how they would comply with 49 CFR 193 and NFPA 59A. USDOT regulations under 49 CFR 193 have some specific requirements on designs to withstand certain loads from natural hazards and also incorporates by reference NFPA 59A (2001 and 2006) and ASCE 7-05 and ASCE 7-93 via NFPA 59A (2001). NFPA 59A (2001) section 2.1.1 (c) also requires that Jordan Cove consider the plant site location in the design of the Project, with respect to the proposed facilities being protected, within the limits of practicality, against natural hazards, such as from the effects of flooding, storm surge, and seismic activities. This would be covered in USDOT's LOD on 49 CFR 193 Subpart B. However, the LOD would not cover whether the facility is designed appropriately against these hazards, which would be part of 49 CFR 193 Subpart C. Unlike other natural hazards, wind loads are covered in 49 CFR 193 Subpart B and would be covered in the LOD. If authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to USDOT's inspection and enforcement programs. The marine facilities would be subject to 33 CFR 127, which requires if the waterfront facility handling LNG is in a region subject to earthquakes the piers and wharves must be designed to resist earthquake forces. In addition, Coast Guard regulations under 33 CFR 127 incorporates by reference certain portions of NFPA 59A (1994) and ASCE 7-88 via NFPA 59A (1994). However, Coast Guard regulations do not provide criteria for a region subject to earthquakes or the earthquake forces the piers and wharves are to withstand and NFPA 59A (1994) section referenced in 33 CFR 127 is for seismic design only and is applicable to stationary LNG containers, which would not be under 33 CFR 127. Therefore, we evaluated the basis of design for all facilities for all natural hazards under FERC jurisdiction, including those under USDOT and Coast Guard jurisdiction.

Jordan Cove states that FERC and NEPA 59A requirements to design in accordance with ASCE 7-05 conflict with local building code requirements in the Oregon Structural Specialty Code (OSSC) of 2014. Specifically, OSSC 2014 is based on ASCE 7-10. To alleviate this conflict, Jordan Cove indicated that they would follow the requirements of ASCE 7-05 and ASCE 7-10 in parallel, with the final design made equal to or greater than the requirements of ASCE 7-05 and ASCE 7-10. Jordan Cove also indicated that in case of conflict, the more stringent requirement would govern. Thus, the final design would be intended to satisfy the FERC, NEPA 59A, ASCE 7-05, and ASCE 7-10 requirements. Jordan Cove states the facilities would also be constructed to the requirements in the 2006 International Building Code (IBC) and the 2014 Oregon State Specialty Code. These standards require various structural loads to be applied to the design of the facilities, including live (i.e., dynamic) loads, dead (i.e., static) loads, and environmental loads. FERC staff also evaluated potential engineering design to withstand impacts from natural hazards, such as earthquakes, tsunamis, seiche, hurricanes, tornadoes, floods, rain, ice, snow, regional subsidence, sea level rise, landslides, wildfires, volcanic activity, and geomagnetism. We recommend in section 4.13.1.6 that Jordan Cove file final design information (e.g., Civil/Structural drawings, specifications, and calculations) and associated quality assurance and control procedures with the documents reviewed, approved, and stamped and sealed by the professional engineer of record in Oregon.

If a project is authorized and constructed, the company would install equipment in accordance with its final design. In addition, we recommend in section 4.13.1.6 that Jordan Cove file, for review and approval, settlement results during hydrostatic tests of the LNG storage containers and periodically thereafter to verify settlement is as expected and does not exceed the applicable criteria in API Standards 620, 625, 653, and ACI 376.

Earthquakes, Tsunamis, and Seiche

FERC regulations under 18 CFR 380.12 (h) (5) requires evaluation of earthquake hazards based on whether there is potential seismicity, surface faulting, or liquefaction. Earthquakes and tsunamis have the potential to cause damage from shaking ground motion and fault ruptures. Earthquakes and tsunamis often result from sudden slips along fractures in the earth's crust (i.e., faults) and the resultant ground motions caused by those movements, but can also be a result of volcanic activity or other causes of vibration in the earth's crust. The damage that could occur as a result of ground motions is affected by the type/direction and severity of the fault activity and the distance and type of soils the seismic waves must travel from the hypocenter (or point below the epicenter where seismic activity occurs). To assess the potential impact from earthquakes and tsunamis, Jordan Cove evaluated historic earthquakes along fault locations and their resultant ground motions.

The USGS maintains a database containing information on surface and subsurface faults and folds in the United States that are believed to be sources of earthquakes of greater than 6.0 magnitude occurring during the past 1.6 million years (Quaternary Period).[199] KBJ performed a site-specific fault and seismic analysis for the Project, involving field investigations and subsequent data evaluation. The project site is covered by more than 100 feet of unconsolidated sand that prevents direct inspection of the bedrock, faults within 5 miles of the Project site have been identified from existing geologic maps. A total of 12 active and potentially active faults were identified within 100 miles of the Project site, but only the Barview fault is within 5 miles of the site. The Barview fault is a south dipping thrust fault that has offset the Miocene Epoch (23 to 5.3 million years ago) Empire Formation and Pleistocene Epoch (2.6 million to 11.7 thousand years ago) marine terrace platforms by about 3 feet. The mapped length of the Barview fault is less than 2 miles and extends from Coos Bay to the east-southeast north of Barview, Oregon (Madin et al., 1995). Based on the distance of the Barview fault from the Project site and its west-northwest strike, the Barview fault would not create a potential for fault offset at or near the ground surface at or near the Project site. KBJ indicated that neither fault is identified to potentially fault material younger than the Eocene Epoch and the location and extent of both faults is uncertain, they are considered unlikely to potentially create fault offset at or near the ground surface at the Project site. The Barview fault is included with South Slough thrust and reverse faults in the USGS Quaternary Fault and Fold database. Ground motions that Barview fault could potentially generate at the site would be evaluated in the Deterministic Seismic Hazard Analysis (DSHA). The Barview Fault and the South Slough thrust and reverse faults are both incorporate into the Probabilisitc Seismic Hazard Analysis (PSHA) as part of the gridded seismic sources and are not explicitly modeled as individual faults. Additionally, Jordan Cove states that there is no historically reported earthquakes have been associated with faults within 5 miles of the site; and the subsurface investigations at the site have not identified fault ruptures and there is no potential for affection faulting on the site.

The Jordan Cove LNG Project is in a region that has exhibited moderate to low seismic activity during the historic record, within the last 170 years. The region has been subject to numerous earthquakes of moment magnitude (MW) 4 or greater; however, the regional rate of seismicity is lower than in California and Washington. Earthquake records dating back to 1900 indicate there is only one record or an earthquake with a magnitude greater than 3 within a 50 km radius of the site. Near-fault effects such as rupture directivity and velocity or displacement pulses are typical for faults within 15 to 30 km of the site (National Earthquake Hazards Reduction [NEHRP], 2009; 2015). Directivity pulses are reasonably likely at 10 to 20 km from a site and polarization of seismic waves in the fault-normal and fault-parallel directions typically extends about 3 to 5 km from the fault (NEHRP 2015). The rupture directivity and pulses are considered for the Project

[199] USGS, Earthquake Hazards Program, Quaternary Fault and Fold Database of the United States, https://earthquake.usgs.gov/hazards/qfaults/, accessed Aug 2018.

site while fault-normal and fault-parallel directions of grounds motion are not considered. KBJ stated the Project site would not be located up-dip from the fault plane and significant directivity or pulses are unlikely. While large magnitude earthquakes have not occurred in the Pacific Northwest during the Historical record, based on the geological record, large magnitude earthquakes with moment magnitudes of 9 have occurred on the CSZ during the past 11,000 years with the last occurring in the year 1700. The CSZ is the dominate earthquake ground motion hazard source for the site. Onshore directivity is not expected for the CSZ because of the anticipated rupture geometry (Baker et al. 2012). Jordan Cove stated that the subsurface investigations at the Project site have not identified fault ruptures, and identified active faults in the region do not have a potential for affecting faulting, and growth faults are not present. While the presence of major tectonic faults and growth faults can require special consideration, the presence or lack of major tectonic faults identified near the site does not define whether earthquake ground motions can impact the site because ground motions can be felt large distances away from an earthquake hypocenter depending on number of factors. Jordan Cove stated that ground motions at the facility would be monitored by three sets of seismometers. An open-field seismometer located in a clear area away from other equipment would provide a baseline ground movement reference for any event. Two seismometers located on the top and bottom of each LNG storage tank. If any of the three seismometers exceeds safe limits, an alarm would sound in the control room where operators could shut down operations.

To address the potential ground motions at the site, USDOT regulations in 49 CFR 193.2101 Subpart C require that field-fabricated LNG tanks must comply with section 7.2.2 of NFPA 59A (2006) for seismic design. NFPA 59A (2006) requires LNG storage tanks be designed to continue safely operating with earthquake ground motions at the ground surface at the site that have a 10 percent probability of being exceeded in 50 years (475 year mean return interval), termed the operating basis earthquake (OBE). In addition, USDOT regulations in 49 CFR 193.2101 Subpart C require that LNG tanks be designed to have the ability to safely shutdown when subjected to earthquake ground motions which have a 2 percent probability of being exceeded in 50 years (2,475 year mean return interval), termed the safe shutdown earthquake (SSE). USDOT regulations in 49 CFR 193.2101 Subpart C also incorporate by reference NFPA 59A (2001) Chapter 6, which require piping systems conveying flammable liquids and flammable gases with service temperatures below −20°F, be designed as required for seismic ground motions. If authorized and constructed, LNG facilities as defined in 49 CFR 193, would be subject to the USDOT’s inspection and enforcement programs.

In addition, FERC staff recognizes Jordan Cove would also need to address hazardous fluid piping with service temperatures at −20 degrees Fahrenheit and higher and equipment other than piping, and LNG storage (shop built and field fabricated) containers. We also recognize the current FERC regulations under 18 CFR 380.12 (h) (5) continue to incorporate National Bureau of Standards Information Report (NBSIR) 84-2833. NBSIR 84-2833 provides guidance on classifying stationary storage containers and related safety equipment as Category I and classifying the remainder of the LNG project structures, systems, and components as either Category II or Category III, but does not provide specific guidance for the seismic design requirements for them. Absent any other regulatory requirements, this guidance recommends that other LNG project structures classified as Seismic Category II or Category III be seismically designed to satisfy the Design Earthquake (DE) and seismic requirements of the ASCE 7-05 in order to demonstrate there is not a significant impact on the safety of the public. ASCE 7-05 is recommended as it is a complete American National Standards Institute (ANSI) consensus design standard, its seismic requirements are based directly on the National Earthquake Hazards Reduction Program (NEHRP) Recommended Provisions, and it is referenced directly by the IBC. Having a link directly to the IBC and ASCE 7 is important to accommodate seals by the engineer of record because the IBC is directly linked to state professional licensing laws while the NEHRP Recommended Provisions are not.

The geotechnical investigations of the existing site performed by KBJ indicate the site class was determined in accordance with ASCE 7-05, ASCE 7-10, and the 2014 edition of the OSSC (Oregon Structural Special Specialty Code) in the Geotechnical Report (KBJ, 2017) using the shear wave velocity measurements form the downhole P-S suspension logging and cross hole seismic logging. The average shearwave velocity in the upper 100 feet (30 meters), VS30 of 697.5 to 783 feet per second, at two of the three locations at the LNG storage tanks. The shear wave velocity measurement at the one location indicated Seismic Site Class E (VS30 of 480.9 feet per second); however, all the locations would be Seismic Site Class D after ground improvement to mitigate liquefiable soils. Seismic Site Class D is valid once liquefiable soils at the site have been mitigated to eliminate Seismic Site Class F conditions (KBJ, 2017). This is in accordance with ASCE 7-05, which is incorporated directly into 49 CFR 193 for shop fabricated containers less than 70,000 gallons and via NFPA 59A (2006) for field fabricated containers.[200] This is also in accordance with IBC (2006). Sites with soil conditions of this type would experience significant amplifications of surface earthquake ground motions at longer periods. Due to the presence of the CSZ (dips under the site) the seismic risk to the site is considered high.

KBJ performed a site-specific seismic hazard study for the site. The study concluded that the site would have a Horizontal Operating Basis Earthquake (OBE) peak spectral ground acceleration at 0.2 s-period of 0.857 g, and a Horizontal Safe Shutdown Earthquake (SSE) peak spectral ground acceleration at 0.2 s-period of 1.537 g based on improved site conditions. The OBE has a 10% probability of being exceed in 50 years (475 year mean return interval) while the SSE has a 2% chance of being exceeded in 50 years (2,475 year mean return interval). The study also provided the site-specific Design Earthquake (DE) values SDS and SD1 of 1.025 g and 1.002 g, respectively. KBJ also developed the Vertical response spectra using the horizontal response spectra and vertical-to-horizontal (V/H) ratios and indicated the V/H ratios are not less than ½ for the Project. Based on the design ground motions for the site and the importance of the facilities, the facility seismic design is assigned Seismic Design Category D in accordance with the IBC (2006) and ASCE 7-05. FERC staff independently evaluated the OBE PGA, SSE PGA, 0.2-second design spectral acceleration, and 1.0-second design spectral accelerations for the site using the Applied Technology Council (ATC) and USGS Earthquake Hazards Program Seismic Design Maps[201] and Unified Hazard[202] tools for all occupancy categories (I through IV). Based on the ATC and USGS tools, FERC found the OBE and SSE peak spectral accelerations at 0.2 s-period for the site based on Site Class D to equal 0.722 g and 1.694 g, respectively. The OBE and SSE that Jordan Cove

[200] There are six different site classes in ASCE 7-05, A through F, that are representative of different soil conditions that impact the ground motions and potential hazard ranging from Hard Rock (Site Class A), Rock (Site Class B), Very dense soil and soft rock (Site Class C), Stiff Soil (Site Class D), Soft Clay Soil (Site Class E), to soils vulnerable to potential failure or collapse, such as liquefiable soils, quick and highly sensitive clays, and collapsible weakly cemented soils (Site Class F).

[201] USGS, Changes to U.S. Seismic Design Maps Web Tools, https://earthquake.usgs.gov/designmaps/us/application.php, accessed December 2018

[202] USGS, Unified Hazards Tool , https://earthquake.usgs.gov/hazards/interactive/, accessed Dec 2018

provided are about 80 percent of the values from the ATC/USGS websites which would be acceptable for site specific values.

In addition to the review of the peak ground accelerations, FERC staff reviewed the correlation between the peak ground accelerations, the Modified Mercalli Intensity scale,[203] and Richter scale. FERC staff found that there is no direct correlation between an earthquake's magnitude and the peak ground accelerations experience at a site. The peak ground accelerations at a site are determined by multiple factors such as site classification, soil types, the distance from an earthquake's epicenter, and would vary from location to location; while an earthquake's magnitude is determined by the amplitude of the seismic wave and energy dispersed. Although there is no direct correlation between a site's peak ground acceleration and a magnitude on the Richter scale, there is an empirical correlation, by the USGS, between the peak ground acceleration and the Modified Mercalli Intensity scale, as well as between the Modified Mercalli Intensity scale and the Richter scale.[204] The Modified Mercalli Intensity scale measures the perceived intensity of an earthquake and the potential damage that could occur to structures based on ground acceleration and velocity. Given the OBE and SSE values provided in the study, the site would experience an Intensity rating of 9, which corresponds to perceived violent shaking and a potential for heavy damage to structures. Taking the Modified Mercalli Intensity rating of 9 and comparing that to the Richter scale, FERC staff found that the OBE and SSE would correspond to a magnitude 6 or greater earthquake from the closest fault. However, FERC staff also acknowledges that this is not a direct comparison and relies on multiple empirical correlations between the accelerations and scales.

ASCE 7-05 also requires determination of the Seismic Design Category based on the Occupancy Category (or Risk Category in ASCE 7-10 and 7-16) and severity of the earthquake design motion. The Occupancy Category (or Risk Category) is based on the importance of the facility and the risk it poses to the public.[205] FERC staff has identified the Project as a Seismic Design Category D based on the ground motions for the site and an Occupancy Category (or Risk Category) of II or III or IV, this seismic design categorization would appear to be consistent with the IBC (2006) and ASCE 7-05 (and ASCE 7-10).

Seismic events can also result in soil liquefaction in which saturated, non-cohesive soils temporarily lose their strength/cohesion and liquefy (i.e., behave like viscous liquid) as a result of

[203] USGS, The Sidebar Computer Program, a seismic-shaking intensity meter: users' manual and software description, http://pubs.er.usgs.gov/publication/ofr03202, accessed March 2019

[204] USGS, Magnitude/Intensity Comparison, https://earthquake.usgs.gov/learn/topics/mag_vs_int.php, accessed March 2019

[205] ASCE 7-05 defines Occupancy Categories I, II, III, and IV. Occupancy Category I represents facilities with a low hazard to human life in even of failure, such as agricultural facilities; Occupancy Category III represents facilities with a substantial hazard to human life in the event of failure or with a substantial economic impact or disruption of day to day civilian life in the event of failure, such as buildings where more than 300 people aggregate, daycare facilities with facilities greater than 150, schools with capacities greater than 250 for elementary and secondary and greater than 500 for colleges, health care facilities with 50 or more patients, jails and detention facilities, power generating stations, water treatment facilities, telecommunication centers, hazardous facilities that could impact public; Occupancy Category IV represents essential facilities, such as hospitals, fire, rescue, and police stations, emergency shelters, power generating stations and utilities needed in an emergency, aviation control towers, water storage and pump structures for fire suppression, national defense facilities, and hazardous facilities that could substantially impact public; and Occupancy Category II represents all other facilities. ASCE 7-10 changed the term to Risk Categories I, II, III, and IV with some modification.

increased pore pressure and reduced effective stress when subjected to dynamic forces such as intense and prolonged ground shaking. Areas susceptible to liquefaction may include saturated soils that are generally sandy or silty. Typically, these soils are located along rivers, streams, lakes, and shorelines or in areas with shallow groundwater. The site-specific seismic study indicates liquefiable soils are present throughout the Project site, and their depths vary with the location. The liquefiable soils at Ingram Yards area and the Access and Utility Corridor have a maximum of approximately EL −30 feet NAVD 88. At the LNG terminal and the Access and Utility Corridor, the liquefiable layers are predicted to extend below the dunes present on the site. At the South Dunes Area, liquefaction is estimated in a soil zone that starts at the groundwater table and extends to variable depths from EL 0 feet to approximately EL −25 feet NAVD 88. Jordan Cove indicated that a detailed review of the potential methods of soil improvement has been undertaken, and a number of these proven methods could be employed for the Project, depending on the results of the final site investigations planned. Those methods are: vibro-compaction; sand compaction; dry excavation and removal; wet excavation and removal and soil mixing. Jordan Cove has indicated that the LNG facilities at the site would be constructed on either a site improved with deep soil mixing or in some cases deep foundations, which would mitigate any potential impacts of soil liquefaction to minimize or eliminate any effects soil liquefaction. Also to counteract associated lateral spreading effects at the marine facilities, Jordan Cove has elected to install a permanent sheet pile wall in combination with improved soils for the LNG marine vessel berth.

Seismic events in waterbodies can also cause tsunamis or seiches by sudden displacement of the sea floors in the ocean or standing water. Tsunamis and seiche may also be generated from volcanic eruptions or landslides. Tsunami wave action can cause extensive damage to coastal regions and facilities. The west coast of the United States has historically been subject to minor inundation from tsunamis generated by distant earthquakes in South America, Alaska, and Japan. Kelsey et al. (2005) note that tsunamis generated from these distant subduction zone earthquakes have minor inundation effects because of the long diagonal approach of tsunami waves to the west coast form these sources. In addition, northern California, Oregon, and Washington have been subjected to large tsunamis from CSZ megathrust earthquakes, with the last one occurring approximately in the year 1700. Jordan Cove conducted hydrodynamic and tsunami modeling studies for the Project site and indicated a tsunami generated by a megathrust earthquake on the CSZ would present the greatest tsunami inundation risk at the project site and the maximum design tsunami run-up elevation for the project site is no greater than 34.5 feet NAVD 88 including co-seismic subsidence and sea level rise effects. The co-seismic subsidence information indicates that the largest coastal subsidence, of 3 to 6 feet, occurred in northern Oregon and southern Washington, with subsidence ranging from 0 to 3 feet elsewhere. Leonard et al. (2004) estimated an average of 2 feet of co-seismic subsidence occurred in the Coos Bay area during the 1700 earthquake. For the Project site and in accordance with more recent tsunami modeling completed for the Southern Oregon Coast (Witter et al. 2011), the estimated subsidence would be on the order of 7.6 feet. Jordan Cove indicated that the Project would be designed to mitigate inundation due to the design tsunami and the design tsunami run-up elevations are established including an allowance for subsidence. In addition, Jordan Cove indicated the design tsunami run-up elevations have been determined in conjuction with a mean high water tide. Jordan Cove also indicated that furthermore tsunami protection berms, safety critical elements of the facility, point of support elevations, invert levels and underside of essential equipment, would be at least 1 foot above the estimated maximum run-up elevation and most will be far above that elevation. The criteria used to evaluate tsunami wave heights it based on new requirements provided in ASCE 7-16 which indicates that Maximum Considered Tsunami (MCT) events should use the same maximum earthquake criteria as used to determine Maximum Consider Ground Motions (and SSE ground motions). FERC staff worked with NOAA who helped developed Tsunami maps for ASCE 7-16 and NOAA determined that inundation elevations from the MCT event for the Jordan Cove LNG Project site were consistent with those determined by Jordan Cove. Therefore, FERC staff agrees that the tsunami elevations that Jordan Cove provided are suitable for the Project site.

Hurricanes, Tornadoes, and other Meteorological Events

Hurricanes, tornadoes, and other meteorological events have the potential to cause damage or failure of facilities due to high winds and floods, including failures from flying or floating debris. To assess the potential impact from hurricanes, tornadoes, and other meteorological events, Jordan Cove evaluated such events historically. The severity of these events are often determined on the probability that they occur and are sometimes referred to as the average number years that the event is expected to re-occur, or in terms of its mean return/recurrence interval.

Because of its location, the Project site would not likely be subject to hurricane force winds during the life of the Project, however, strong extratropical cyclones (baroclinic, cold core systems are common in the region. These storms are capable of producing winds of hurricane force, and as such, Jordan Cove has indicated that the project site would be designed to withstand strong wind events. However, because wind speeds at the Project location are considerably less than those that occur in the Gulf Coast east region and the east cose of the US, Jordan Cove stated that the wind load combinations specified in Chapter 2 of ASCE 7-10 should be used. Jordan Cove stated that the design wind speed using ASCE 7-10 Load and Resistance Factor Design (LRFD) and Allowable Stress Design (ASD) for LNG facilities and hazardous structures, which would be categorized as Risk Category III and IV (Occupancy Category in ASCE 7-05).

Jordan Cove hired Cermak Peterka Peterson (CPP) to perform a site specific wind speed assessment for this Project. CPP determined 127 mph 3-second gust as the Design Wind Speed (3-second gust, 33 feet, Exposure category C). The 127 mph 3-second gust was determined based on the criteria specified in 49 CFR 193.2067 and ASCE 7 based on a 10,000 year mean return interval, or a 0.5 percent probability of occurrence within a 50-year period for the site. CPP stated that the 127 mph wind speed is a strength level speed corresponding directly to the mean recurrence interval (MRI) criteria. The 127 mph 3-second gust converts to a sustained wind speed of approximately 102 mph. When using this wind speed with ASCE 7-05 load combinations, the value should be reduced by a factor of square root of 1.6 or the design wind pressure reduced by a factor of 1.6 in order to achieve the desired 10,000-year MRI. When using the 127 mph wind speed with ASCE 7-10 load combinations, no additional factors are required. In both cases, the wind importance factor is not applicable due to the wind speed directly corresponding with the required return period. The 127 mph 3-second gust equates to a strong Category 2 Hurricane using the Saffir-Simpson scale (96 to 110 mph sustained winds, 117 to 140 mph 3-second gusts). FERC staff found that when reviewing Figure 6-1A of ASCE 7-05, the Project location would be closest to the 90 mph 3-second gust isocontour in the special wind region area. Because the Project site is located within a special wind region, FERC staff did not utilize the ATC hazard tool, but instead utilized the ASCE 7 hazard tool, which provides the 3-second gust at a height of 33 feet above ground level and Exposure Category C. For the Project site, the ASCE 7-10 3-second gust is observed to be 115 mph. Jordan Cove indicated that non-hazardous buildings and structures would be designed to satisfy the design win speed requirements of the OSSC, rather than the requiremnts of USDOT regulations. Moreover, Jordan Cove confirmed that all facilities, including those containing LNG or other hazardous fluids (and associated safety systems), would be designed for wind loads in accordance with Chapters 26 through 31 of ASCE 7-10 using the site specific wind speed in accordance with 49 CFR 193.2067 and code-based wind directionality factor, velocity pressure exposure coefficient and topographic factor as specified in ASCE 7-10 based on Exposure Category D and structure type, accordingly. For simplicity and consistency, Jordan Cove intends to use a single conservative Exposure Category D for all wind design regardless of physical location within the facility. Jordan Cove's final wind speed design 127 mph 3-second gust, 33 feet, Exposure Category D is more conservative than CPP suggested 127 mph 3-second gust, 33 feet, Exosure Category C. However it is unclear whether some of the non-hazardous buildings and structures would qualify as LNG facilities under USDOT regulations, and, if so, whether a 10,000 year return period (123 mph 3-second gust, Exposure Category D) would meet USDOT requirements. Therefore, we recommend in section 4.13.1.6 that Jordan Cove consult with USDOT staff as to whether the design wind speed for other non-hazardous buildings and structures would be subject to USDOT requirements prior to the end of the comment period of the draft EIS.

Jordan Cove must meet 49 CFR 193.2067 Subpart B for wind load requirements. In accordance with the MOU, the USDOT will evaluate in its LOD whether an applicant's proposed Project meets the USDOT requirements under Subpart B. If the Project is authorized and constructed, the facilities would be subject to the USDOT's inspection and enforcement programs. Final determination of whether the facilities are in compliance with the requirements of 49 CFR 193 Subpart B would be made by the USDOT staff.

In addition, as noted in the limitation of ASCE 7-05 section 6.5.4.3 and ASCE 7-10 section 26.5.4, tornadoes were not considered in developing basic wind speed distributions. This leaves a potential gap in potential impacts from tornadoes. Therefore, FERC staff evaluated the potential for tornadoes. Appendix C of ASCE 7-05 makes reference to American Nuclear Society 2.3 (1983 edition), *Standard for Estimating Tornado and Extreme Wind Characteristics at Nuclear Power Sites*. This document has since been revised in 2011 and reaffirmed in 2016 and is consistent with NUREG/CR-4461, *Tornado Climatology of the Contiguous U.S.*, Rev. 2 (NUREG 2007). These documents provide maps of a 100,000 mean year return period for tornadoes using 2 degree latitude and longitude boxes in the region to estimate a tornado impacting a structure with a 200 foot characteristic length. Figures 5-8 and 8-1 from NUREG/CR-4461 indicate a 100,000 year maximum tornado wind speeds would be less than 65 mph 3-second gusts for the Project site location. Later editions of ASCE 7 (ASCE 7-10 and ASCE 7-16) make reference to International Code Council (ICC) 500, *Standard for Design and Construction of Storm Shelters*, for 10,000 year tornadoes. However, the ICC 500 maps were conservatively developed based on tornadoes striking regions and indicate a 130 mph 3-second gust for a 10,000 year event, which is higher than the 65 mph 3-second gust in American Nuclear Society 2.3 and NUREG/CR-4461. As a result, we conclude the use of an equivalent 127 mph 3-second gust, 33 feet, Exposure Category D, is adequate for the LNG storage tanks and conservative from a risk standpoint for the other LNG and hazardous facilities. USDOT will provide a LOD on the Project's compliance with 49 CFR 193 Subpart B in regard to wind speed. This determination will be provided to the Commission as further consideration to the Commission on its decision to authorize or deny the Project.

The USDOT regulations in 49 CFR 193.2067 Subpart B would require the impounding system for the LNG storage tanks to withstand impact forces from wind borne missiles. ASCE 7 also recognizes the facility would be in a wind borne debris region. Wind borne debris has the potential to perforate equipment and the LNG storage tanks if not properly designed to withstand such impacts. The potential impact is dependent on the equivalent projectile wind speed, characteristics of projectile, and methodology or model used to determine whether penetration or perforation would occur. However, no criteria are provided in 49 CFR 193 or ASCE 7 for these specific parameters. NFPA 59A (2016) recommends Comite Euro-International du Beton (CEB) 187 be used to determine projectile perforation depths. In order to address the potential impact, we recommend in section 4.13.1.6 that Jordan Cove provide a projectile analysis for review and approval to demonstrate that the outer concrete impoundment wall of a full-containment LNG tank could withstand wind borne projectiles prior to construction of the final design. The analysis should detail the projectile speeds and characteristics and method used to determine penetration or perforation depths. FERC staff would compare the analysis and specified projectiles and speeds using established methods, such as CEB 187, and DOE and Nuclear Regulatory Commission (NRC) guidance.

In addition, FERC staff evaluated historical tropical storm, hurricane, and tornado tracks in the vicinity of the project facilities using data from the Department of Homeland Security (DHS) Homeland Infrastructure Foundation Level Data (HILFD) and NOAA Historical Hurricane Tracker.[206,207] Since 1900, there is no historical storm or hurricane that has been reported within 65 nautical miles of the LNG terminal site. Hurricanes do not occur near the LNG terminal site as the environment does not support these barotropic, warm core systems. Since 1950, there is no historical tornado event that has been reported within 10 nautical miles of the LNG terminal site. Although tropical cyclones do not occur at the Project site, extreme storms offshore sometimes cause the water level along the coastline to raise significantly beyond the normal tide levels. This phenomenon is referred to as storm surge. Jordan Cove discussed storm surge expected at the site based on the NAVD 88 using a Federal Emergency Management Agency (FEMA) conversion factor, indicating a storm surge elevation of 24.62 feet at the Project site. Jordan Cove indicated that the storm surge is not considered additive to the tsunami inundation height as both storm surge and tsunami are low frequency events. FERC staff agrees that storm surge and tsunami would not need to be considered simultaneously.

Potential flood levels may also be informed from the FEMA Flood Insurance Rate Maps, which identify Special Flood Hazard Areas (base flood) that have a 1 percent probability of exceedance in 1 year to flood (or a 100 year mean return interval) and moderate flood hazard areas that have a 0.2 percent probability of exceedance in 1 year to flood (or a 500 year mean return interval). According to the FEMA National Flood Hazard Layer, portions of the Project would be located in the 100-year floodplain. In addition, according to FEMA flood hazard maps (2018), the 100-year flood elevation at the site is +12.4 feet NAVD 88 and the 500-year flood elevation is +13 feet NAVD 88. We recognize that a 500 year flood event has been recommended as the basis of design for critical infrastructure in publications, including ASCE 24, Flood Resistant Design and Construction. Therefore, it is our opinion that it is good practice to design critical energy infrastructure to withstand 500 year event from a safety and reliability standpoint for the still water elevation (SWEL) and wave crests. Furthermore, we determined the use of intermediate values

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206 DHS, Homeland Infrastructure Foundation Level Data, https://hifld-geoplatform.opendata.arcgis.com/, August 2018.

207 NOAA, Historical Hurricane Tracker, https://coast.noaa.gov/hurricanes/, August 2018.

from NOAA for sea level rise and subsidence is more appropriate for design and higher projections are more appropriate for planning in accordance with NOAA (2017)[208] which recommends defining a central estimate or mid-range scenario as baseline for shorter-term planning, such as setting initial adaptation plans for the next two decades and defining upper bound scenarios as a guide for long-term adaptation strategies and a general planning envelope. Jordan Cove has indicated that the facility would be designed to handle a 100-year storm surge without any wave overtopping, and would be designed to accommodate the wave overtopping that would occur from a 500-year storm surge. Jordan Cove stated the storm surge expected at the site based on the NAVD 88 using a FEMA conversion factor, indicating a coastal flooding (storm surge) elevation of 24.62 feet at the Project site. The Project site elevations of pipeline and all above ground facilities are higher than the maximum coastal flooding elevations estimated.

Jordan Cove proposes to construct most structures above the elevation +46 feet NAVD 88 which would minimize impacts associated with potential storm surges. Exceptions include the LNG storage tanks and water-dependent facilities such as the marine terminal and Material Offloading Facility (MOF). The LNG storage tank base would have an elevation of approximately +27 feet NAVD 88 would be surrounded by a tertiary protective berm with a crest elevation of no less than +46 feet NAVD 88. Jordan Cove indicated that the parts of the marine facilities that are normally occupied or operational would typically be at an elevation of +34.5 feet or greater, whereas normally unoccupied/non-operational parts of the marine facilities may be at a lower elevation.

We generally evaluate the design against a 500-year SWEL with a 500-year wave crest and relative sea level rise and subsidence. According to FEMA Flood Insurance Study (FIS) for Coos County, Oregon, the average wave height offshore from Coos County is 8.5 feet, while the average peak spectral wave period is 11.1 seconds, although a period of 20 to 25 seconds is not uncommon. Also we would expect an intermediate projected sea level rise of 1.02 feet between 2020 and 2050 as provided by NOAA (2017). Adding the 500-year storm surge, wave crest elevations, relative sea level rise and subsidence results in a total elevation of 42 feet. FERC staff evaluated Jordan Cove's proposed 500-year flood against the 2014 FEMA Flood Insurance Study (FIS) for Coos County, Oregon, which provides various transection lines and associated 10-, 50-, 100-, and 500-year SWELs, 500-year wave envelopes, and 500-year wave effects along the length of the transection lines. We believe the use of intermediate values from NOAA for relative sea level rise and subsidence is more appropriate for design and higher projections are more appropriate for planning envelope. Also, the Project area is outside of the VE (velocity wave) zone that corresponds to the 100-year (1 percent annual chance) coastal floodplains that have additional hazards associated with storm waves. The Project area is also outside the 500-year (0.2 percent annual chance) flood area. As a result, we conclude that the facility would be able to withstand storm surge without damage during a 500-year storm event.

Shoreline erosion could occur at the Project site and along the opposite shoreline as a result of waves, currents, and vessel wakes. Jordan Cove stated that the Project basin shoreline would be protected from scour and erosion using stone or a cement based rip rap. Even though shoreline erosion is a concern at the site, the proposed mitigation measures would minimize erosion and scour impacts.

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[208] Global And Regional Sea Level Rise Scenarios for the United States, U.S. Department Of Commerce, National Ocean and Atmospheric Administration, National Ocean Service Center for Operational Oceanographic Products and Services, January 2017.

FERC staff evaluated the basis of design for the Project relating to withstanding rain, ice, and snow events. To handle the rain the area receives, Jordan Cove stated that the roofs of permanent structures to be located onsite would be designed to preclude instability resulting from ponding effects by ensuring adequate primary and secondary drainage systems, slope, and member stiffness. Jordan Cove discussed the ice load design for the Project and stated the ice load is not applicable for the Project site and design ice thickness is 0 inches in accordance with ASCE 7-10 and climatological studies. The coastal location of this Project also impacts the amount of snow the area receives. Jordan Cove states that the snow design for this Project was based on ASCE 7-10 design maps and the 2014 OSSC. Jordan Cove indicated the snow load design bases for this Project are 5 pounds per square foot (psf) for ground snow load and 20 psf for the roof snow load.

Landslides and other Natural Hazards

Landslides in the United States occur in all 50 states. The primary regions of landslide occurrence and potential are the coastal and mountainous areas of California, Oregon, and Washington, the states comprising the intermountain west, and the mountainous and hilly regions of the eastern United States. Jordan Cove evaluated the type and occurrence of landslides in the vicinity of the Project site and indicated that no landslide deposits were identified within the Project area. There is a moderate to high landslide susceptibility hazard on the dune ridges at the Project site; however, the active landslides have not been identified on the sand dunes. The high susceptibility at the Project site is primarily based on the steep slopes of the dune deposits. Jordan Cove states that they would regrade the steep dunes thereby eliminating potential landslide hazards related to dune sand stability. The potential for tsunamis associated with submarine landslides is more likely a source in the CSZ. Jordan Cove evaluated the type and occurrence of landslides for the Project area and indicated that no landslides deposits were identified with the Project site. A moderate to high landslide susceptibility hazard is mapped on the dune ridges at the Project site; however, active landslides have not been identified on the sand dunes. The high susceptibility indicated at the Project site is primarily based on the steep slopes of the dune deposits. Jordan Cove would regrade the steep dunes thereby eliminating potential landslide hazards related to dune sand stability.

Volcanic activity is primarily a concern along plate boundaries on the West Coast and Alaska and also Hawaii. Based on FERC staff review of maps from USGS[209] and DHS[210] and Jordan Cove report: the Cascade Mountain Range is the volcanic arc complex of the CSZ and is located approximately 100 miles east of the Project site. Volcanoes of the Cascade Mountains are found from northern California to British Columbia. The nearest Cascade Volcano is the Crater Lake caldera that was formed during the eruption and collapse of Mount Mazama approximately 7,700 years ago. The Project site would not be directly affected by the various types of volcanic eruption hazards due to the distance of the hazards, the upwind location of the Project site from the volcanic hazard, and the low likelihood of volcanic eruption during the lifetime of the Project.

The west coast is often associated with the potential of wildfires. According to the Oregon Department of Forestry (ODF), have been a number of fires that have occurred within 100 miles of the Jordan Cove site, however, none of these fires occurred in the immediate proximity of Coos

[209] United States Geological Survey, U.S. Volcanoes and Current Activity Alerts, https://volcanoes.usgs.gov/index.html, accessed Aug 2018.
[210] Department of Homeland Security, Homeland Infrastructure, Foundation-Level data (HIFLD), Natural Hazards, hifld-geoplatform.opendata.arcgis.com, accessed Aug 2018

Bay. In addition, Jordan Cove site is surrounded by water on the southern and eastern side, separating the site from the more forested areas to the east of the site. As such, it is unlikely that a wildfire would occur at the Project site. Additionally, Jordan Cove indicated that the plans for how to handle fires are provided in the Emergency Response Plan that has been developed for the site.

Geomagnetic disturbances (GMDs) may occur due to solar flares or other natural events with varying frequencies that can cause geomagnetically induced currents, which can disrupt the operation of transformers and other electrical equipment. USGS provides a map of GMD intensities with an estimated 100 year mean return interval.[211] The map indicates the Jordan Cove site could experience GMD intensities of 400 nano-Tesla (nT) with a 100 year mean return interval. However, Jordan Cove would be designed such that if a loss of power were to occur the valves would move into a fail-safe position. In addition, Jordan Cove is an export facility that does not serve any U.S. customers.

External Impact Review

To assess the potential impact from external events, FERC staff conducted a series of reviews to evaluate transportation routes, land use, and activities within the facility and surrounding the the LNG terminal site, and the safeguards in place to mitigate the risk from events, where warranted. FERC staff coordinated the results of the reviews with other federal agencies to assess potential impacts from vehicles and rail; aircraft impacts to and from nearby airports and heliports; pipeline impacts from nearby pipelines; impacts to and from adjacent facilities that handle hazardous materials under the EPA's Risk Management Plan (RMP) regulations and power plants, including nuclear facilities under the Nuclear Regulatory Commission's regulations. Specific mitigation of impacts from use of external roadways, rail, helipads, airstrips, or pipelines are also considered as part of the engineering review done in conjunction with the NEPA review.

FERC staff uses a risk-based approach to assess the potential impact of the external events and the adequacy of the mitigation measures. The risk-based approach uses data based on the frequency of events that could lead to an impact and the potential severity of consequences posed to the LNG terminal site and the resulting consequences to the public beyond the initiating events. The frequency data is based on past incidents and the consequences are based on past incidents and/or hazard modeling of potential failures.

Road

FERC staff reviewed whether any truck operations would be associated with the project and whether any existing roads would be located near the site. FERC staff uses this information to evaluate whether the project and any associated truck operations could increase the risk along the roadways and subsequently to the public and whether any pre-existing unassociated vehicular traffic could adversely increase the risk to a project site and subsequently increase the risk to the public. In addition, if authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to the USDOT's inspection and enforcement programs. USDOT regulations under 49 CFR 193.2155 (a) (5) (ii) Subpart C require that structural members of an impoundment system must be designed and constructed to

[211] United States Geological Survey, Magnetic Anomaly Maps and Data for North America, https://mrdata.usgs.gov/magnetic/map-us.html#home, accessed Aug 2018.

prevent impairment of the system's performance reliability and structural integrity as a result of a collision by or explosion of a tank truck that could reasonably be expected to cause the most severe loading if the liquefaction facility adjoins the right-of-way of any highway. Similarly, NFPA 59A (2001), section 8.5.4, requires transfer piping, pumps, and compressors to be located or protected by barriers so that they are safe from damage by rail or vehicle movements. However, the USDOT regulations and NFPA 59A (2001) requirements do not indicate what collision(s) or explosion(s) could reasonably be expected to cause the most severe loading. FERC staff evaluated consequence and frequency data from these events to evaluate these potential impacts.

FERC staff evaluated the risk of the truck operations based on the consequences from a release, incident data from the USDOT's Federal Highway Administration (FHWA), National Highway Traffic Safety Administration (NHTSA), and Pipeline and Hazardous Materials Safety Administration (PHMSA), EPA, NOAA, and other reports[212,213,214,215,216,217,218], and frequency of trucks and proposed mitigation to prevent or reduce the impacts of a vehicular incident.

Incident data from DOT FHWA, DOT NHTSA, and DOT PHMSA indicate hazardous material incidents are very infrequent (4e-3 incidents per lane mile per year) and nearly 75 to 80 percent of hazardous material vehicular incidents occur during unloading and loading operations while the other 20 to 25 percent occur while in transit or in transit storage. In addition, approximately 99 percent of releases are 1,000 gallons or less and catastrophic events that would spill 10,000 gallons or more make up less than 0.1 percent of releases. In addition, less than 1 percent of all reportable hazardous material incidents with spillage result in injuries and less than 0.1 percent of all reportable hazardous material incidents with spillage result in fatalities.

The EPA and NOAA report that 80 percent of fires that lead to container ruptures results in projectiles and that 80 percent of projectiles from liquefied petroleum gas (LPG) incidents, which constitute the largest product involved in BLEVEs, travel less than 660 feet. The EPA also reports that on average container ruptures would result in less than four projectiles for cylindrical containers and 8.3 for spherical vessels. FERC staff evaluated other reports that affirmed the EPA estimates based on data for approximately 150 experimental and accidental pressure vessel bursts (PVBs) and BLEVEs with approximately 683 total projectiles (4.6 average fragments per incident) that showed approximately 80 percent of fragments traveled 490 to 820 feet and within 6.25 times the estimated or observed fireball radius. The data also showed projectiles have traveled up to 3,900 feet for large LPG vessels and 1,200 feet for LPG rail cars. In all the documented cases, the

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212 USDOT FHWA, Office of Highway Policy Information, *Highway Statistics 2016*, https://www.fhwa.dot.gov/policyinformation/statistics/2016/, accessed March 2019.

213 USDOT NHTSA, *Traffic Safety Facts Annual Report Tables*, https://cdan.nhtsa.gov/tsftables/tsfar.htm, accessed March 2019.

214 USDOT PHMSA, Office of Hazardous Material Safety, *Incident Reports Database Search*, https://hazmatonline.phmsa.dot.gov/IncidentReportsSearch/Welcome.aspx, accessed March 2019.

215 U.S. Environmental Protection Agency, National Oceanic and Atmospheric Administration, ALOHA®, User's Manual, The CAMEO® Software System, February 2007.

216 Birk, A.M., BLEVE Response and Prevention Technical Documentation, 1995.

217 American Institute of Chemical Engineers, Center for Chemical Process Safety, Guidelines for Vapor Cloud Explosion, Pressure Vessel Burst, BLEVE, and Flash Fire Hazards, Second Edition, 2010.

218 Lees, F.P, Lees' Loss Prevention in the Process Industries: Hazard Identification, Assessment, and Control, Volume 2, Second Edition, 1996.

projectiles traveled less than 15 times the fireball diameter, but one of the reports indicated up to 30 times the fireball diameter is possible albeit very rare.

Unmitigated consequences under average ambient conditions from releases of 1,000 gallons through a 1-inch hole would result in distances ranging from 25 to 200 feet for flammable vapor dispersion, and 75 to 175 feet for jet fires. Unmitigated consequences under worst case weather conditions from catastrophic failures of trucks proposed at the site generally can range from 200 to 2,000 feet for flammable vapor dispersion, 275 to 350 feet for radiant heat of 5 kW/m^2 from jet fires, 800 to 1,050 feet to a 1 psi overpressure from a BLEVE, 850 to 1,500 feet for a heat dose equivalent to a radiant heat of 5 kW/m^2 over 40 seconds from 250 to 325 feet radii fireballs burning for 5 to 15 seconds from a BLEVE, and projectiles from BLEVEs possibly extending farther. Based on distribution function of the projectile distances, FERC staff estimate approximately 90 percent of all projectiles for a 10,000-gallon tanker truck would be within 0.5 mile and there is approximately a 1 percent probability they would extend beyond 1 mile and less than 0.1 percent probability they would extend 30 times the fireball diameter. These values are also close to the distances provided by the USDOT FHWA for designating hazardous material trucking routes (0.5 mile for flammable gases for potential impact distance) and USDOT PHMSA for emergency response (0.5 to 1 mile for initial evacuation and 1 mile for potential BLEVEs for flammable gases).

During startup and operation of the project, Jordan Cove estimates 22 refrigerant make-up trucks, 8 amine trucks, 4 nitrogen trucks, 160 aqueous ammonia trucks, and 28 diesel trucks would be needed at the site annually. The most frequent truck deliveries would occur during commissioning and startup activity at the site and would deliver refrigerants to load the liquefaction trains. Between 15 and 20 trucks are expected over an approximately 2 week timefame to load each liquefaction train. The refrigerant deliveries would be repeated for the startup of each subsequent liquefaction train. Jordan Cove does not plan to utilize any trucks to deliver LNG. The Transpacific Parkway, which connects to State Highway (SH) 101 is located directly to the north of the facility property and would be used to access the Jordan Cove Project site. The Transpacific Parkway is a two lane bi-directional route with a 45 mph speed limit. Jordan Cove provided a Road Safety and Reliability Impact Study (RSRIS). The RSRIS addresses potential safety and reliability impacts of proposed tanker trucks loaded or unloaded at the LNG terminal, and from commercial and recreational roadway traffic along the Transpacific Parkway. The separation distance between the Transpacific Parkway and the Project facilities that would contain hazardous fluids would be greater than 300 feet which would exceed the distances estimated for flammable vapor dispersion and radiant heat from an LNG truck 1-inch hole release. In addition, the Project would install an 80-feet tall impervious barrier that would separate the Transpacific Parkway and the process equipment located in the Ingram Yards area. FERC staff did not identify any other major highways or roads within close proximity to piping or equipment containing hazardous materials at the site that would not be protected by this separation distance and 80-feet tall barrier to raise concerns of direct impacts from a vehicle impacting the site.

Therefore, we conclude that the Project would not pose a significant risk or significant increase in risk to the public due to vehicle impacts as a result of the potential consequences, incident data, frequency of trucks, proposed mitigation by Jordan Cove, and additional mitigation measures proposed by FERC staff.

Rail

FERC staff reviewed whether any rail operations would be associated with the Project and whether any existing rail lines would be located near the site. FERC staff uses this information to evaluate whether the Project and any associated rail operations could increase the risk along the rail line and subsequently to the public and whether any pre-existing unassociated rail operations could adversely increase the risk to the Jordan Cove site and subsequently increase the risk to the public. In addition, if authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to the USDOT's inspection and enforcement programs. USDOT regulations under 49 CFR 193.2155 (a) (5) (ii) Subpart C state that if the LNG facility adjoins the right-of-way of any railroad, the structural members of an impoundment system must be designed and constructed to prevent impairment of the system's performance reliability and structural integrity as a result of a collision by or explosion of a train or tank car that could reasonably be expected to cause the most severe loading.

Section 8.5.4 of NFPA 59A (2001), incorporated by reference in 49 CFR 193, requires transfer piping, pumps, and compressors to be located or protected by barriers so that they are safe from damage by rail or vehicle movements. However, the USDOT regulations and NFPA 59A (2001) requirements do not indicate what collision(s) or explosion(s) could reasonably be expected to cause the most severe loading. Therefore, FERC staff evaluated consequence and frequency data from these events to evaluate these potential impacts. FERC staff evaluated the risk of the rail operations based on the consequences from a release, incident data from the Federal Rail Administration (FRA) and PHMSA, and frequency of rail operations nearby Jordan Cove.

FERC staff evaluated the risk of the rail operations based on the consequences from a release, incident data from the DOT Federal Railroad Administration (FRA) and DOT PHMSA, and frequency of rail operations near the LNG Terminal site. Incident data from DOT FRA and DOT PHMSA indicates hazardous material incidents are very infrequent (6e-3 incidents per rail mile per year). In addition, approximately 95 percent of releases are 1,000 gallons or less, and catastrophic events that would spill 30,000 gallons or more make up less than 1 percent of releases. In addition, less than 1 percent of hazardous material incidents result in injuries and less than 0.1 percent of hazardous material incidents result in fatalities.

As previously discussed, the EPA and NOAA report that 80 percent of fires that lead to container ruptures results in projectiles and that 80 percent of projectiles from LPG incidents, which constitute the largest product involved in BLEVEs, travel less than 660 feet. The EPA also reports that on average container ruptures would result in less than four projectiles for cylindrical containers and 8.3 for spherical vessels. FERC staff evaluated other reports that affirmed the EPA estimates based on data for approximately 150 experimental and accidental PVBs and BLEVEs with approximately 683 total projectiles (4.6 average fragments per incident) that showed approximately 80 percent of fragments traveled 490 to 820 feet and within 6.25 times the estimated or observed fireball radius. The data also showed projectiles have traveled up to 3,900 feet for large LPG vessels and 1,200 feet for LPG rail cars. In all the documented cases, the projectiles traveled less than 15 times the fireball diameter, but one of the reports indicated up to 30 times the fireball diameter is possible albeit very rare.

Unmitigated consequences under average ambient conditions from releases of 1,000 gallons through a 1-inch hole would result in distances ranging from 25 to 200 feet for flammable vapor dispersion, and 75 to 175 feet for jet fires. Unmitigated consequences under worst-case weather conditions from catastrophic failures of rail cars containing various flammable products generally can range from 300 to 3,000 feet for flammable vapor dispersion, 450 to 575 feet for radiant heat of 5 kW/m^2 from jet fires, 1,225 to 1,500 feet to a 1 psi overpressure from a BLEVE, 1,250 to 2,100 feet for a heat dose equivalent to a radiant heat of 5 kW/m^2 over 40 seconds from 350 to 450 feet radii fireballs burning for 7 to 20 seconds from a BLEVE, and projectiles from BLEVEs possibly extending farther. Based on distribution function of the projectile distances, FERC staff estimate approximately 80 percent of all projectiles for a 30,000 gallon rail car would be within 0.5 mile and there is approximately a 5 percent probability they would extend beyond 1 mile and less than 0.1 percent probability they would extend 30 times the fireball diameter. These values are also close to the distances provided by USDOT PHMSA for emergency response (0.5 to 1 mile for initial evacuation and 1 mile for potential BLEVEs for flammable gases).

The closest rail line would be the Coos Bay Rail Line (CBRL) located directly to the north of the Project site. The CBRL is a single line railroad that provides delivery of forestry products (e.g., wood products, fertilizer, organic dairy feed) to the nearby Roseburg Forest Products Plant. The Project would install an 80-feet tall impervious barrier that would separate the CBRL and the process equipment. BakerRisk, Inc. performed a rail risk safety analysis and security risk assessment for Jordan Cove that evaluated the potential safety, security, and reliability impacts from the CBRL.

The closest Project facilities would be the ground flare approximately 60 feet from the rail line separated by a retaining wall, the closest auxiliary power generators and pretreatment facilities approximately 400 to 450 feet from the rail line, the closest LNG storage tank approximately 1,150 feet from the rail line, and the closest liquefaction train approximately 1,200 feet from the rail line. However the rail line would not transport pressurized or flammable hazard fluids. Therefore the rail road would not pose a vapor dispersion, fireball, jet fire, pool fire, BLEVE, or projectile hazard to the Project. In addition, Jordan Cove would coordinate with local emergency responders with regard to potential rail incidents. Due to the extremely low likelihood and mitigating actions, we conclude the Project would not pose a significant increase in risk to the public as a result of the proximity of the Project to the rail lines

In addition Jordan Cove would install a railroad construction spur within the plant boundaries that would be located approximately 750 feet east of the process equipment and anticipates to utilize the construction spur approximately 2 times every 3 years for maintenance. The Project would install a 100-feet tall impervious barrier that would separate the construction spur and the process equipment. If the Project is authorized, Jordan Cove would keep the construction spur in place to provide delivery of maintenance equipment, spare parts, and other oversized equipment that would be suited for rail transport. Based on the potential consequences, incident data, distance, and location of the CBRL as well as the anticipated frequency of railroad delivery via the construction spur, we conclude that the Project would not pose a significant increase in risk to the public as a result of the proximity of the Project to the rail lines.

Air

FERC staff reviewed whether any aircraft operations would be associated with the Project and whether any existing aircraft operations would be located near the site. FERC staff uses this information to evaluate whether the Project and any associated aircraft operations could increase the risk to the public and whether any pre-existing unassociated aircraft operations could adversely increase the risk to the Project site and subsequently increase the risk to the public. In addition, if authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to the USDOT's inspection and enforcement programs. USDOT regulations under 49 CFR 193.2155 (b), Subpart C, require a LNG storage tank must not be located within a horizontal distance of one mile from the ends, or 0.25 miles from the nearest point of a runway, whichever is longer and that the height of LNG structures in the vicinity of an airport must comply with USDOT FAA requirements. In addition, FERC staff evaluated the risk of an aircraft impact from nearby airports.

Two mixed use aviation airports, Southwest Oregon Regional Airport and Lakeside Municipal Airport, would be located 0.6 mile southeast and 10.9 miles northeast of the LNG terminal site, respectively. The one general aviation airport is the Sunnyhill- North Bend Airport located 4.7 miles northeast of the LNG terminal site. These are all farther than the 0.25-mile distance referenced in USDOT regulations.

FAA regulations in 14 CFR 77 require Jordan Cove to provide a notice to the FAA of its proposed construction. This notification should identify all equipment that are more than 200 feet above ground level or lesser heights if the facilities are within 20,000 feet of an airport (at 100:1 ratio or 50:1 ratio depending on length of runway) or within 5,000 feet of a helipad (at 100:1 ratio). In addition, mobile objects, including the LNG marine vessel that would be above the height of the highest mobile object that would normally traverse it would require notification to FAA.

The Project would include permanent structures that would be taller than 200 feet. Therefore, in accordance with the regulations in 14 CFR 77, Jordan Cove submitted notice to the FAA for an aeronautical obstruction study for the tallest structures at its property. However, Jordan Cove did not submit a notice for temporary construction equipment, such as cranes, derricks, etc., which may be taller than permanent structures and would be used during construction of the Project. Therefore we recommend in section 4.13.1.6 that Jordan Cove file notice to the FAA for temporary structures that would require an Aeronautical Study.

On May 7, 2018, the FAA issued its findings for the LNG marine vessel (at multiple locations during transit), LNG storage tanks, Amine regenerator column, and the thermal oxidizer stack and stated that each of the structures would exceed obstruction standards and would be a presumed hazard to air navigation. However, it should also be noted that the FAA's Notice of Presumed Hazard is not a final determination and each notice states that if the maximum heights of the structures that exceed obstruction standards were reduced to 167 feet above mean seal level (AMSL), it would not create a substantial adverse effect and a favorable determination could subsequently be issued. Jordan Cove has indicated that it would continue to meet with FAA to investigate potential options for eliminating or mitigating the presumed hazards. While Jordan Cove did not provide any additional correspondence with FAA or Southwest Oregon Regional Airport, these potential hazards were previously discussed in the Jordan Cove Energy Project FEIS under Docket Number CP13-483-000 and would be applicable here as similar tall structures reported in the previous application also received a Notice of Presumed Hazard.

As discussed in the Jordan Cove Energy Project FEIS under Docket Number CP13-483-000, two options were identified for mitigating the presumed hazards. One option would maintain the existing flight pattern and require additional lighting and markings on the LNG storage tanks and amine columns. Raising the altitude of planes would provide another level of safety. The other option would “flip” the flight patterns for Runway 04 from their current alignment as a left-handed pattern to the north of the airport that would fly over the Project site, to a right-handed pattern south of the airport that would avoid the terminal. However, the Southwest Oregon Regional Airport did not support the concept of flipping the flight patterns at Runway 04 because that would place aircraft over a populated area. Instead, the Southwest Oregon Regional Airport preferred marking the tanks and towers and concluded that the Jordan Cove LNG terminal would not represent a substantial hazard to aircraft because:

- the existing floor of the airport’s traffic pattern is 1,000 feet AMSL and no aircraft flying in the pattern would have to change course or altitude to avoid any of the proposed structures;
- the amine towers are lower than surrounding structures, terrain, and surveyed trees. The LNG storage tanks are taller than the trees, but still lower than the McCullough bridge located within the flight pattern area at 268 feet AMSL; and
- marked obstacles (including both structures and trees) are higher than the airport’s elevation and require aircraft to operate at altitudes more than 500 feet above the amine towers and the LNG tanks and no current visual flight rules would have to change course or altitude to avoid the proposed structures.

However, since the FAA has not issued the final determination, there is a potential significant impact to the safe air operations of the Southwest Oregon Regional Airport if a resolution cannot be settled. Therefore, we recommend in section 4.13.1.6 that Jordan Cove should file the final determinations from the FAA prior to initial site preparation that indicate there will be no hazard to aircraft using the Southwest Oregon Regional Airport, and copies of all studies related to the Project’s potential impact on the airport. If a determination of no hazard cannot be reached then a notice to proceed with the project would not be granted and a modification, variance, or amendment may be needed.

In addition, FERC staff used DOE Standard 3014, Accident Analysis for Aircraft Crash into Hazardous Facilities, which utilizes a 22-mile threshold radius around the hazardous facility for consideration of hazards posed by airport and heliport operations to the Project facilities. There are two mixed use airports (commercial, military, and general aviation), and one general aviation airport within the 22-mile radius. Per the DOE standard 3014, heliports need only be considered if there are local overflights associated with facility operations and/or area operations. The Project site does have a facility associated heliport in the South Dunes area that would be located approximately 1.2 miles east of processing areas. The heliport would support the Southwest Oregon Regional Safety Center and would generally be used for emergency response and annual exercises. In addition, the Project would install a 100-feet tall impervious barrier that would located between the process equipment and the heliport. Based on the potential separation distance between the process equipment and the heliport as well as the anticipated limited use of the heliport, we conclude the impact risk due to heliport operations would not be significant.

Comments from the public and feedback from FAA indicated potential impacts to and from the Project and the nearby Southwest Oregon Regional Airport. FERC staff conducted internal analyses, and requested information from the applicant on the likelihood and consequences from a potential aircraft impacting the Project and determined that the potential impact to the facility would be above the initial 3e-5 per year screening threshold identified for the process areas and the LNG storage tanks. The potential consequences of such an incident at the tank roof or in the process areas would likely result in a release and fire that would be within the existing hazard footprints already evaluated for a complete tank roof fire and full impoundment fire that is sized for the largest spill in the process area. However depending on the location of impact and extent of damage, the potential fire hazard could extend beyond those evaluated from the LNG storage tank roof fire and the impoundment basin fires. Therefore, FERC staff evaluated whether the full containment walls would withstand aircraft impacts using established methods, such as CEB 187 and other publications. Based on this analysis, FERC staff determined that the full containment LNG storage tanks could withstand general aviation impacts without perforation of the outer tank wall from aircraft impacts that exceed frequencies of 3e-5 per year. However, FERC staff also determined that the LNG storage tanks may not withstand commercial aviation impacts without perforation of the outer tank wall from aircraft impacts that exceed frequencies of 3e-5 per year. As discussed above, potential fire hazard distances from aircraft impacts to the LNG storage tank could extend beyond the property lines, however, these fire hazards would not impact the public. Therefore, we conclude that with the implementation of our recommendations, the Project would not pose a significant risk or increase risk to the public from aircraft impacts to either the LNG storage tanks or the process areas due to the potential consequences, incident data, and the distance and position of aircraft operations relative to the populated areas in the North Bend community.

Pipelines

FERC staff reviewed whether any pipeline operations would be associated with the Project and whether any existing pipelines would be located near the site. FERC staff uses this information to evaluate whether the Project and any associated pipeline operations could increase the risk to the pipeline facilities and subsequently to the public and whether any pre-existing unassociated pipeline operations could adversely increase the risk to the Project site and subsequently increase the risk to the public. In addition, pipelines associated with this Project must meet USDOT regulations under 49 CFR 192 and are discussed in section 4.13.3. If authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 192 and 49 CFR 193 and would be subject to the USDOT's inspection and enforcement programs. FERC staff evaluated the risk of a pipeline incident impacting the Project and the potential of cascading damage increasing the risk to the public based on the consequences from a release, incident data from the USDOT PHMSA, and proposed mitigation to prevent or reduce the impacts of a pipeline incident from Jordan Cove.

For existing pipelines, FERC staff identified an existing natural gas pipeline located approximately 1.75 miles southwest of the site. FERC staff evaluated the potential risk from an incident from the pipeline and its potential impacts by considering the design and operating conditions and location of the pipeline. This pipeline would be located too far to impact the Project site in the event of an incident.

In addition, based on the potential likelihood of pipeline incidents and potential consequences from a pipeline incident, we conclude that the Project would not significantly increase the risk to the public beyond existing risk levels that would be present from a pipeline leak or pipeline rupture worst-case event near the Project site.

Hazardous Material Facilities and Power Plants

FERC staff reviewed whether any EPA RMP regulated facilities handling hazardous materials and power plants were located near the site to evaluate whether the facilities could adversely increase the risk to the Project site and whether the Project site could increase the risk to the EPA RMP facilities and power plants and subsequently increase the risk to the public.

There were no facilities handling hazardous materials or power plants identified adjacent to the site. The closest EPA RMP regulated facilities handling hazardous materials would be the City of North Bend Wastewater Treatment Plant located approximately 1.03 miles away, and the Pony Creek Water Treatment Plant located approximately 3.50 miles away. The EPA RMP regulations require certain hazard distances to be calculated and a risk management plan to be developed commensurate with those consequences. In addition, the closet power plant identified would be the Douglas County Forest Products Biomass Plant approximately 46 miles away and the closest nuclear plant would be the Columbia Generating Station located over 300 miles away.

Given the distances, locations, and risk management plan requirements of the facilities relative to the populated areas of the North Bend communities, we conclude that the Project would not pose a significant increase in risk to the public or that the hazardous material facilities and power plants would not pose a significant risk to the Project and subsequently to the public.

Onsite and Offsite Emergency Response Plans

As part of its application, Jordan Cove indicated that the Project would develop a comprehensive ERP with local, state, and federal agencies and emergency response officials to discuss the Facilities. Jordan Cove would continue these collaborative efforts during the development, design, and construction of the Project. The emergency procedures would provide for the protection of personnel and the public as well as the prevention of property damage that may occur as a result of incidents at the Project facilities. The facility would also provide appropriate personnel protective equipment to enable operations personnel and first responder access to the area.

As required by 49 CFR 193.2509 Subpart F, Jordan Cove would need to prepare emergency procedures manuals that provide for: a) responding to controllable emergencies and recognizing an uncontrollable emergency; b) taking action to minimize harm to the public including the possible need to evacuate the public; and c) coordination and cooperation with appropriate local officials. Specifically, 49 CFR 193.2509 (b) (3) requires "Coordinating with appropriate local officials in preparation of an emergency evacuation plan…," which sets forth the steps required to protect the public in the event of an emergency, including catastrophic failure of an LNG storage tank. USDOT regulations under 49 CFR 193.2905 Subpart J also require at least two access points in each protective enclosure to be located to minimize the escape distance in the event of emergency.

Title 33 CFR 127.307 also requires the development of emergency manual that incorporates additional material, including LNG release response and emergency shutdown procedures, a description of fire equipment, emergency lighting, and power systems, telephone contacts, shelters, and first aid procedures. In addition, 33 CFR 127.207 establishes requirements for warning alarm systems. Specifically, 33 CFR 127.207 (a) requires that the LNG marine transfer area to be equipped with a rotating or flashing amber light with a minimum effective flash intensity, in the horizontal plane, of 5000 candelas with at least 50 percent of the required effective flash intensity in all directions from 1.0 degree above to 1.0 degree below the horizontal plane. Furthermore, 33 CFR 127.207 (b) requires the marine transfer area for LNG to have a siren with a minimum 1⁄3- octave band sound pressure level at l meter of 125 decibels referenced to 0.0002 microbars. The siren must be located so that the sound signal produced is audible over 360 degrees in a horizontal plane. Lastly, 33 CFR 127.207 (c) requires that each light and siren must be located so that the warning alarm is not obstructed for a distance of 1.6 km (1 mile) in all directions. The warning alarms would be required to be tested in order to meet 33 CFR 127. Jordan Cove would be required to meet the warning alarms requirements specified in 33 CFR 127.207.

In accordance with the EPAct 2005, FERC must also approve an ERP covering the terminal and ship transit prior to construction. Section 3A (e) of the NGA, added by section 311 of the EPAct 2005, stipulates that in any order authorizing an LNG terminal, the Commission must require the LNG terminal operator to develop an ERP in consultation with the Coast Guard and state and local agencies. The final ERP would need to be evaluated by appropriate emergency response personnel and officials. Section 3A (e) of the NGA (as amended by EPAct 2005) specifies that the ERP must include a Cost-Sharing Plan that contains a description of any direct cost reimbursements the applicant agrees to provide to any state and local agencies with responsibility for security and safety at the LNG terminal and in proximity to LNG marine vessels that serve the facility. The Cost-Sharing Plan must specify what the LNG terminal operator would provide to cover the cost of the state and local resources required to manage the security of the LNG terminal and LNG marine vessel, and the state and local resources required for safety and emergency management, including:

- direct reimbursement for any per-transit security and/or emergency management costs (for example, overtime for police or fire department personnel);
- capital costs associated with security/emergency management equipment and personnel base (for example, patrol boats, firefighting equipment); and
- annual costs for providing specialized training for local fire departments, mutual aid departments, and emergency response personnel; and for conducting exercises.

The cost-sharing plan must include the LNG terminal operator's letter of commitment with agency acknowledgement for each state and local agency designated to receive resources.

Jordan Cove submitted a draft ERP to address emergency events and potential release scenarios in the Application. The ERP would include public notification, protection, and evacuation. As part of the FEED review, FERC staff evaluated the initial draft of the emergency response procedures to assure that it covers the hazards associated with the Project. In addition, we recommend in section 4.13.1.6 that Jordan Cove provide additional information, for review and approval, on development of updated emergency response plans prior to initial site preparation. We also recommend in section 4.13.1.6 that Jordan Cove file three dimensional drawings, for review and approval, that demonstrate there is a sufficient number of access and egress locations. If this Project is authorized and constructed, Jordan Cove would coordinate with local, state, and federal agencies on the development of an emergency response plan and cost sharing plan. We recommend in section 4.13.1.6 that Jordan Cove provide periodic updates on the development of these plans for review and approval, and ensure they are in place prior to introduction of hazardous fluids. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facility and would continue to require companies to file updates to the ERP.

4.13.1.6 Recommendations from FERC Preliminary Engineering and Technical Review

Based on our preliminary engineering and technical review of the reliability and safety of the Jordan Cove LNG Project, we recommend the following mitigation measures as conditions to any order authorizing the Project. These recommendations would be implemented prior to the end of the DEIS comment period, prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout the life of the facility to enhance the reliability and safety of the facility and to mitigate the risk of impact on the public.

- **<u>Prior to end of the draft EIS comment period</u>, Jordan Cove should file with the Secretary documentation of consultation with USDOT PHMSA staff as to whether the design wind speed for other non-hazardous buildings and structures would be subject to USDOT requirements.**

- **<u>Prior to the end draft EIS comment period</u>, Jordan Cove should file with the Secretary an analysis that demonstrates the flammable vapor dispersion from design spills would be prevented from dispersing underneath the elevated LNG storage tanks, or the LNG storage tanks would be able to withstand an overpressure due to ignition of the flammable vapor dispersion cloud that disperses underneath the elevated LNG storage tanks.**

- **<u>Prior to initial site preparation</u>, Jordan Cove should file with the Secretary documentation demonstrating it has received a determination of no hazard (with or without conditions) by USDOT FAA for all permanent structures, temporary construction equipment, and mobile objects that exceed the height requirements in 14 CFR 77.9.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file with the Secretary the following information, stamped and sealed by the professional engineer-of-record, registered in Oregon:**

  a. site preparation drawings and specifications;

  b. LNG terminal structures, LNG storage tank, and foundation design drawings and calculations (including prefabricated and field constructed structures);

  c. seismic specifications for procured Seismic Category I equipment prior to the issuing of request for quotations;

  d. quality control procedures to be used for civil/structural design and construction; and

  e. a determination of whether soil improvement is necessary to counteract soil liquefaction.

  In addition, Jordan Cove should file, in its Implementation Plan, the schedule for producing this information.

- **<u>Prior to construction of final design,</u> Jordan Cove should file with the Secretary consultation with USDOT PHMSA staff as to whether the use of normally closed valves to remove stormwater from curbed areas would meet USDOT PHMSA requirements.**

- **<u>Prior to commencement of service</u>, Jordan Cove should file with the Secretary a monitoring and maintenance plan, stamped and sealed by the professional engineer-of-record registered in Oregon, which ensures the facilities are protected for the life of the LNG terminal considering settlement, subsidence, and sea level rise.**

Information pertaining to the following specific recommendations should be filed with the Secretary for review and written approval by the Director of OEP, or the Director's designee, within the timeframe indicated by each recommendation. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 833 (Docket No. RM16-15-000), including security information, should be submitted as critical energy infrastructure information pursuant to 18 CFR 388.113. See Critical Electric Infrastructure Security and Amending Critical Energy Infrastructure Information, Order No. 833, 81 Fed. Reg. 93,732 (December 21, 2016), FERC Stats. & Regs. 31,389 (2016). Information pertaining to items such as offsite emergency response, procedures for public notification and evacuation, and construction and operating reporting requirements would be subject to public disclosure. All information should be filed **<u>a minimum of 30 days</u>** before approval to proceed is requested.

- **<u>Prior to initial site preparation</u>, Jordan Cove should file an overall Project schedule, which includes the proposed stages of the commissioning plan.**

- **<u>Prior to initial site preparation</u>, Jordan Cove should file procedures for controlling access during construction.**

- **<u>Prior to initial site preparation</u>, Jordan Cove should file quality assurance and quality control procedures for construction activities for both the Engineering Procurement Contractor and Jordan Cove to monitor construction activities.**

- **<u>Prior to initial site preparation</u>, Jordan Cove should specify a spill containment system around the Warm Flare Knockout Drum.**

- **<u>Prior to initial site preparation</u>, Jordan Cove should develop an ERP (including evacuation) and coordinate procedures with the Coast Guard; state, county, and local emergency planning groups; fire departments; state and local law enforcement; and appropriate federal agencies. This plan should include at a minimum:**

  a. designated contacts with state and local emergency response agencies;

  b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;

  c. procedures for notifying residents and recreational users within areas of potential hazard;

  d. evacuation routes/methods for residents and public use areas that are within any transient hazard areas along the route of the LNG marine transit;

e. locations of permanent sirens and other warning devices; and

f. an "emergency coordinator" on each LNG marine vessel to activate sirens and other warning devices.

Jordan Cove should notify the FERC staff of all planning meetings in advance and should report progress on the development of its ERP <u>at 3-month intervals</u>.

- **<u>Prior to initial site preparation</u>, Jordan Cove should file a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on state and local agencies. This comprehensive plan should include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. Jordan Cove should notify FERC staff of all planning meetings in advance and should report progress on the development of its Cost Sharing Plan at <u>3-month intervals</u>.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file change logs that list and explain any changes made from the FEED provided in Jordan Cove LNG Project's application and filings. A list of all changes with an explanation for the design alteration should be provided and all changes should be clearly indicated on all diagrams and drawings.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file information/revisions pertaining to Jordan Cove's response numbers 8c, 13, 15, 21, 22, 23, 24, 26, 27, 28, and 31 of its December 20, 2018 filing and 6, 9, 10, 11, 17, 19, 32, 34, and 36 of its February 6, 2019 filing which indicated features to be included or considered in the final design.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file drawings and specifications for crash rated vehicle barriers at each facility entrance for access control.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file drawings of the security fence. The fencing drawings should provide details of fencing that demonstrates it would restrict and deter access around the entire facility and has a setback from exterior features (e.g., power lines, trees, etc.) and from interior features (e.g., piping, equipment, buildings, etc.) that does not allow the fence to be overcome.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file drawings of internal road vehicle protections, such as guard rails, barriers, and bollards to protect transfer piping, pumps, compressors, hydrants, monitors, etc. to ensure that they are located away from roadway or protected from inadvertent damage from vehicles.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file security camera and intrusion detection drawings. The security camera drawings should show the locations, areas covered, and features of each camera (e.g., fixed, tilt/pan/zoom, motion detection alerts, low light, mounting height, etc.) to verify camera coverage of the entire perimeter with redundancies for cameras interior to the facility to enable rapid monitoring of the facility, including a camera at the top of each LNG storage tank,**

and coverage within pretreatment areas, within liquefaction areas, within truck transfer areas, within marine transfer areas, and buildings. The drawings should show or note the location of the intrusion detection to verify it covers the entire perimeter of the facility.

- **Prior to construction of final design, Jordan Cove should file lighting drawings. The lighting drawings should show the location, elevation, type of light fixture, and lux levels of the lighting system and should be in accordance with API 540 and provide illumination along the perimeter of the facility, process equipment, mooring points, and along paths/roads of access and egress to facilitate security monitoring and emergency response operations.**

- **Prior to construction of final design, Jordan Cove should file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems. This lighting plan should also be in compliance with the lighting recommendation in section 4.5.**

- **Prior to construction of final design, Jordan Cove should file three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion.**

- **Prior to construction of final design, Jordan Cove should file up-to-date process flow diagrams (PFDs) and piping and instrument diagrams (P&IDs) including vendor P&IDs. The PFDs should include heat and material balances. The P&IDs should include the following information:**

  a. **equipment tag number, name, size, duty, capacity, and design conditions;**

  b. **equipment insulation type and thickness;**

  c. **storage tank pipe penetration size and nozzle schedule;**

  d. **valve high pressure side and internal and external vent locations;**

  e. **piping with line number, piping class specification, size, and insulation type and thickness;**

  f. **piping specification breaks and insulation limits;**

  g. **all control and manual valves numbered;**

  h. **relief valves with size and set points; and**

  i. **drawing revision number and date.**

- **Prior to construction of final design, Jordan Cove should file P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect subsequently constructed facilities with the operational facilities.**

- **Prior to construction of final design, Jordan Cove should file a car seal philosophy and a list of all car-sealed and locked valves consistent with the P&IDs.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file information to demonstrate the EPC contractor has verified that all FEED HAZOP and LOPA recommendations have been addressed.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file a hazard and operability review prior to issuing the P&IDs for construction. A copy of the review, a list of the recommendations, and actions taken on the recommendations should be filed.**

- **Prior to construction of final design<u>, Jordan Cove should provide a check valve upstream of the amine contractor column to prevent backflow or provide a a dynamic simulation that shows that upon plant shutdown, the swan neck would be sufficient for this purpose.</u>**

- **<u>Prior to construction of final design</u>, Jordan Cove should specify how Mole Sieve Gas Dehydrator support and sieve material would be prevented from migrating to the piping system.**

- **<u>Prior to construction of final design</u>, Jordan Cove should specify how the regeneration gas heater tube design temperature would be consistent with the higher shell side steam temperatures.**

- **<u>Prior to construction of final design</u>, Jordan Cove should specify a cold gas bypass around the defrost gas heater to prevent defrost gas heater high temperature shutdown during low flow and startup conditions.**

- **<u>Prior to construction of final design</u>, Jordan Cove shall demonstrate that the differential pressure (dp) level transmitters on the LNG flash drum would not result in an excess number of false high-high-high level shutdowns.**

- **<u>Prior to construction of final design</u>, Jordan Cove should specify a means to stop LNG flows to the BOG suction drum when the BOG compressor is shutdown to prevent filling the BOG suction drum with LNG.**

- **<u>Prior to construction of final design</u>, Jordan Cove should specify a low instrument air pressure shutdown to prevent loss of control to air operated valve.**

- **<u>Prior to construction of final design</u>, Jordan Cove should evaluate and, if applicable, address the potential for cryogenic feed gas back flow in the event relief valve 30-PSV-01002A/B is open.**

- **<u>Prior to construction of final design</u>, Jordan Cove should include LNG tank fill flow measurement with high flow alarm.**

- **<u>Prior to construction of final design</u>, Jordan Cove should specify a discretionary vent valve on each LNG storage tank that is operable through the Distributed Control System (DCS). In addition, a car sealed open manual block valve should be provided upstream of the discretionary vent valve.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file the safe operating limits (upper and lower), alarm and shutdown set points for all instrumentation (e.g., temperature, pressures, flows, and compositions).**

- **<u>Prior to construction of final design</u>, Jordan Cove should file cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices should include alarms and shutdown functions, details of the voting and shutdown logic, and set points.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file an up-to-date equipment list, process and mechanical data sheets, and specifications. The specifications should include:**

  a. **building specifications (e.g., control buildings, electrical buildings, compressor buildings, storage buildings, pressurized buildings, ventilated buildings, blast resistant buildings);**

  b. **mechanical specifications (e.g., piping, valve, insulation, rotating equipment, heat exchanger, storage tank and vessel, other specialized equipment);**

  c. **electrical and instrumentation specifications (e.g., power system, control system, safety instrument system [SIS], cable, other electrical and instrumentation); and**

  d. **security and fire safety specifications (e.g., security, passive protection, hazard detection, hazard control, firewater).**

- **<u>Prior to construction of final design</u>, Jordan Cove should file a list of all codes and standards and the final specification document number where they are referenced.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file a complete specifications and drawings of the proposed LNG tank design and installation.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file an evaluation of emergency shutdown valve closure times. The evaluation should account for the time to detect an upset or hazardous condition, notify plant personnel, and close the emergency shutdown valve(s).**

- **<u>Prior to construction of final design</u>, Jordan Cove should file an evaluation of dynamic pressure surge effects from valve opening and closure times and pump startup and shutdown operations.**

- **<u>Prior to construction of final design</u>, Jordan Cove should demonstrate that, for hazardous fluids, piping and piping nipples 2 inches or less in diameter are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators.**

- **<u>Prior to construction of final design</u>, Jordan Cove should clearly specify the responsibilities of the LNG tank contractor and the EPC contractor for the piping associated with the LNG storage tank.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file the sizing basis and capacity for the final design of the flares and/or vent stacks as well as the pressure and vacuum relief valves for major process equipment, vessels, and storage tanks.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file an updated fire protection evaluation of the proposed facilities. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations should be filed. The evaluation should justify the type, quantity, and location of hazard detection and hazard control, passive fire protection, emergency shutdown and depressurizing systems, firewater, and emergency response equipment, training, and qualifications in accordance with NFPA 59A (2001). The justification for the flammable and combustible gas detection and flame and heat detection systems should be in accordance with ISA 84.00.07 or equivalent methodologies and would need to demonstrate 90 percent or more of releases (unignited and ignited) that could result in an off-site or cascading impact would be detected by two or more detectors and result in isolation and de inventory within 10 minutes. The analysis should take into account the set points, voting logic, wind speeds, and wind directions. The justification for firewater should provide calculations for all firewater demands based on design densities, surface area, and throw distance as well as specifications for the corresponding hydrant and monitors needed to reach and cool equipment.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file spill containment system drawings with dimensions and slopes of curbing, trenches, impoundments, and capacity calculations considering any foundations and equipment within impoundments, as well as the sizing and design of the down-comers. The spill containment drawings should show containment for all hazardous fluids including all liquids handled above their flashpoint, from the largest flow from a single line for 10 minutes, including de-inventory, or the maximum liquid from the largest vessel (or total of impounded vessels) or otherwise demonstrate that providing spill containment would not significantly reduce the flammable vapor dispersion or radiant heat consequences of a spill.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file electrical area classification drawings.**

- **<u>Prior to construction of final design</u>, Jordan Cove should provide documentation demonstrating adequate ventilation, detection, and electrical area classification based on the final selection of the batteries, and associated hydrogen off-gassing rates.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system meet the requirements of NFPA 59A (2001).**

- **<u>Prior to construction of final design</u>, Jordan Cove should file details of an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each**

air gap should vent to a safe location and be equipped with a leak detection device that should continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems.

- **<u>Prior to construction of final design</u>, Jordan Cove should file complete drawings and a list of the hazard detection equipment. The drawings should clearly show the location and elevation of all detection equipment. The list should include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file a technical review of facility design that:**

  a. **identifies all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and**

  b. **demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices would isolate or shutdown any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file a design that includes hazard detection suitable to detect high temperatures and smoldering combustion products in electrical buildings and control room buildings.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file an evaluation of the voting logic and voting degradation for hazard detectors.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of the hazard detectors when determining the lower flammable limit set points for methane, ethylene, propane, isopentane, and condensate.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of hazard detectors when determining the set points for toxic components such as condensate and hydrogen sulfide.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file a drawing showing the location of the emergency shutdown buttons. Emergency shutdown buttons should be easily accessible, conspicuously labeled, and located in an area which would be accessible during an emergency.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file facility plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Plan drawings should clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers and should demonstrate the spacing of extinguishers meet prescribed NFPA 10 travel distances. The list should include the equipment tag number, type, capacity, equipment covered, discharge rate,**

and automatic and manual remote signals initiating discharge of the units and should demonstrate they meet NFPA 59A.

- **<u>Prior to construction of final design</u>, Jordan Cove should file drawings and specifications for the structural passive protection systems to protect equipment and supports from cryogenic releases.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file calculations or test results for the structural passive protection systems to protect equipment and supports from cryogenic releases.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file drawings and calculations that demonstrate passive protection is provided in areas where jet fires may result in failure of structural supports.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file a detailed quantitative analysis to demonstrate that adequate thermal mitigation would be provided for each significant component within the 4,000 Btu/ft^2-hr zone from an impoundment, or provide an analysis that assesses the consequence of pressure vessel bursts and boiling liquid expanding vapor explosions. Trucks at the truck transfer station should be included in the analysis. A combination of passive and active protection should be provided and demonstrate the effectiveness and reliability. Effectiveness of passive mitigation should be supported by calculations for the thickness limiting temperature rise and effectiveness of active mitigation should be justified with calculations demonstrating flow rates and durations of any cooling water would mitigate the heat absorbed by the vessel.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file an evaluation and associated specifications and drawings of how they would prevent cascading damage of transformers (e.g., fire walls or spacing) in accordance with NFPA 850 or equivalent.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file facility plan drawings showing the proposed location of the firewater and any foam systems. Plan drawings should clearly show the location of firewater and foam piping, post indicator valves, and the location and area covered by, each monitor, hydrant, hose, water curtain, deluge system, foam system, water-mist system, and sprinkler. All areas of the pretreatment area should have adequate coverage. The drawings should also include piping and instrumentation diagrams of the firewater and foam systems.**

- **<u>Prior to construction of final design</u>, Jordan Cove should specify that the firewater pump shelter is designed to remove the largest firewater pump or other component for maintenance with an overhead or external crane.**

- **<u>Prior to construction of final design</u>, Jordan Cove should demonstrate that the firewater storage tanks are in compliance with NFPA 22 or demonstrate how API Standard 650 provides an equivalent or better level of safety.**

- **<u>Prior to construction of final design</u>, Jordan Cove should specify that the firewater flow test meter is equipped with a transmitter and that a pressure transmitter is installed upstream of the flow transmitter. The flow transmitter and pressure transmitter should be connected to the DCS and recorded.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file the settlement results during hydrostatic tests of the LNG storage containers and periodically thereafter to verify settlement is as expected and does not exceed the applicable criteria in API 620, API 625, API 653, and ACI 376.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file drawings of the storage tank piping support structure and support of horizontal piping at grade including pump columns, relief valves, pipe penetrations, instrumentation, and appurtenances.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file the structural analysis of the LNG storage tank and outer containment demonstrating they are designed to withstand all loads and combinations.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file an analysis of the structural integrity of the outer containment of the full containment LNG storage tank demonstrating it can withstand the radiant heat from a roof tank top fire or adjacent tank roof fire.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file a projectile analysis to demonstrate that the outer concrete impoundment wall of a full-containment LNG storage tank could withstand projectiles from explosions and high winds. The analysis should detail the projectile speeds and characteristics and method used to determine penetration or perforation depths.**

- **<u>Prior to commissioning</u>, Jordan Cove should file a detailed schedule for commissioning through equipment startup. The schedule should include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids and during commissioning and startup. Jordan Cove should file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued.**

- **<u>Prior to commissioning</u>, Jordan Cove should file detailed plans and procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service.**

- **<u>Prior to commissioning</u>, Jordan Cove should file settlement results from the hydrostatic tests of the LNG storage containers and should file a plan to periodically verify settlement is as expected and does not exceed the applicable criteria set forth in API 620, API 625, API 653, and ACI 376. The program should specify what actions would be taken after various levels of seismic events.**

- **<u>Prior to commissioning</u>, Jordan Cove should file the operation and maintenance procedures and manuals, as well as safety procedures, hot work procedures and**

permits, abnormal operating conditions reporting procedures, simultaneous operations procedures, and management of change procedures and forms.

- **Prior to commissioning, Jordan Cove should file a plan for clean-out, dry-out, purging, and tightness testing. This plan should address the requirements of the American Gas Association's Purging Principles and Practice, and should provide justification if not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing.**

- **Prior to commissioning, Jordan Cove should tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves.**

- **Prior to commissioning, Jordan Cove should file a plan to maintain a detailed training log to demonstrate that operating, maintenance, and emergency response staff have completed the required training.**

- **Prior to commissioning, Jordan Cove should file the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3. The procedures should include a line list of pneumatic and hydrostatic test pressures.**

- **Prior to introduction of hazardous fluids, Jordan Cove should complete and document a pre-startup safety review to ensure that installed equipment meets the design and operating intent of the facility. The pre-startup safety review should include any changes since the last hazard review, operating procedures, and operator training. A copy of the review with a list of recommendations, and actions taken on each recommendation, should be filed.**

- **Prior to introduction of hazardous fluids, Jordan Cove should complete and document all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the DCS and SIS that demonstrates full functionality and operability of the system.**

- **Prior to introduction of hazardous fluids, Jordan Cove should develop and implement an alarm management program to reduce alarm complacency and maximize the effectiveness of operator response to alarms.**

- **Prior to introduction of hazardous fluids, Jordan Cove should complete and document a clean agent acceptance tests.**

- **Prior to introduction of hazardous fluids, Jordan Cove should complete and document a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant should be shown on facility plot plan(s).**

- **Prior to introduction of hazardous fluids, Jordan Cove should complete and document foam system and sprinkler system acceptance tests.**

- **Jordan Cove should file a request for written authorization from the Director of OEP prior to unloading or loading the first LNG commissioning cargo. After production of first LNG, Jordan Cove should file weekly reports on the commissioning of the proposed systems that detail the progress toward demonstrating the facilities can safely and reliably operate at or near the design production rate. The reports should include a summary of activities, problems encountered, and remedial actions taken. The weekly reports should also include the latest commissioning schedule, including projected and actual LNG production by each liquefaction train, LNG storage inventories in each storage tank, and the number of anticipated and actual LNG commissioning cargoes, along with the associated volumes loaded or unloaded. Further, the weekly reports should include a status and list of all planned and completed safety and reliability tests, work authorizations, and punch list items. Problems of significant magnitude should be reported to the FERC within 24 hours.**

- **Prior to commencement of service, Jordan Cove should file a request for written authorization from the Director of OEP. Such authorization would only be granted following a determination by the Coast Guard, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the MTSA of 2002, and the Security and Accountability For Every Port Act, that appropriate measures to ensure the safety and security of the facility and the waterway have been put into place by Jordan Cove or other appropriate parties.**

- **Prior to commencement of service, Jordan Cove should notify the FERC staff of any proposed revisions to the security plan and physical security of the plant.**

- **Prior to commencement of service, Jordan Cove should label piping with fluid service and direction of flow in the field, in addition to the pipe labeling requirements of NFPA 59A (2001).**

- **Prior to commencement of service, Jordan Cove should provide plans for any preventative and predictive maintenance program that performs periodic or continuous equipment condition monitoring.**

- **Prior to commencement of service, Jordan Cove should develop procedures for offsite contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by Jordan Cove staff.**

In addition, we recommend that the following measures should apply throughout the life of the Jordan Cove LNG Project.

- **The facility should be subject to regular FERC staff technical reviews and site inspections on at least an annual basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Jordan Cove should respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed P&IDs reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, should be submitted.**

- **<u>Semi-annual</u> operational reports should be filed with the Secretary to identify changes in facility design and operating conditions; abnormal operating experiences; activities (e.g., ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil off/flash gas); and plant modifications, including future plans and progress thereof. Abnormalities should include, but not be limited to, unloading/loading/shipping problems, potential hazardous conditions from offsite vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tank, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluids releases, fires involving hazardous fluids and/or from other sources, negative pressure (vacuum) within a storage tank, and higher than predicted boil off rates. Adverse weather conditions and the effect on the facility also should be reported. Reports should be submitted <u>within 45 days after each period ending June 30 and December 31</u>. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" should be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance at the LNG facilities.**

- **In the event the temperature of any region of the LNG storage container, including any secondary containment and imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission should be notified <u>within 24 hours</u> and procedures for corrective action should be specified.**

- **Significant non-scheduled events, including safety-related incidents (e.g., LNG, condensate, refrigerant, or natural gas releases; fires; explosions; mechanical failures; unusual over pressurization; and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) should be reported to the FERC staff. In the event that an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made <u>immediately</u>, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification should be made to the FERC staff <u>within 24 hours</u>. This notification practice should be incorporated into the liquefaction facility's emergency plan. Examples of reportable hazardous fluids-related incidents include:**

  a. **fire;**

  b. **explosion;**

  c. **estimated property damage of $50,000 or more;**

  d. **death or personal injury necessitating in-patient hospitalization;**

  e. **release of hazardous fluids for 5 minutes or more;**

  f. **unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural**

integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure-limiting or control devices;

i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;

j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;

l. safety-related incidents from hazardous fluids transportation occurring at or en route to and from the LNG facility; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property, or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, the FERC staff would determine the need for a separate follow-up report or follow up in the upcoming semi-annual operational report. All company follow-up reports should include investigation results and recommendations to minimize a reoccurrence of the incident.

4.13.2 Pacific Connector Pipeline Project

The transportation of natural gas by pipeline involves some incremental risk to the public due to the potential for accidental release of natural gas. The greatest hazard is a fire or explosion following a major pipeline rupture.

Methane, the primary component of natural gas, is colorless, odorless, and tasteless. It is not toxic, but is classified as a simple asphyxiant, possessing a slight inhalation hazard. If breathed in high concentration, oxygen deficiency can result in serious injury or death. Methane has an auto-ignition temperature of 1,000°F and is flammable at concentrations between 5.0 percent and 15.0

percent in air. An unconfined mixture of methane and air is not explosive; however, it may ignite and burn if there is an ignition source.

4.13.2.1 Safety Standards

The USDOT is mandated to provide pipeline safety under 49 U.S.C. § 601. The PHMSA Office of Pipeline Safety (OPS) administers the national regulatory program to ensure the safe transportation of natural gas and other hazardous materials by pipeline. It develops safety regulations and other approaches to risk management that ensure safety in the design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Many of the regulations are written as performance standards which set the level of safety to be attained and allow the pipeline operator to use various technologies to achieve safety. The PHMSA ensures that people and the environment are protected from the risk of pipeline incidents. This work is shared with state agency partners and others at the federal, state, and local level. Section 5(a) of the Natural Gas Pipeline Safety Act provides for a state agency to assume all aspects of the safety program for intrastate facilities by adopting and enforcing the federal standards, while section 5(b) permits a state agency that does not qualify under section 5(a) to perform certain inspection and monitoring functions. A state may also act as the USDOT's agent to inspect interstate facilities within its boundaries; however, the USDOT is responsible for enforcement action. Most of the states have either 5(a) certifications or 5(b) agreements, while nine states act as interstate agents.

Under an MOU on natural gas transportation facilities dated January 15, 1993 between the USDOT and the FERC, the USDOT has the exclusive authority to promulgate federal safety standards used in the transportation of natural gas. The USDOT pipeline standards are published in 49 CFR Parts 190-199; Part 192 of 49 CFR specifically addresses natural gas pipeline safety issues. Section 157.14(a)(9)(vi) of the FERC's regulations require that an applicant certify that it will design, install, inspect, test, construct, operate, replace, and maintain the facility for which a certificate is requested in accordance with federal safety standards and plans for maintenance and inspection, or shall certify that it has been granted a waiver of the requirements of the safety standards by the USDOT in accordance with section 3(e) of the Natural Gas Pipeline Safety Act. The FERC accepts this certification and does not impose additional safety standards other than the USDOT standards. If the Commission becomes aware of an existing or potential safety problem, there is a provision in the MOU to promptly alert the USDOT. The MOU also provides for referring complaints and inquiries made by state and local governments as well as the general public involving safety matters related to pipelines under the Commission's jurisdiction.

The FERC also participates as a member of the USDOT's Technical Pipeline Safety Standards Committee, which determines if proposed safety regulations are reasonable, feasible, and practicable.

The Pacific Connector pipeline and aboveground facilities must be designed, constructed, operated, and maintained in accordance with the USDOT Minimum Federal Safety Standards in 49 CFR Part 192. The regulations are intended to ensure adequate protection for the public and to prevent natural gas facility accidents and failures. The USDOT specifies material selection and qualification; minimum design requirements; and protection from internal, external, and atmospheric corrosion.

The USDOT also defines area classifications, based on population density in the vicinity of the pipeline, and specifies more rigorous safety requirements for populated areas. The class location unit is an area that extends 220 yards on either side of the centerline of any continuous 1-mile length of pipeline. The four area classifications are defined below:

- Class 1 – Location with 10 or fewer buildings intended for human occupancy;
- Class 2 – Location with more than 10 but less than 46 buildings intended for human occupancy;
- Class 3 – Location with 46 or more buildings intended for human occupancy or where the pipeline lies within 100 yards of any building, or small well-defined outside area occupied by 20 or more people on at least 5 days per week for 10 weeks in any 12-month period; and
- Class 4 – Location where buildings with four or more stories aboveground are prevalent.

Class locations representing more populated areas require higher safety factors in pipeline design, testing, and operation. Pipelines constructed on land in Class 1 locations must be installed with a minimum depth of cover of 30 inches in normal soil and 18 inches in consolidated (solid) rock. Class 2, 3, and 4 locations, as well as drainage ditches of public roads and railroad crossings, require a minimum cover of 36 inches in normal soil and 24 inches in consolidated rock.

Class locations also specify the maximum distance to a sectionalizing block valve (e.g., 10.0 miles in Class 1, 7.5 miles in Class 2, 4.0 miles in Class 3, and 2.5 miles in Class 4). Pipe wall thickness and pipeline design pressures, hydrostatic test pressures, MAOP, inspection and testing of welds, and frequency of pipeline patrols and leak surveys must also conform to higher standards in more populated areas. Class locations by MP are listed in table 4.13.2-1.

TABLE 4.13.2.1-1

USDOT Class Locations for the Proposed Pacific Connector Pipeline

Beginning MP	Ending MP	Class Location
0	1.24	1
1.24	1.33	3
1.33	2.34	1
2.34	3.11	2
3.11	3.38	1
3.38	6.47	2
6.47	21.12	1
21.12	21.25	3
21.25	22.39	1
22.39	22.74	2
22.74	22.89	1
22.89	23.26	2
23.26	50.66	1
50.66	51.14	2
51.14	51.39	1
51.39	51.59	2
51.6	55.54	1
55.54	57.76	2
57.76	94.67	1
94.68	94.89	2
94.89	121.88	1

TABLE 4.13.2.1-1 (continued)

USDOT Class Locations for the Proposed Pacific Connector Pipeline

Beginning MP	Ending MP	Class Location
121,88	122.15	2
122.15	122.18	1
122.18	122.43	2
122.43	122.45	1
122.45	123.23	2
123.23	132.46	1
132.47	169.50	1
169.51	197.65	1
197.65	198.08	3
198.08	198.17	1
198.17	198.57	2
198.57	198.61	1
198.61	198.74	3
198.74	198.96	1
198.96	199.09	3
199.09	203.79	1
199.09	203.79	1
203.79	204.13	2
204.13	204.58	2
204.58	204.90	2
204.9	228.81	1

If a subsequent increase in population density adjacent to the right-of-way indicates a change in class location for the pipeline, Pacific Connector would be required to reduce the MAOP or replace the segment with pipe of sufficient grade and wall thickness, if applicable, to comply with the USDOT code of regulations for the new class location.

We received comments requesting that unified safety standards be applied across the entire pipeline route; however, as discussed previously, the FERC does not have the jurisdiction to require safety standards beyond those outlined by Part 192 of 49 CFR (which are required and enforced by the USDOT).

The USDOT Pipeline Safety Regulations require operators to develop and follow a written integrity management program that contain all the elements described in 49 CFR 192.911 and address the risks on each transmission pipeline segment. The rule establishes an integrity management program which applies to all high consequence areas (HCA).

The USDOT has published rules that define HCAs where a gas pipeline accident could do considerable harm to people and their property and requires an integrity management program to minimize the potential for an accident. This definition satisfies, in part, the Congressional mandate for USDOT to prescribe standards that establish criteria for identifying each gas pipeline facility in a high-density population area.

The HCAs may be defined in one of three ways. In the first method, an HCA includes:

- current Class 3 and 4 locations, or

- any area in Class 1 or 2 where the potential impact radius[223] is greater than 660 feet and there are 20 or more buildings intended for human occupancy within the potential impact circle,[224] or
- any area in Class 1 or 2 where the potential impact circle includes an identified site.[225]

In the second method, an HCA includes any area within a potential impact circle which contains:

- 20 or more buildings intended for human occupancy, or
- an identified site.

Once a pipeline operator has determined the HCAs on its pipeline, it must apply the elements of its integrity management program to those segments of the pipeline within HCAs. The USDOT regulations specify the requirements for the integrity management plan at section 192.911. Table 4.13.2.1-2 identifies the HCAs that are crossed by or adjacent to the proposed pipeline route. The pipeline integrity management rule for HCAs requires inspection of the entire pipeline in HCAs every 7 years.

TABLE 4.13.2.1-2

USDOT Class 3 Locations and High Consequence Areas
Crossed by and Adjacent to the Proposed Pacific Connector Pipeline

Beginning MP	Ending MP	Criteria
1.24	1.33	Vicinity to ball park and commercial buildings with potential occupancy of over 20 people
21.12	21.25	Vicinity to cell tower with associated commercial buildings with potential occupancy of over 20 people
197.65	198.08	Vicinity to sawmill with potential occupancy of over 20 people
198.61	198.74	Vicinity to commercial buildings with potential occupancy of over 20 people
198.96	199.09	Vicinity to commercial buildings with potential occupancy of over 20 people

Part 192 prescribes the minimum standards for operating and maintaining pipeline facilities, including the requirement to establish a written plan governing these activities. Under section 192.615, each pipeline operator must also establish an emergency response plan (ERP) that includes procedures to minimize the hazards in a natural gas pipeline emergency. Pacific Connector would establish written procedures, in accordance with 49 CFR 192.615, that provide the following:

- establishing and maintaining adequate means of communication with appropriate fire, police, and other public officials;
- notifying appropriate fire, police, medical and other public, local, and state official of gas pipeline emergencies and coordinating with them both planned responses and actual responses during an emergency;
- receiving, identifying, and classifying notices of events that require immediate response by the operator;

[223] The potential impact radius is calculated as the product of 0.69 and the square root of the MAOP of the pipeline in psi multiplied by the pipeline diameter in inches.
[224] The potential impact circle is a circle of radius equal to the potential impact radius.
[225] An identified site is an outside area or open structure that is occupied by 20 or more persons on at least 50 days in any 12-month period; a building that is occupied by 20 or more persons on at least 5 days per week for any 10 weeks in any 12-month period; or a facility that is occupied by persons who are confined, are of impaired mobility, or would be difficult to evacuate.

- prompt and effective response to a notice of each type of emergency (gas detection, fire, explosion, natural disaster); prescribe actions directed toward protecting people first and then property; emergency shutdown and pressure reduction in any section of the pipeline necessary to minimize hazards to life or property;
- actions required to be taken by control room personnel during an emergency in accordance with 49 CFR section 192.631;
- ensuring the availability of service subcontractors, personnel, equipment, tools, and materials, as needed at the scene of any emergency;
- making safe any actual or potential hazard to life or property;
- safely restoring any service outage; and
- beginning incident investigation process as soon after the end of the emergency as possible.

Part 192 requires that each operator must establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency, and to coordinate mutual assistance. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials. Operations personnel will attend training for emergency response procedures and plans prior to commencing pipeline operation. No additional specialized local fire protection equipment would be required to handle pipeline emergencies.

Pipeline system emergencies can include gas leaks, fire or explosion, and/or damage to the pipeline and aboveground facilities. Pacific Connector would maintain 24-hour emergency response capabilities, including an emergency-only phone number, which accepts collect charges. The number would be included in informational mail-outs, posted on all pipeline markers (installed at public road crossings), and provided to local emergency agencies in the vicinity of the pipeline and compressor station.

As part of Pacific Connector's ERP, operations personnel would attend training for emergency response procedures and plans prior to commencing pipeline operations. Pacific Connector would meet with local emergency responder groups (fire departments, police departments, land-managing agencies including the BLM, Forest Service, and Reclamation, and other public officials) to review plans and would work with these groups to communicate the specifics about the pipeline facilities in the area and the need for emergency response. Pacific Connector would also meet periodically with the groups to review the plans and revise them when necessary. If requested by local public emergency response personnel, Pacific Connector would participate in any operator-simulated emergency exercises and post-exercise critiques. Pacific Connector would use adequate local or contract resources to support the pipeline and facilities if an emergency occurs.

All of the information that Pacific Connector gathers about its system would be used to tailor its safety and integrity management activities, so that parts of the system in the greatest need of attention receive greater scrutiny, such as residential areas or areas subject to growth and development. For example, Pacific Connector would decide where and when to internally inspect the pipeline based on this information. Risk assessment of the pipeline system determines what inspection criteria are required. This may include many different types of assessment tools that provide specific types of information about the condition of the pipeline.

The Klamath Compressor Station would also be equipped with automatic emergency detection and shut down systems. For example, the station would have hazardous gas and fire detection systems, and an emergency shutdown system. These safety and emergency systems would be tested routinely to ensure they are operating properly. The emergency shutdown system would be designed to shut down and isolate elements of the compressor station in the event of a fire, before the development of a flammable mixture of gas could occur. The system would include sensors for detecting natural gas concentrations as well as ultraviolet sensors for detecting flames. Additionally, the compressor station equipment would be designed to shut down automatically if a mechanical failure poses risk to the equipment or otherwise constitutes a hazard. The compressor station would be equipped with relief valves to protect the piping from over pressurization and would be equipped with a blowdown system that can safely and rapidly depressurize part or all of the compressor station to a safe location.

Personnel would be able to respond to a compressor station emergency in 60 minutes or less during non-scheduled work hours and within a few minutes if they are at the compressor station. Personnel would be on call at all times, 24 hours a day, 365 days a year to respond to emergencies. Emergencies while the compressor station is unattended would be monitored remotely via Pacific Connector's gas control facility. Personnel living within a 30-minute travel time of the compressor station would be dispatched by the gas control facility in the event of an emergency at the compressor station.

Personnel would be Operator Qualified per USDOT PHMSA requirements for operational and emergency situations at the station. Fire protection, first aid, and safety equipment would be maintained at the compressor station, and personnel would be trained in first aid and proper equipment use.

The Pacific Connector pipeline would cross areas subject to ongoing and future land management activities on federal lands managed by BLM, Forest Service, and Reclamation. Pacific Connector would be required to prepare a POD for activities on these federal lands that also addresses other safety and reliability measures requested by the BLM, Forest Service, and Reclamation. The BLM, Forest Service, and Reclamation would review and approve draft plans to ensure all safety concerns associated with construction and operation of the proposed Pacific Connector pipeline on federally managed lands are addressed.

Pipeline Standards to Minimize Fire Risk to Forest Lands

The Pacific Connector pipeline would be in areas where forest fires could occur. Pacific Connector proposes to meet or exceed USDOT pipeline burial depth requirements (found in 49 CFR Part 192) and would install the Pacific Connector pipeline with at least 36 inches of cover in Class I locations with normal soils and at least 24 inches of cover in consolidated rock areas.

Pursuant to 49 CFR 192.615, each pipeline operator must also develop an ERP that includes procedures to minimize the hazards in the event of a natural gas pipeline emergency. The key elements of the required plan include establishing and maintaining communications with local fire officials and coordinating emergency response, emergency shutdown of the system and safe restoration of service, making personnel, equipment, tools, and materials available at the scene of an emergency, and protecting people and property from hazards. Part 192 specifically requires that each pipeline operator establish and maintain liaison with appropriate fire officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency, and must coordinate mutual assistance. The previous discussion in section 4.13.9.1 describes the specific emergency response capabilities of the Project, including maintenance by Pacific Connector of 24-hour emergency response capabilities.

In addition, in compliance with the federal requirements discussed above, Pacific Connector must develop an ERP for the entire system. A draft ERP was included as Appendix H to the POD.[226] The ERP requires operations personnel to attend training for emergency response procedures and requires the pipeline operators to meet with local emergency responder groups, including fire departments, to review plans and educate the responder groups on the specifics of the pipeline facilities within the relevant service area. After the initial coordination with local responders, Pacific Connector would also meet periodically with the groups to review plans and revise them when necessary. Finally, if requested by local response personnel, Pacific Connector would participate in any simulated emergency exercises and post-exercise critiques. Through these coordination activities, the fire response personnel would become familiar with the location and specific safety and fire issues associated with the pipeline. This information would significantly reduce risks to the fire response personnel responding to a fire either caused by or in the vicinity of the pipeline alignment. The majority of the training costs would be borne by Pacific Connector; therefore, the coordination requirements would not significantly increase fire suppression costs.

In the event a fire was to occur on the surface in the vicinity of the pipeline, the presence of the pipeline would not increase fire hazards. Fires on the surface are not a direct threat to underground natural gas pipelines because of the insulating effects of soil cover over the pipeline. Soil is a poor conductor of heat with thermal conductivity values ranging from 0.44 to 1.44 Btu/ft-hr-°F. The heat capacity of most soils is 0.20 to 0.25 Btu/lb-°F. Based on the proposed burial depth of 24 to 36 inches, and the insulating effects of soil cover over the pipeline, we do not believe that forest fires would affect pipeline integrity. In addition, we do not believe that additional burial depth beyond what is proposed by Pacific Connector would be necessary to protect against damage by forest fires.

When forest fires arise in the area, Pacific Connector would closely monitor and protect the pipeline from wildfires. Pacific Connector would also have facilities built along the pipeline to aid in protecting the pipeline from wildfires. Along with Pacific Connector's pipeline control there are MLV sites on the pipeline to aid in isolating which portions of the pipeline have product in them. Pacific Connector would be in communications with emergency management office and monitoring the wildfires. Pacific Connector can determine what actions need to be taken to protect the pipeline and facilities in the area of the wildfires. If a wildfire was near Pacific Connector's facility locations or an MLV site, Pacific Connector would consider shutting down and isolating those facilities until the fire risk was mitigated. After all threats to safety for the area were assessed those facilities would be inspected to ensure there was no damage from the fire before restarting. In past situations, local operation personnel have protected above ground mainline valves by burying the valves with sand and earth material. Pacific Connector remains in close

[226] Pacific Connector's POD was filed with the FERC on January 23, 2018.

communication with its operations staff at each of their locations to ensure the circumstance of the fire is tended to accordingly.

Pacific Connector has also developed a *Fire Prevention and Suppression Plan.*[227] This plan is consistent with Forest Service and BLM policies and current practices. Although designed for federal lands, it would be applicable to the entire pipeline route; regardless of landownership. The intent of the plan is to identify measures to minimize the chances of a fire starting and spreading from project facilities and to reduce the risk of wildland and structural fire.

4.13.2.2 Pipeline Accident Data

The USDOT requires all operators of natural gas transmission pipelines to notify the USDOT of any significant incident and to submit a report within 20 days. Significant incidents are defined as any leaks that:

- caused a death or personal injury requiring hospitalization; or
- involve property damage of more than $50,000 (1984 dollars[228]).

During the 20-year period from 1996 through 2015, a total of 1,310 significant incidents were reported on the more than 300,000 total miles of natural gas transmission pipelines nationwide.

Additional insight into the nature of service incidents may be found by examining the primary factors that caused the failures. Table 4.13.2.2-1 provides a distribution of the causal factors as well as the number of each incident by cause.

TABLE 4.13.2-3

Natural Gas Transmission Pipeline Significant Incidents by Cause (1996–2015) a/

Cause	No. of Incidents	Percentage
Corrosion	311	23.7
Excavation b/	210	16.0
Pipeline material, weld or equipment failure	354	27.0
Natural force damage c/	146	11.1
Outside force c/	84	6.4
Incorrect operation	40	3.1
All other causes d/	165	12.6
Total	**1,310**	**100**

a/ All data gathered from PHMSA Significant Transmission Pipeline Incident files. https://hip.phmsa.dot.gov/analyticsSOAP/saw.dll?Go
b/ Includes third-party damage.
c/ Fire, explosion, vehicle damage, previous damage, intentional damage
d/ Miscellaneous causes or unknown causes

The dominant causes of pipeline incidents are corrosion and pipeline material, weld or equipment failure constituting 50.7 percent of all significant incidents. The pipelines included in the data set in table 4.13.2.2-1 vary widely in age, diameter, and level of corrosion control. Each variable influences the incident frequency that may be expected for a specific segment of pipeline.

[227] Included as Appendix K to Pacific Connector's 2018 POD.
[228] $50,000 in 1984 dollars is approximately $122,000 based on the March 2018 Consumer Price Index.

The frequency of significant incidents is strongly dependent on pipeline age. Older pipelines have a higher frequency of corrosion incidents, since corrosion is a time-dependent process. The use of both an external protective coating and a cathodic protection system[229], required on all pipelines installed after July 1971, significantly reduces the corrosion rate compared to unprotected or partially protected pipe.

Outside forces are the cause in 33.5 percent of significant pipeline incidents. These result from the encroachment of mechanical equipment such as bulldozers and backhoes; earth movements due to soil settlement, washouts, or geologic hazards; weather effects such as winds, storms, and thermal strains; and willful damage.

Older pipelines have a higher frequency of outside forces incidents partly because their location may be less well known and less well marked than newer lines. In addition, the older pipelines contain a disproportionate number of smaller-diameter pipelines; which have a greater rate of outside forces incidents. Small-diameter pipelines are more easily crushed or broken by mechanical equipment or earth movement. Table 4.13.2.2-2 shows the various causes of outside force incidents.

TABLE 4.13.2.2-2

Outside Forces Significant Incidents by Cause (1996-2015) a/

Cause	No. of Incidents	Percent of all Incidents b/, c/
Third-party excavation damage	172	13.6
Operator excavation damage	25	1.9
Unspecified excavation damage/previous damage	13	1.0
Heavy rain/floods	74	5.7
Earth movement	32	2.4
Lightning/temperature/high winds	27	2.1
Natural force (unspecified and other)	13	1.0
Vehicle (not engaged with excavation)	49	3.7
Fire/explosion	9	0.7
Previous mechanical damage	6	0.5
Fishing or maritime activity	9	0.7
Intentional damage	1	0.1
Electrical arcing from other equipment/facility	1	0.1
Other outside force	9	0.7
Total	**440**	**33.5**

a/ All data gathered from PHMSA Significant Transmission Pipeline Incident files. https://hip.phmsa.dot.gov/analyticsSOAP/saw.dll?Go
b/ Percentage of all incidents was calculated as a percentage of the total number of natural gas transmission pipeline significant incidents (i.e., all causes) presented in table 4.13.9.2-1.
c/ Due to rounding, column does not sum to 33.5 percent.

Since 1982, operators have been required to participate in "One Call" public utility programs in populated areas to minimize unauthorized excavation activities in the vicinity of pipelines. The "One Call" program is a service used by public utilities and some private sector companies (e.g., oil pipelines and cable television) to provide preconstruction information to contractors or other maintenance workers on the underground location of pipes, cables, and culverts.

[229] Cathodic protection is a technique to reduce corrosion (rust) of the natural gas pipeline through the use of an induced current or a sacrificial anode (like zinc) that corrodes at faster rate to reduce corrosion.

4.13.2.3 Impact on Public Safety

Pipeline Construction

Active pipeline construction can increase safety risks to the public generally in two ways, from an increase of traffic on roadways in the vicinity of the pipeline, and from potential exposure to construction activity itself within the construction right-of-way.

During periods of active construction, roadways in the vicinity of the pipeline project would experience an increase in small vehicle traffic from the construction work force, as well as large vehicle traffic transporting construction equipment and materials. Where the pipeline would cross roadways, access to and from the right-of-way by construction vehicles and construction activity itself at the roadway crossing could disrupt traffic and create potential safety hazards to the public. Pacific Connector has developed Transportation Plans for both private and federal lands that describe measures that it would implement to minimize public access and safety concerns as a result of construction vehicle traffic and construction activity at roadway crossings (see additional discussion in section 4.10). In addition, Pacific Connector would obtain all necessary permits for public roadway crossings and roadway use, and would comply with traffic control and public safety mitigation measures that are conditions of these permits.

During pipeline construction, the general public could be exposed to safety hazards within the pipeline construction right-of-way itself. Hazards would be typical of a construction site involving clearing, grading, and excavation, and could include timber felling, heavy equipment operation including on steep slopes, open trench, falling or rolling rock on steep slopes, and fly rock from blasting. During active construction the contractor and company personnel present on the job would limit access to the public to potentially hazardous situations such as operation of heavy equipment, or blasting for trench excavation. During construction off hours, the public could be exposed to hazards such open trench or loose rock. Locating the pipeline in non-populated areas helps to minimize the chance for unauthorized public access to the right-of-way.

Where the pipeline would be placed within residential areas, Pacific Connector would minimize impacts and potential safety hazards by ensuring that the construction proceeds quickly through such areas. Where the construction work area would be within 50 feet of a residence, Pacific Connector would install safety fence along the edge of the work area for a distance of 100 feet on either side of the residence. Fencing would be maintained, at a minimum, throughout the open trench phases of pipeline installation. Where feasible, Pacific Connector has reduced the width of the construction right-of-way near residences and placed TEWAs as far as practicable from the residences. In residential areas Pacific Connector would also limit the period of time the trench remains open prior to backfilling to 10 days. For the residences within 50 feet of the proposed right-of-way, Pacific Connector has developed site-specific plans showing the temporary and permanent rights-of-way and noting special construction techniques and mitigation measures.

The BLM, Forest Service, and Reclamation can require Pacific Connector to incorporate additional specific public safety measures into the POD as a condition of a Right-of-Way Grant for use of federal lands.

Pipeline Operation

During pipeline operation Pacific Connector would comply with the USDOT pipeline safety standards as well as regular monitoring and testing of the pipeline. While pipeline failures are rare, the potential for pipeline systems to rupture and the risk to nearby residents is discussed below.

The serious incidents data summarized in table 4.13.2.3-1 include pipeline failures of all magnitudes with widely varying consequences. Table 4.13.2.3-1 presents the average annual injuries and fatalities that occurred on natural gas transmission lines in the 5-year period between 2013 and 2017.

TABLE 4.13.2.3-1

Injuries and Fatalities – Natural Gas Transmission Pipelines

Year	Injuries	Fatalities
2013	2	0
2014	1	1
2015	16	6
2016	3	3
2017	3	3

The majority of fatalities from pipelines are due to local distribution pipelines not regulated by the FERC. These are natural gas pipelines that distribute natural gas to homes and businesses after transportation through interstate natural gas transmission pipelines. In general, these distribution lines are smaller diameter pipes and/or plastic pipes which are more susceptible to damage. Local distribution systems do not have large rights-of-way and pipeline markers common to the FERC-regulated natural gas transmission pipelines.

The nationwide totals of accidental fatalities from various anthropogenic and natural hazards are listed in table 4.13.2.3-2 to provide a relative measure of the industry-wide safety of natural gas transmission pipelines. Direct comparisons between accident categories should be made cautiously, however, because individual exposures to hazards are not uniform among all categories. The data nonetheless indicate a low risk of death due to incidents involving natural gas transmission pipelines compared to the other categories. Furthermore, the fatality rate is much lower than the fatalities from natural hazards such as lightning, tornados, or floods.

TABLE 4.13.2.3-2

Accidental Deaths by Cause

Type of Accident	Number of Fatalities a/
All injuries (unintentional)	146,571
Motor vehicle accident	37,757
Poisoning (unintentional)	47,478
Falls (unintentional)	33,381
Suffocation (unintentional)	6,917
Drowning (unintentional)	3,602
Fire/flame (unintentional)	2,646
Floods b/	84
Lightning b/	47
Natural gas distribution lines c/	11
Natural gas transmission pipelines c/	3

a/ All data, unless otherwise noted, reflect 2015 statistics from the National Vital Statistics Reports https://www.cdc.gov/nchs/data/nvsr/nvsr66/nvsr66_06.pdf
b/ NOAA National Weather Service, Office of Climate, Water and Weather Services, 30-year average (1987-2016) http://www.weather.gov/om/hazstats.shtml.
c/ PHMSA significant incident files, March 16, 2018. https://hip.phmsa.dot.gov/analyticsSOAP/saw.dll, 20-year average.

The available data show that natural gas transmission pipelines continue to be a safe, reliable means of energy transportation. From 1998 to 2017, there were an average of 68 significant incidents, 9 injuries, and 3 fatalities per year. The number of significant incidents over the more than 2.21 million miles of natural gas transmission lines in service indicates that the risk is low for an incident at any given location. The operation of the Pacific Connector pipeline would represent a slight increase in risk to the nearby public.

4.13.3 Conclusions

As part of the NEPA review and NGA determinations, Commission staff assesses the potential impact to the human environment in terms of safety and whether the proposed facilities would operate safely, reliably, and securely.

As a cooperating agency, the USDOT assists the FERC by determining whether Jordan Cove LNG Project's proposed design would meet the USDOT's 49 CFR 193 Subpart B siting requirements. USDOT will provide a Letter of Determination on the Project's compliance with 49 CFR 193 Subpart B. This determination will be provided to the Commission as further consideration to the Commission on its decision to authorize or deny the Project. If the Project is authorized and constructed, the facility would be subject to the USDOT's inspection and enforcement program and final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by the USDOT staff.

As a cooperating agency, the Coast Guard also assisted the FERC staff by reviewing the proposed LNG terminal and the associated LNG marine vessel traffic. The Coast Guard reviewed a WSA submitted by Jordan Cove that focused on the navigation safety and maritime security aspects of LNG marine vessel transits along the affected waterway. On May 10, 2018, the Coast Guard issued an LOR that recommended the Coos Bay Channel be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this Project based on the WSA and in accordance with the guidance in the Coast Guard's NVIC 01-11. If the Project is authorized and constructed, the facilities would be subject to the Coast Guard's inspection and enforcement program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

FERC staff conducted a preliminary engineering and technical review of the Jordan Cove LNG Project design, including potential external impacts based on the site location. Based on this review, we recommend a number of mitigation measures, which would ensure continuous oversight prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout life of the facility to enhance the reliability and safety of the facility to mitigate the risk of impact on the public. With the incorporation of these mitigation measures and oversight, FERC staff concluded that the Jordan Cove LNG Project design would include acceptable layers of protection or safeguards that would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public.

The pipeline would be constructed in compliance with the USDOT pipeline standards (as published in 49 CFR Parts 190-199; Part 192 of 49 CFR). Based on the implementation of the required BMPs and adherence to USDOT standards, the Project would not significantly affect public safety.

4.14 CUMULATIVE IMPACTS

Coastal and southern Oregon have been affected by human activity for thousands of years and the existing environmental conditions in the Project area reflect extensive changes to natural resources brought about by past human activities. In 1850, there were about 432,808 acres of farmland in Oregon. By 1954, farmland increased to 21 million acres. In 2007, 16.4 million acres in Oregon were used for agriculture (Ballard 1959; Sorte et al. 2011). Farming activities have modified the environment through land clearing and planting of non-native species.

Oregon has lost an estimated 38 percent of its original wetlands (Morlan 2000). Most Oregon estuaries have been significantly altered through the diking and draining of marshes in the early to mid-1900s for agricultural use, and urban development. Between 1870 and 1970, tidal wetlands within the Coos Bay estuary decreased an estimated 66 percent (Oregon Progress Board 2009).

Cutting of forests in the region began with Euro-American settlement. Initially, forests in the valley floors were cleared to make way for agriculture. Lowland areas close to population centers were logged first, followed by less accessible areas in more mountainous terrain.

Shortly after World War II, improvements in the gas-powered chain saw and transportation led to increased logging in the Pacific Northwest, with a shift to timber sales on federal lands. There was a boom in demand for wood products during the 1950s and 1960s, with a post-war need for framing lumber and plywood for new housing. More than 70 plywood plants opened in Oregon between 1940 and 1960, including plants in North Bend, Coos Bay, and Coquille. As timber inventories on private lands were depleted, pressure to harvest timber on federal lands increased. In 1952, western Oregon’s peak year for timber production, about one-third of the 10.4 billion board feet harvested came from federal lands. By 1963, more timber was harvested on federal lands than private lands.

As a result of over a century of logging and fire control, the portions of forests of the Pacific Northwest consist of a mosaic of recent clearcuts, thinned stands, and young plantations interspersed with unmanaged stands. The remaining unmanaged stands range from 1,000-year-old or older forests with large trees to relatively young, even-aged stands that have regenerated following wildfires. Because wildfires and windstorms often killed only some of the trees in a stand, natural stands are frequently characterized by a mixture of trees that survived a catastrophic event and younger trees that filled in the understory after the event. Where many large old trees remain in the overstory, these stands have been referred to as “old growth,” “late successional,” or “ancient” forests (FEMAT 1993). Where only scattered individuals or patches of large old trees remain and the majority of the stand consists of young or mature trees, stands are referred to as “mixed age” or even “young.” Mixed-age stands are particularly common in some areas, such as the Oregon Coast Range, where extensive fires occurred in the 1800s. Species associated with or dependent on these late-successional and old-growth forests, such as the NSO and MAMU, have been negatively affected by habitat loss (see section 4.6 of this EIS).

Today, Oregon’s environment reflects a mixture of natural processes and human influences across a range of conditions, from areas defined by relatively natural structures and functions to areas completely dominated by human activities (Oregon Progress Board 2000). In the past decade, large, stand-replacing wildfires have affected public lands in southwest Oregon. Since the inception of the NWFP in 1994, the majority of the NSO habitat loss in the region has been the result of stand-replacing wildfire.

Concerning these past activities, the CEQ issued an interpretive memorandum on June 24, 2005, regarding analysis of past actions, which stated: "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions." These activities are included herein to provide historical context. To understand the contribution of past actions to the cumulative effects of the proposed action, this analysis relies on current environmental conditions as a proxy for the effects of past actions. Existing conditions reflect the aggregate effects of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects. In this analysis, we generally consider the effects of past projects as part of the affected environment (environmental baseline) which was described previously. However, this analysis does consider, as applicable, the present effects of past actions.

This analysis is also consistent with Forest Service implementing NEPA Regulations (36 CFR 220.4(f)) (July 1, 2012), which state, in part:

> *CEQ regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions. Once the agency has identified those present effects of past actions that warrant consideration, the agency assesses the extent that the effects of the proposal for agency action or its alternatives will add to, modify, or mitigate those effects. The final analysis documents an agency assessment of the cumulative effects of the actions considered (including past, present, and reasonable foreseeable future actions) on the affected environment. With respect to past actions, during the scoping process and subsequent preparation of the analysis, the agency must determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects. Cataloging past actions and specific information about the direct and indirect effects of their design and implementation could in some contexts be useful to predict the cumulative effects of the proposal. The CEQ regulations, however, do not require agencies to catalogue or exhaustively list and analyze all individual past actions. Simply because information about past actions may be available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decision making. (40 CFR 1508.7)*

In accordance with NEPA, we identified other actions near the Project facilities and evaluated the potential for a cumulative effect on the environment. As defined by the CEQ, a cumulative effect is the impact on the environment resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of which agency or person undertakes such other actions. "Past" actions were addressed in the preceding discussion. "Present" actions are those currently ongoing, either being constructed or are in operation and affecting the environment in such a manner that could contribute to a cumulative impact. "Reasonably foreseeable actions" are proposed projects or developments that have applied for a permit from local, state, or federal authorities or planned projects which have been publicly announced.

Consistent with CEQ guidance, and cooperating agencies' regulations and recommendations, we identified and considered present and reasonably foreseeable actions within an appropriate "geographic scope". The geographic scopes considered in this analysis vary depending on the environmental resource and are identified in table 4.14-1. Actions located outside the geographic scopes are not evaluated because their potential to contribute to a cumulative impact diminishes with increasing distance from the Project.

A nearby project must affect the same resource as the Project to have a cumulative impact on that resource. As previously stated, the effects of more distant actions/projects (outside the HUC 10 or HUC 8 watersheds) are not assessed because their impacts are not expected to overlap with the Project; and therefore, would not contribute to a cumulative impact. Two examples representing opposite ends of the spectrum with regard to geographic scope are cultural resources and air quality. With some exceptions, Project effects on cultural resource sites are localized in nature. For example, a direct impact on an archaeological site would typically not affect other sites; therefore, the geographic scope for archaeological sites is limited to the area within which sites could be directly or indirectly affected by an action. In contrast, the impact of air emissions could be felt over a relatively large distance; therefore, the geographic scope for air quality is larger than for other resources. When determining the significance of a cumulative impact, we consider the duration of the impact; the geographic, biological, and/or social context in which the impact would occur; and the magnitude and intensity of the impact. The duration, context, and magnitude of impacts vary by resource and therefore significance varies accordingly.

As identified in table 4.14-1, we are generally considering HUC 10 (fifth-field) watersheds crossed as the geographic scope for potential cumulative impacts. The Project facilities would be located within 19 HUC 10 watersheds (figures 4.14-1a and 4.14-1b). Additionally, the COE currently considers HUC 8 (fourth-field) watershed to assess cumulative effects, therefore, we are including impacts and compensatory mitigation information provided by the COE within the larger HUC 8 watershed area for analysis of cumulative impacts on wetlands and surface waters. Project facilities would be located within six HUC 8 watersheds. Within these watersheds we have identified six general actions/project types that could contribute to a cumulative impact. These actions are: COE permits and mitigation projects, minor federal agency projects (including road/utility improvements, water flow control, weed treatments, and miscellaneous mitigation), residential and commercial development, timber harvest and forest management activities, livestock grazing, and solar power panel fields.

Of these six project types, some additional context is necessary for livestock grazing and timber harvest and forest management. Livestock grazing occupies far and away the largest footprint of any of the project types considered (approximately 292,000 acres or about 83 percent of the projects considered in our analysis). It also displays a complex temporal niche in that grazing, having occurred for hundreds of years in Oregon, is both a present and reasonably foreseeable activity and a large component of the affected environment. That is, the continuation of grazing is now essentially just the maintenance of the existing environment. The exception, of course, is for the addition of lands not previously open to grazing. These additions include an episodic and conversional set of impacts that would be cumulative with the resources also affected by the Project if they occurred during construction and restoration of the pipeline.

The continued use of grazed lands does not contribute episodic impacts, but rather ongoing perturbation that may have a set of related resource impacts, such as suppression of arboreal and natural vegetative communities that would otherwise develop. In addition, livestock grazing disrupts soil profiles, breaks down stream banks, and contributes to water quality degradation of streams. Accordingly, we characterize livestock grazing impacts as ongoing, landscape-level impacts with relatively small incremental impacts distributed over the present and future timeframe that is also affected by the Project. Consequently, livestock grazing impacts during any discrete period of time, such as the limited period that pipeline construction would occur within a given HUC-10 watershed, contributes only minor impacts on the resources also affected by the Project. For this reason, we identify ongoing livestock grazing projects in our list of projects within the geographic scope of our cumulative impacts analysis, but unless otherwise noted, we do not include them in our analysis of potential cumulative impacts on each resource.

Timber harvesting and forest management activities make up the second largest footprint of the project types considered (50,950 acres or about 14 percent of the projects considered in our analysis). Timber harvesting and forest management impacts are episodic and conversional. Timber harvesting dramatically alters multiple interlaced resources including vegetative and wildlife communities, soils, water resources, and visual aesthetics. In addition to the larger scale of the impacts, there is a longer-term temporal impact. While revegetation of affected communities may be allowed to occur after harvesting, complete restoration (i.e., the point in which the affected area no longer contributes to cumulative impacts) is most often measured in decades.

Additionally, non-jurisdictional utilities at the terminal site, the use of LNG carriers, ongoing maintenance dredging, the Port's Channel Modification Project, Project impact mitigation projects, and the removal of PacifiCorp dams on the Klamath River could also contribute to a cumulative impact(s). Table 4.14-2 identifies these actions by watershed, and table N-1 in appendix N lists the resources each project could affect and summarizes the area of known impacts. We generally do not include in our analysis projects such as small commercial developments and small road projects located within towns and other developed areas, because these actions have a small footprint, are consistent with surrounding land uses, and contribute only minutely to cumulative impacts on the resources evaluated in this EIS.

In addition to the geographic relationship between the Project and other projects, we also consider the temporal relationship. For the purposes of this analysis, the temporal extent of other projects would start generally in the past[230] and extend out for the expected duration of the impacts caused by the Project.

Not all future projects that may occur are well defined with regard to scope, location, timing, and resource footprint. Without specific information, inclusion of these projects may not be meaningful. For example, between 2010 and 2017, the counties crossed by the Project have grown by an average of about 4 percent; and along with that growth, numerous residential subdivisions, commercial developments, roads and utilities, and maintenance and upgrading of existing infrastructure have been constructed (or were proposed). If growth continues, similar future actions may occur, affecting a range of natural resources, including soils, waterbodies and wetlands, vegetation, and wildlife. There is also the potential that over time federal and state agencies and private conservation organizations may implement projects and actions that improve habitat, water quality, and air quality throughout the Project area. It is not possible to quantify or assess the potential cumulative impacts or benefits that may accrue from these undefined future projects. In addition, we anticipate that at a future date the Forest Service may address the

[230] We consider only those past projects that contribute ongoing effects on resources. Generally, more recent projects contribute a greater impact.

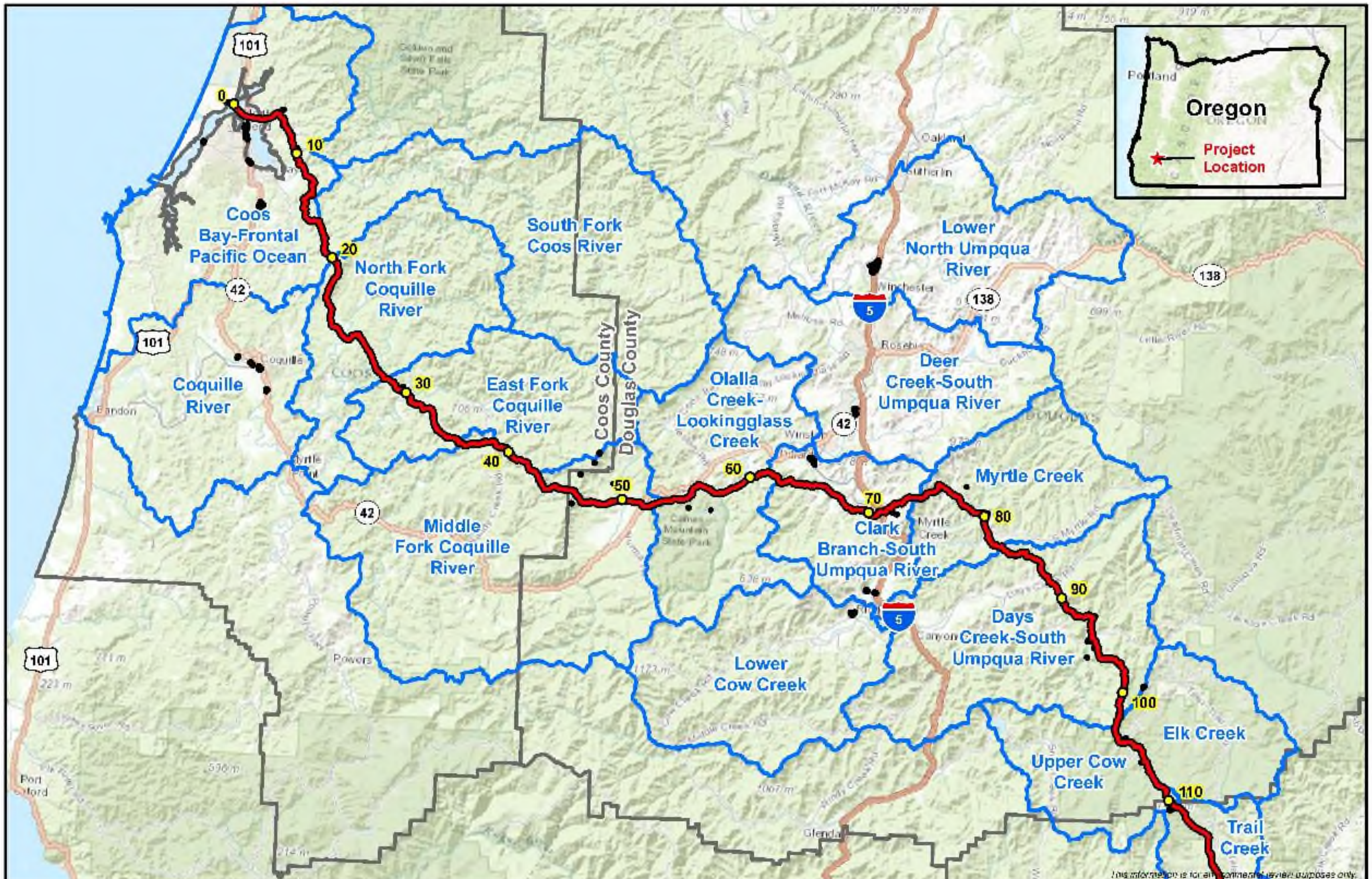
cumulative effects of currently undefined Project-related mitigation actions that these agencies may require on Forest Service and BLM-managed lands.

Additional discussion of cumulative effects on federally listed and proposed wildlife, fish, and plant species will be provided in our pending BA. The ESA defines cumulative effects as the "effects of future state or private activities, not involving Federal activities (Federal activities are subject to project-specific, individual ESA reviews), that are reasonably certain to occur within the action area of the Federal action subject to consultation." The determinations of effect in the BA will consider cumulative effects. Additionally, the Services are required to consider cumulative effects in formulating their biological opinions (50 CFR §402.14(g)(3) and (4)).

TABLE 4.14-1

Geographic Scope, by Resource, for Cumulative Effects Analysis

Resource	Geographic Scope	Rationale for Potential Cumulative Impact Analysis Area
Soils	HUC-10 watersheds	Projects within the HUC-10 watershed could contribute to cumulative impacts on soils within the watershed; therefore, the Project would result in additional incremental impacts on soils within the HUC-10 watersheds.
Water Resources and Wetlands	HUC-10 watersheds HUC-8 watersheds for COE wetland mitigation projects	Projects within the HUC-10 watershed could contribute to cumulative impacts on water resources and wetlands within the watershed.
Vegetation	HUC-10 watersheds	Projects within the HUC-10 watershed could contribute to cumulative impacts on vegetation within the watershed
Wildlife and Aquatic Resources	HUC-10 watersheds marine waters outside of Coos Bay	Projects within the HUC-10 watershed could contribute to cumulative impacts on wildlife and aquatic resources within the watershed; and projects from the mouth of Coos Bay to the outer continental shelf could contribute to impacts on listed marine species
Land Use	HUC-10 watersheds	Projects within the HUC-10 watershed could contribute to cumulative impacts on land use within the watershed
Recreation and Visual Resources	HUC-10 watersheds Viewshed from which Project construction or permanent facilities can be seen	Projects within the HUC-10 watershed could contribute to cumulative impacts on recreation; and projects within the viewshed of the Project could contribute to cumulative impacts on visual resources
Socioeconomics	Coos, Douglas, Jackson, and Klamath counties	Projects within the four counties with proposed Project facilities could contribute to cumulative impacts on socioeconomics
Environmental Justice	The census tracts directly affected by the Project	Projects within the census tracts directly affected by the proposed Project facilities could contribute to cumulative impacts on Environmental Justice communities
Transportation	Coos, Douglas, Jackson, and Klamath counties and the Coos Bay Federal Navigation Channel	Projects within the four counties with proposed Project facilities, as well as those along the Coos Bay Federal Navigation Channel could contribute to cumulative impacts on transportation
Cultural Resources	Direct and indirect Area of Potential Effect (APE)	Projects within the disturbance footprint (direct APE) or adjacent areas that could potentially experience visual, atmospheric, or audible cumulative impacts from Project construction or operation (indirect APE) could contribute to cumulative impacts on cultural resources
Air Quality	Within 0.25 mile of construction, and 50 km of LNG terminal and Klamath Compressor Station during operation	Projects within these geographic scopes could contribute to cumulative impacts on air quality during construction and operation
Noise	Within 0.25 mile (daytime) and 0.5 mile (nighttime) of construction, and 1 mile of LNG terminal and Klamath Compressor Station during operation	Projects within these geographic scopes could contribute to cumulative impacts on daytime and nighttime noise during construction and operation



Page 1 of 2

Figure 4.14-1a

Watersheds and Counties Crossed by the Project

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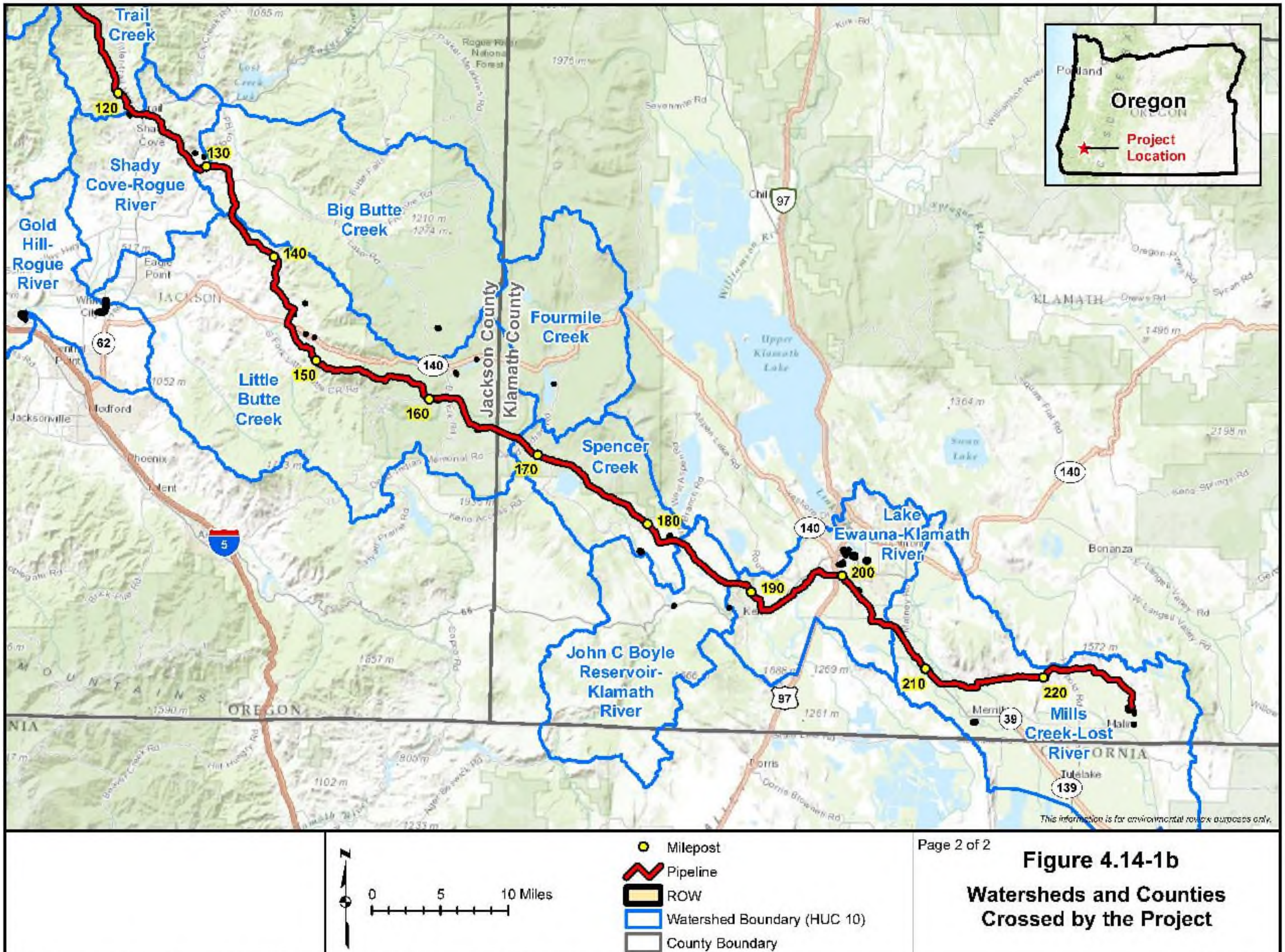

Page 2 of 2

Figure 4.14-1b

Watersheds and Counties Crossed by the Project

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TABLE 4.14-2

Past, Present, or Reasonably Foreseeable Actions that May Cumulatively Affect Resources a/

Project	County
Coos Bay-Frontal Pacific Ocean Watershed	
COE - Permits and Mitigation (**Coos Fourth-Field Watershed)**	Various
Non-jurisdictional facility - LNG carriers	Coos
Non-jurisdictional facility – Utilities	Coos
Jordan Cove – Maintenance Dredging	Coos
Jordan Cove – Project impact mitigation	Coos
Port of Coos Bay - Coos Bay Railroad Bridge Rehabilitation	Coos
Port of Coos Bay – Maintenance Dredging	Coos
Port of Coos Bay – Coos Bay Rail Line Tunnel Rehabilitation	Coos
COE - Coos Bay Jetties Rehabilitation Project	Coos
CTCLUSI - Coos Head Area Master Plan, Hollering Place	Coos
City of North Bend – Department of Human Services Building Relocation	Coos
Port of Coos Bay - Coos Bay Section 408/204(f) Channel Modification b/	Coos
COE - Coos Bay Federal Navigation Channel Maintenance Dredging	Coos
Coos County Airport District — Southwest Oregon Regional Airport Expansion	Coos
Tioga Sports Park	Coos
Coos Bay Village commercial development	Coos
BLM — Catching Creek Conversion Timber Sale	Coos
BLM — Other Commercial Thinning Timber Sales	Coos
South Fork Coos River	
BLM - Tioga Creek Instream Restoration Phase 1	Coos
BLM - Helipond and Pump Chance Maintenance EA	Coos
Coquille River Watershed (Fourth Field)	
COE Permits and Mitigation	Coos
Coquille River Watershed	
BLM – Calloway Creek Timber Sale	Coos
BLM – Whistle Stop Conversion Timber Sale	Coos
BLM —Wilson Creek 4 Timber Sale	Coos
BLM — West Cunningham Timber Sale	Coos
BLM – Other CT Timber Sales	Coos
North Fork Coquille River Watershed	
BLM — Manual Maintenance	Coos
BLM — Whiskey Train Timber Sale	Coos
BLM — Steele 23 CT Timber Sale	Coos
BLM — Cloud 19 CT Timber Sale	Coos
BLM — Hungry Mountain Timber Sale	Coos
BLM — Woodward 11 Timber Sale	Coos
BLM - Rock Prairie Timber Sale (Lone Pine EA)	Coos
BLM — Hidden Gem Timber Sale	Coos
BLM — Zumwalt Commercial thinning	Coos
BLM — Johns Creek Commercial thinning	Coos
BLM — Llewellyn Commercial thinning (Lone Pine EA)	Coos
BLM — Other commercial thinning and sales (Lone Pine EA)	Coos
BLM - Helipond and Pump Chance Maintenance EA	Coos
ODFW – Winter Lake Access Road Project	Coos
BLM — Steel Cherry Timber Sale	Coos
BLM — Yankee Panky Timber Sale	Coos
BLM — ERFO Road repairs	Coos
BLM — Weed Treatment	Coos
BLM — Weekly Commercial Thinning	Coos
BLM – Steel Creek Instream Restoration and Riparian Invasive Species removal/planting	Coos
BLM – Helipond and Pump Chance Maintenance EA	Coos
BLM – Scattered Skeeter Density Management Thinning	Coos
BLM – Broken Wagon Density Management Thinning	Coos
Methane Energy Corp (MEC), Coos County Methane Project	Coos

TABLE 4.14-2 (continued)

Past, Present, or Reasonably Foreseeable Actions that May Cumulatively Affect Resources a/

Project	County
BLM – Crosby Timber Sale	Coos
BLM – East Cherry Timber Sale	Coos
BLM – Wagon Road Pilot Timber Sale	Coos
BLM – Steel Trap Density Management Thinning	Coos
BLM – Weed Treatment	Coos
BLM – Brownstone Commercial thinning	Coos
BLM – My Frona Commercial thinning	Coos
BLM – Steel Cherry Commercial Thinning	Coos
Middle Fork Coquille Watershed	
BLM —Weaver Tie Timber Sale	Coos/ Douglas
BLM – Manual Maintenance	Coos/ Douglas
BLM – Weed Treatment	Coos/ Douglas
BLM – Helipond and Pump Chance Maintenance EA	Coos/ Douglas
BLM – Camas Valley Timber Sales	Coos/ Douglas
South Umpqua Watershed (Fourth Field)	
COE Permits and Mitigation	Douglas
Olalla Creek-Lookingglass Watershed	
BLM — Suicide Bar and other Commercial Thinning	Douglas
Clark Branch-South Umpqua River Watershed	
BLM- Shively-Clark Timber Sale EA	Douglas
Myrtle Creek Watershed	
BLM- Myrtle Creek REA Timber Sales	Douglas
Two Industrial Buildings	Douglas
Days Creek-South Umpqua River Watershed	
BLM – Upper Cow Late Successional Reserve Project	Douglas
BLM – Days Creek EA Timber Sales	Douglas
BLM – Shively-Clark EA Timber Sales	Douglas
Deer Creek South Umpqua River Watershed	
Grange Road Development	Douglas
Roseburg Public Works Projects	Douglas
Elk Creek Watershed	
Forest Service — Noxious Weed Treatment	Douglas
Forest Service – Livestock Grazing	Douglas
Forest Service—Tiller Aquatic Restoration Project	Douglas
Forest Service—Elk Creek Watershed Restoration Project	Douglas
Upper Cow Creek Watershed	
Forest Service—Livestock Grazing	Douglas/ Jackson
Forest Service - Upper Cow Creek Hazardous Fuels Project	Douglas/ Jackson
Forest Service –Tiller Aquatic Restoration Project	Douglas
BLM – Upper Cow Late Successional Reserve Project	Douglas
BLM – Young Stand Management	Douglas
BLM – Fuels Treatments	Douglas
Upper Rogue Watershed (Fourth Field)	
COE Permits and Mitigation	Jackson
Trail Creek Watershed	
Forest Service- Livestock Grazing	Jackson
BLM — Proposed Trail Creek Forest Management	Jackson
BLM – Proposed Trail Creek Forest Management	Jackson
BLM – Proposed Trail Creek Forest Management	Jackson
BLM – Proposed Trail Creek Forest Management	Jackson
BLM — Mouse Trail Timber Sale	Jackson
BLM – Livestock Grazing	Jackson
BLM – Elk Camel Forest Management Project	Jackson
BLM – Livestock Grazing	Jackson
Rogue River Drive Estates Subdivision	Jackson

TABLE 4.14-2 (continued)

Past, Present, or Reasonably Foreseeable Actions that May Cumulatively Affect Resources a/

Project	County
Gold-Hill Rogue River Watershed	
Saddlebrook Meadows Subdivision, Phase 2	Jackson
FB Owen Inc - Valley Meadows Estates	Jackson
Big Butte Creek Watershed	
BLM – Big Butte Forest Management Project	Jackson
BLM – Proposed Obenchain Forest Management Project	Jackson
BLM – Livestock Grazing	Jackson
BLM – Friese Camp Forest Management Project	Jackson
BLM - Double Bowen Forest Management Project	Jackson
BLM – Elk Camel Forest Management Project	Jackson
Forest Service-Livestock Grazing	Jackson
Little Butte Creek Watershed	
BLM – Proposed Obenchain Forest Management Project	Jackson/ Klamath
BLM - South Fork Little Butte Timber Sale	Jackson/ Klamath
BLM – Livestock Grazing	Jackson
Forest Service —2013 Big Elk Cinder Pit CE	Jackson/ Klamath
Forest Service- Livestock Grazing	Jackson/ Klamath
Spencer Creek Watershed	
Forest Service – Livestock Grazing	Klamath
Forest Service — Dead Indian Memorial and Clover Creek Roads Noxious Weed Treatment	Klamath
Forest Service — Lake of the Woods VVUI Project b	Klamath
Forest Service – Roadside Firewood Collection	Klamath
BLM — North Landscape Timber Sales	Klamath
BLM — Spencer Creek Thinning	Klamath
Upper Klamath Fourth-Field Watershed	
COE Permits and Mitigation	Klamath
Lost River Fourth-Field Watershed	
COE Permits and Mitigation	Klamath
John C. Boyle Reservoir-Klamath River/Lake Ewauna-Upper Klamath River/Mills Creek-Lost River Watersheds	
Oregon Department of Forestry - Bad Ham Timber Sale	Klamath
BLM — North Landscape Timber Sales	Klamath
BLM — Swan Lake Hydroelectric Pumped Storage Project	Klamath
BLM — Bryant Mountain Vegetation Treatments	Klamath
BLM – Bryant Mountain Juniper Treatment	Klamath
BLM – Stukel Juniper Treatment	Klamath
PacifiCorp. Klamath Dam Removal Project	Klamath
Turkey Hill Solar Project	Klamath
Merrill Solar Project	Klamath
BNSF Railway Crew Facility	Klamath
Klamath Irrigation District – Stukel Spill Project	Klamath
Non-jurisdictional facility – Utilities for Pacific Connector	Klamath and others

a/ Details on most future activities on private lands, such as commercial harvests, are not publicly available. These activities are expected to continue at current rates. See appendix N for acreage, status, approximate location relative to nearest Project facilities, and resources potentially affected by each project listed in this table.

b/ The Port's project is made up of several proposed actions to improve navigation efficiency, reduce shipping transportation costs, and facilitate the shipping industry's transition to larger, more efficient vessels. The Port is currently in the engineering and design phase and is coordinating with the COE since they play several roles in the area, including new long-term maintenance of the channel. The project will also require authorization from the COE and other agencies before conducting the dredging activities. The COE is preparing an EIS to analyze the potential impacts associated with the project.

The Ruby and GTN pipeline system are present in this watershed; however, as stated previously, we consider the effects of past projects as part of the affected environment

4.14.1 Cumulative Effects

Based on available information, the actions listed in table 4.14-2 would affect soils, water resources, vegetation, wildlife, fisheries and aquatic resources, socioeconomics, land use, recreation and visual resources, transportation, cultural resources, air quality, and noise; and as such, we are assessing the potential for cumulative impacts on these resources. Project impacts on geology were assessed in this EIS; however, because impacts on geology (with exceptions) are generally limited, we are not assessing cumulative impacts on geology unless specifically noted.

The acres affected by the projects listed in table 4.14-2 are summarized in table 4.14.1-1 by HUC-10 watershed, including the percentage of each watershed. The values presented for project-related mitigation on federal lands are approximate and may be subject to change within or between watersheds as a result of changing conditions and agency management priorities. In some of these watersheds, the cumulative effects from the other projects included in this analysis represent a relatively large percentage of the total watershed area. In these cases, the significance of the cumulative impact may be only minimally altered by the contribution of the Project. For example, the Elk Creek HUC-10 watershed covers about 54,356 acres. The Project's impacts (as described in the preceding analyses) within this watershed are inconsequential (40 acres) when compared to the total watershed area, and contribute impacts on only 0.07 percent of the watershed. However, the other projects considered have/would impact about 12,248 acres, or 22.6 percent of the watershed. In this example, whether the Project is constructed or not has no discernible effect on the cumulative impact exerted on the resources and approval and implementation of the other projects determines the significance of the cumulative impact.

TABLE 4.14.1-1

Area Affected by Projects Included in Cumulative Effects Analysis, by Watershed

HUC-10 Watershed	Total Area Within HUC-10 Watershed (Acres)	Proposed Project Impact Area (Acres) a/	Other Project Impact Area (Acres) b/	Combined Area of HUC-10 Watershed (%)
Coos Bay-Frontal Pacific	151,611	370	713	0.7
South Fork Coos River	160,146	29	11	0.0
Coquille River	111,644	36	1,029	1.0
North Fork Coquille River	98,406	189	4,802	5.1
East Fork Coquille River	85,963	172	0	0.2
Middle Fork Coquille River	197,314	272	1,097	0.7
Olalla Creek-Lookingglass	103,212	159	188	0.3
Clark's Branch-S Umpqua R	59,577	272	441	1.2
Lower Cow Creek	102,447	16	0	0.0
Myrtle Creek	76,250	247	1,077	1.7
Days Creek-S Umpqua R	141,569	567	3,297	2.7
Deer Creek-S Umpqua R	110,072	16	30	0.0
Lower North Umpqua River	106,406	102	0	0.1
Elk Creek	54,356	40	12,248	22.6
Upper Cow Creek	47499	89	2,419	5.3
Trail Creek	35,338	221	9,597	27.8
Shady Cove-Rogue River	74,268	140	755	1.2
Gold-Hill Rogue River	136,049	106	6	0.1
Big Butte Creek	158,243	89	4,941	3.2
Little Butte Creek	238,879	637	3,770	1.8
Spencer Creek	54,247	231	4,470	8.7
John C. Boyle Reservoir-Klamath River/Lake Ewauna-Upper Klamath River/Mills Creek-Lost River	349	921	9,725	3.1
TOTAL	**2,650,575**	**4,921**	**60,616**	**2.5**

a/ Only includes watersheds with at least 1 acre of Project disturbance.
b/ Includes projects listed in table 4.14-2 and table N-1 with exception of ongoing grazing on existing allotments.

4.14.1.1 Soils and Sediments

The other projects occurring in Coos Bay including the Port's Channel Modification Project and the COE's North Jetty Maintenance Project would temporarily and periodically impact Coos Bay sediments. Disturbing Coos Bay sediments would affect channel dynamics, water quality, adjacent sediments, fisheries and other aquatic organisms, and aquatic vegetation (see sections 4.1, 4.2, 4.3, 4.4, and 4.5). The impacts of these projects when combined with the impacts of the Project could result in a cumulative impact. However, the magnitude of any cumulative impact would depend on the location and timing of the other projects relative to the Project. The Port's Channel Modification Project would occur in part, adjacent to the LNG terminal site and associated marine facilities, but would likely occur after construction of the marine facilities is complete. It is possible that dredging activities associated with both the Project and the Port's Channel Modification Project could overlap. The North Jetty Maintenance Project would occur at the mouth of Coos Bay; however, a final construction schedule is still being developed. The North Jetty Maintenance Project would occur approximately seven river miles downstream from the LNG terminal site, but would be located less than two river miles from the nearest portion of the Project's proposed modifications to the marine waterway.

Sediments present in Coos Bay are naturally disturbed, flushed, and replenished by water inflows into the system. Dredging sediments disrupts the naturally occurring sediment flow process resulting in sediment reductions and accumulations. The other projects could impact the Coos Bay shoreline. Specifically, the use of marine vessels to construct and maintain the other projects would increase wave action within Coos Bay, and when combined with the wave actions resulting from Project-related vessels (tugs, barges, and LNG carriers) could result in a cumulative impact. Based on the location of the Project (including the Project's proposed modifications to the marine waterway), the locations of the other projects relative to the Project, and the expected timing of the other projects impacts (initial construction and maintenance), which we assume will not be concurrent (however, at some point in the future channel maintenance and Project maintenance may occur simultaneously), we conclude that the cumulative impact on sediments and the Coos Bay shoreline would not be significant.

At least six timber sale projects affecting a total of over 5,000 acres of land have or would cross/overlap about six miles of pipeline construction right-of-way and workspace. It is also likely that an undeterminable amount of other timber-related activities; maintenance, commercial thinning, and management have or would cross/overlap pipeline construction right-of-way and workspace. The Project would affect about 4,500 acres of land. Cumulative impacts on soils may result from the additive loss of soil (erosion), rutting and compaction, or disturbance of the profile that may affect the revegetation potential. In general, the use of heavy equipment, and the harvesting and maintenance of timber related to timber sales and other timber-related activities would impact underlying soils in a manner similar to that described for construction of the pipeline. However, these combined impacts would not be significant because the cumulative impact on soils would be limited to the relatively narrow width of the pipeline construction right-of-way (and associated construction workspace) and because of the minimization and protection measures included in the erosion control plans for the projects. The approximately 9,500 acres of land cumulatively affected by the six timber sale projects and the proposed Project that could potentially overlap represents about 0.02 percent of the total amount of land within the watersheds crossed by the Project.

By implementing the measures discussed in section 4.1, the Project would minimize incremental impacts on soils. With the exception of the timber sale projects discussed above, other projects identified in table 4.14-2 would not overlap with the pipeline construction workspace, and therefore, we conclude that the cumulative impact on soils would not be significant.

4.14.1.2 Water Resources and Wetlands

All of the projects identified in table 4.14-2 could affect underlying groundwater. Ground disturbing activities including aboveground facility and pipeline construction; and the use of equipment in support of those activities can affect groundwater recharge (surface water infiltration), subsurface lateral water flow, and groundwater quantity and quality. Together, the Project and the other projects would affect about 65,000 acres of land which represents about 2.5 percent of the total amount of land within the watersheds crossed by the Project. With the exception of three watersheds, cumulative impacts on lands within an individual watershed vary between less than 0.1 percent and 5.3 percent of total land amounts. The three remaining watersheds experience a greater cumulative impact due to the presence of large timber sales, and other timber-related activities (4,470 – 12,248 acres of impact in each watershed). Withdrawal requirements from underlying groundwater associated with these projects, if any, are unknown.

As described previously, we conclude that the impacts of the Project on groundwater would not be significant. These impacts would also be temporary, relatively minor, and localized. Additionally, the ground-disturbance and subsequent effects on groundwater resulting from timber-related activities are common in the region have not been found to be individually or cumulatively significant in other federal actions. Therefore, based on the cumulative amount of land affected and that area's proportion of the overall amount of land within the affected watersheds, we conclude that the cumulative impact on groundwater would not be significant.

The COE permits and mitigation projects, including stream restoration and enhancement projects affecting a total of about 71.0 river/stream miles, would occur in the watersheds affected by the Project. Additionally, the use of the Coos Bay Navigation Channel by LNG carriers travelling to and from the terminal facilities, the proposed modification of this channel, the regular maintenance of the channel, and the removal of dams along the Klamath River would also contribute to a cumulative impact on waterbodies affected by the Project. Other projects that could contribute to a cumulative impact on waterbodies crossed by the Project include minor federal agency projects (instream and aquatic restoration projects), and timber-related activities.

Numerous concerns about cumulative impacts on water quality in Coos Bay have been expressed by the public, the CTLUSI, the CIT, and the COE. The Port's Channel Modification Project would likely have the largest incremental contribution to cumulative impacts on Coos Bay. The Port's Channel Modification Project's impacts will be disclosed through the COE's review process; however, detailed information on this project is limited at this time. Additional information about the Port's Channel Modification Project, would be incorporated into the assessment presented in our final EIS. The CTCLUSI's Hollering Place which includes the installation of sheet piling along the shoreline of Coos Bay is currently under construction and would not significantly contribute to a cumulative impact on water quality. As described previously, other projects in Coos Bay would affect water quality and channel dynamics including channel geometry and flow. Changes to water quality would also affect fisheries and other aquatic organisms, and aquatic vegetation. These impacts when combined with the impacts of the Project could result in a cumulative impact on water resources, but this impact would also depend on the location and timing of the other projects. Based on available information, it is expected that dredging in Coos Bay would be temporary and periodic, generally occurring over several months. Impacts on water quality due to increased turbidity and sedimentation would be localized and temporary, returning to pre-construction conditions in a relatively short amount of time due to the dynamic and natural hydraulic regime of Coos Bay. The navigational channel improvements and the other projects, primarily the Port's Channel Modification Project would contribute to a cumulative impact on channel dynamics (e.g., channel geometry and flow). This change to channel geometry and flow would be permanent; however, the Project's contribution to this change would be significantly less than the Port's Channel Modification Project's contributions, which would have the largest incremental contribution to this permanent effect. Regular channel maintenance activities would not likely occur at the same time as the initial construction dredging activities associated with the Project and the Port's Channel Modification Project; therefore, a cumulative impact during construction is not anticipated, although a cumulative impact during operation is possible. Should channel and Project marine facility maintenance occur at or near the same time, a cumulative impact would occur; however, again, this impact would be temporary. Therefore, we conclude that the cumulative impact on Coos Bay would not be significant.

The impacts of LNG carriers and tug vessels traversing Coos Bay are different in nature than those of dredging projects, but would still affect water quality in the bay. LNG carrier water withdrawals and discharges related to ballast and engine cooling operations would affect small portions of Coos Bay (via potential introduction of invasive species and modifying water temperatures) primarily at and near the LNG marine facilities (see section 4.3 and 4.5). However, given the size of Coos Bay, the frequency of LNG carries in the bay, and the current use of the bay by other marine vessels, we conclude that any cumulative would not be significant.

Along the pipeline route, in-water work and ground disturbing activities near waterbodies can affect water quality. The locations, scopes of work, and timing of the other projects are not all known, so we cannot quantify the specific impacts of these projects or determine if these impacts would overlap with the impacts of the Project. However, based on available information (see table 4.14.-2) and the temporary and localized impacts of the Project on surface waters as described in the preceding environmental analyses, Pacific Connector's use of HDDs to cross major waterbodies, and its implementation of erosion and sediment control measures as well as other impact minimization measures, we conclude that these impacts and the potential impacts of the other projects would result in a cumulative impact; but, this impact would not be significant.

Additionally, the Klamath, Yurok, and Karuk Tribes expressed concern that an adverse cumulative impact on the Klamath River in Klamath County and downstream into California would occur resulting from the Project and the removal of dams along the Klamath River. The tribes expressed concern about impacts on water quality and fish, especially salmon. Pacific Connector would cross the Klamath River using an HDD. Furthermore, Pacific Connector has prepared a site-specific crossing plan for the Klamath River that indicates all workspaces and measures that would be implemented to avoid and minimize impacts on the Klamath River. As described previously, the use of an HDD significantly reduces the potential for impacts on a waterbody. Should an inadvertent release of drilling fluid(s) occur into the Klamath River, water quality would be temporarily affected. The river would experience increased turbidity and sedimentation. However, these increases would subside quickly, and the resulting turbidity would also settle out quickly. The removal of dams along the Klamath River would result in a significant impact on downstream water quality; however, these significant impacts would not occur in areas where the Project's impacts would occur. Furthermore, because the Project would use an HDD to cross the river and would likely be completed before the dams are removed, the Project's incremental contributions to a cumulative impact would not be significant.

COE permits and mitigation projects would affect a total of about 50 acres of wetlands in the watersheds crossed by the Project. The extent of impacts on wetlands from the other projects identified in table 4.14.-2 (beyond the COE permits and mitigation projects in Coos Bay) are unknown, but we assume wetlands could be affected. As described previously, the Project would impact about 200 acres of wetlands, with about 45 percent of the wetlands affected by the Project associated with the LNG terminal facilities. Of the remaining 55 percent, about 110 acres of wetlands would experience temporary to short-term impacts, and about 3 acres of forested wetland would experience long-term impacts. Cumulatively, at least 250 acres of wetlands would be affected. However, this cumulative impact would not be significant given the sizes of the watersheds crossed, relative to the extent and duration of the impacts.

4.14.1.3 Vegetation

Timber sales, commercial thinning, forest management, timber-related activities, and other projects would affect over 40,000 acres of vegetation within the watersheds crossed by the Project. These projects would primarily impact forest and herbaceous vegetation. Impacts include permanent clearing and loss, and long- and short-term disturbance (clearing and thinning). Many of these projects are BLM or Forest Service projects and as such have undergone an environmental review.

As described previously, the Project would affect about 4,500 acres of vegetation. Cumulatively, the Project along with the projects identified in table 4.14-2 would impact over 65,000 acres. If all 65,000 acres were vegetated, this impact would account for about 2.5 percent of the total amount of vegetation within the watersheds crossed by the Project. Considering forest vegetation, if the entire area affected by the projects considered in this analysis were forested it would account for about 4.6 percent of the total amount of forested area within the watersheds based on USGS National Land Cover Database which estimates about 1.4 million acres of forest within the watersheds. Additionally, the Project would impact 773 acres of LSOG forest. Pacific Connector would fund various projects on federal lands that would mitigate for the impacts on LSOG on federal lands to the extent required by BLM and Forest Service LRMPs. Implementation of new LRMPs and RMPs on both BLM and NFS lands in the 1990s resulted in a substantial reduction in lands available for timber harvest due to the establishment of LSRs and Riparian Reserves. Regrowth in previously harvested areas would, over time, result in more area supporting LSOG in the watersheds crossed by the Project. The clearing of LSOG by the Project would represent a loss of 0.01 percent of the remaining LSOG forest in the four physiographic provinces crossed by the Project.

Any of the projects identified in table 4.14-2 could result in the introduction or spread of invasive or noxious weeds as a result of ground disturbance and/or movement of equipment from one site to another. To avoid introducing or spreading invasive species, Jordan Cove would follow recommendations from several state and federal plans and programs including ODA, OISC, and BLM, as well as Project-specific measures (see section 4.4.1.6). It would be expected that the other projects on federal lands, or that would be subject of a federal permit review, would also implement some measures to minimize or control the spread of invasive or noxious weeds. Therefore, based on the analysis provided above, we conclude that the cumulative impact on vegetation would not be significant.

4.14.1.4 Wildlife and Aquatic Resources

All of the projects identified in table 4.14-2 could affect wildlife, including threatened and endangered species, and other species of concern. Ground-disturbing activities; and the use of equipment in support of those activities can increase the rates of stress, injury, and mortality experienced by wildlife. Additionally, these activities can result in the temporary and permanent loss or conversion of wildlife habitats. Threatened and endangered species may be particularly vulnerable to these ground-disturbing activities and associated habitat loss. The timber harvest projects and a number of the other timber-related projects could result in the long-term loss of forested habitat which supports a variety of wildlife, including MAMU and NSO. Timber sales projects could also result in the loss of forested habitat and affect wildlife. For the purposes of this analysis, we consider timber harvest and timber sales collectively as potential impacts on mature wildlife habitat; however, we recognize that some of these projects could be beneficial for forest health and wildlife. Furthermore, some timber management activities would affect mature wildlife habitat, but would generally result in temporary impacts with a goal of promoting the long-term enhancement of mature habitat. As discussed previously, wildlife would generally avoid or be displaced by disturbance. As a result, wildlife would experience increased rates of stress, injury, and mortality. Additionally, when wildlife is displaced or behaviors change in response to disturbance and habitat loss, competition and predation pressures from other wildlife that move to occupy abandoned habitats or are occupying habitats that displaced wildlife is trying to use can increase which can result in a decrease in overall fitness (including reduced rates of reproduction) for some species.

Impacts on wildlife (and threatened and endangered species) would vary depending on the amount and quality of habitat, and the duration of impacts, the fitness of an individual(s), and the concentration of individuals within affected habitats. As stated previously, the Project and the other projects would affect about 65,000 acres of land (and associated wildlife habitats) which represents about 2.5 percent of the total amount of land within the watersheds crossed by the Project. However, some habitat types may be more sensitive to disturbance that others, such as those defined as “irreplaceable, essential, or limited” by the ODFW (see section 4.5); information on the extent of impacts that would occur to these sensitive habitat types as a result of the reasonable foreseeable projects is not available or quantifiable at this time. Therefore, we conclude that the resulting cumulative impact of the Project and the other projects would not be significant because of the total amount of land and habitat affected relative to the amounts available within the watersheds crossed and wildlife’s general ability to avoid construction activities and adapt to disturbance.

In Section 4.06, we address the Project’s extensive impacts on federally listed threatened and endangered species. In the forthcoming biological assessment, we address cumulative effects on federally listed threatened and endangered species. However, acknowledging that many federally-protected species in the Project area depend on LSOG habitat for one or more life stages and due to their particular sensitivity, we discuss further cumulative impacts on two of those species MAMU and NSO. The projects identified in table 4.14-12 include timber sales and forest management projects involving timber harvest on about 694 acres within watersheds where MAMU occur and about 10,439 acres within watersheds where NSO occur. The majority of these harvests are of regenerating stands rather than LSOG, so they are more likely to prevent forested habitat from becoming LSOG (and thus suitable for LSOG-associated species) than remove existing LSOG that is currently suitable for MAMU and NSO. As a result, the Project-related habitat loss described in section 4.6 would contribute to a cumulative impact on MAMU and NSO habitat. Furthermore, of the projects considered in this analysis, this Project would have the largest incremental impact to these species.

COE permits and mitigation projects, minor federal agency projects (instream and aquatic restoration projects), timber-related activities, and livestock grazing would occur in the watersheds affected by the Project and would impact aquatic resources, including threatened and endangered species and other species of concern. Additionally, LNG carriers, the Port's Channel Modification Project, the regular maintenance of the channel, other projects in Coos Bay, and the removal of dams along the Klamath River would also impact aquatic resources including fish, marine mammals, and other aquatic organisms. In-water work and ground-disturbing activities associated with these projects would affect aquatic habitats, fish, marine mammals, and other aquatic organisms in a manner similar to that described for the Project (see sections 4.5 and 4.6). Aquatic habitats would be both temporarily and permanently affected; and fish and water-dependent wildlife would experience increased rates of stress, injury, and mortality.

Concerns about the importance of fish to communities affected by the Project and the potential for cumulative impacts on fish were expressed in numerous comments to the Commission. Comments provided by several tribes specifically identified Coos Bay and the Klamath River as fisheries that could be subject to adverse cumulative impacts. With the exception of the Port's Channel Modification Project, the COE's North Jetty Maintenance Project, LNG carriers, and channel maintenance activities, the other projects affecting Coos Bay are temporary in nature resulting in temporary impacts on aquatic habitats, fish, marine mammals and other aquatic organisms primarily from dredging activities that result in the loss of habitat and increase rates of turbidity and sedimentation. LNG carriers and other marine vessel traffic in Coos Bay would occur regularly; however, the disturbance caused by ships (increased wave action, underwater noise, and water withdrawal/discharge) in Coos Bay is not expected to adversely impact fish and other aquatic resources including crabbing. Channel maintenance activities would occur periodically, but the impacts of these activities on fisheries and aquatic resources would be temporary. The impacts of these projects when combined with the impacts of the Project would not result in a significant cumulative impact on fish, marine mammals, and other aquatic organisms in Coos Bay.

Along the pipeline route, in-water work, ground-disturbing activities, and vegetation clearing related to other projects can affect aquatic habitats, fish, and water-dependent wildlife. Aquatic habitat disturbance would affect fish behavior, migration, feeding, and reproduction, and would increase rates of stress, injury, and mortality experienced by fish and other wildlife. Threatened, endangered, and other special status fish species may be particularly vulnerable to these ground-disturbing activities and the associated aquatic habitat disturbance. As described previously, the details of the other projects are not well known, so we cannot quantify the specific impacts of these projects or determine if these impacts would overlap with the impacts of the Project. Turbidity generated by the various projects is generally not additive because the generation of plumes is uncommonly synchronized and spatially overlapping. Sedimentation, however, would be additive at common settling points. Settling points within each stream are largely determined by flow dynamics within short stream segments. Consequently, the common deposition points are likely to be past and ongoing points where sediments accumulate. Additional sediment accumulation at these points is clearly an impact, but likely not a conversion of habitat type. Based on the Project's impacts on aquatic resources and the impacts of the other projects which are expected to be similar to those of the Project, we conclude that the resulting cumulative impact would not be significant.

Pacific Connector would cross the Klamath River using an HDD. As described previously, the use of an HDD significantly reduces the potential for impacts on a waterbody and any aquatic resources within or dependent on that waterbody. Should an inadvertent release of drilling fluid occur into the Klamath River, aquatic habitat and fish would be temporarily affected. The removal of the four dams along the Klamath River would temporarily and permanently significantly affect fish and other aquatic resources in the river. Short-term impacts on aquatic resources would result from increases in turbidity and long-term beneficial impacts would result from the permanent modification of (and access to) stream reaches due to changes in flow. The closest dam removal planned to the Project's crossing of the Klamath River would occur about 20 miles downstream. Because the dam is 20 miles downstream, the impacts of its removal would not be additive with the impacts of the Project; therefore, we conclude that the Project would not significantly contribute to an adverse cumulative impact.

4.14.1.5 Land Use

There are no other projects in Coos Bay whose impacts when combined with those of the LNG terminal would result in a significant cumulative impact on land use. As described previously, the Project and the other projects identified in table 4.14-2 would cumulatively affect about 65,000 acres of land (about 2.5 percent of the total amount of land within the watersheds crossed by the Project). Affected lands support a number of uses including natural forest, silviculture, residential, grazing, commercial, agricultural, and industrial activities. Timber and forest management are commonplace in the region and are not, with the exception of growth of trees and installation of permanent aboveground facilities over the pipeline, prohibited or restricted by the Project. Clearing of forested areas for construction of the Pacific Connector pipeline would amount to less than nine percent of the acreage of timberlands affected by the BLM and Forest Service vegetation management projects listed in table 4.14-2. The acreage of forested land affected by the pipeline that would not be reforested (i.e., the permanent operational right-of-way and aboveground facilities) would constitute less than two percent of the timberlands affected by the BLM and Forest Service vegetation management projects listed in table 4.14-2. Overall, the impacts of the Project when combined with the impacts of the other projects would not result in a significant cumulative impact on land use.

4.14.1.6 Visual Resources and Recreation

The only projects listed in table 4.14-2 that involve new permanent aboveground facilities within the viewshed of the LNG terminal is the City of North Bend's Department of Human Services Building and the CTCLUSI Hollering Place. The non-jurisdictional SORSC would be located within the footprint of the LNG terminal site and is considered from a visual perspective as part of the LNG terminal site. Also, although not a permanent aboveground facility, the regular use of the Federal Navigational Channel by LNG carriers and associated project-related marine vessel traffic would also constitute an impact on the visual character of Coos Bay. The Department of Human Services Building is located less than a mile from the LNG terminal and may be visible from the same vantage points (viewpoints 6-10 as shown on figure 4.8-2); however, it is located on the developed Southwest Oregon Regional Airport property and is visually consistent with the existing industrial/commercial visual character. When complete, the CTCLUSI's Hollering Place would be located just over 2 miles southwest of the LNG terminal site along the community of Empire's shoreline. The LNG carries would occur frequently in Coos Bay and would be distinguishable from other marine traffic where the navigation channel is visible from vantage points in Charleston, Barview, Empire, and North Bend. As described in section 4.8.2, we conclude that the LNG terminal would have a significant impact on a limited number of viewers and locations around Coos Bay. Therefore, because the Project's impact on Coos Bay's visual character would be significant, a significant cumulative impact would result; however, we conclude that the impacts of the Human Services building, CTCLUSI's Hollering Place, and the increased marine traffic would not contribute to a greater impact on the visual character of Coos Bay.

As described previously, at least six timber sale projects affecting a total of over 5,000 acres of land have or would cross/overlap about six miles of pipeline construction right-of-way and workspace. It is also likely that an undeterminable amount of other timber-related activities; maintenance, commercial thinning, and timber management have or would cross/overlap pipeline construction right-of-way and workspace. A cumulative impact on visual resources would occur if visible impacts of these projects and the Project are observable from one or more shared vantage points. Numerous commenters including the Klamath Indian Tribe have expressed concern about an adverse cumulative impact on the visual character of the Project area. Commenters cited the spiritual and intrinsic value of potentially affected viewsheds. Timber-related activities, sales, and forest management are common practices in Oregon and their visual impacts can be observed across the landscape. The impact of the pipeline operational easement would resemble other utilities and forest access roads, and would not generally be out of character for the region. There would, however, be locations where the pipeline route would be in less developed and managed areas and its visual impact would be less common; but because of the remote siting, the number of possible viewpoints and receptors would be small. According to the Forest Service, the majority of the timber-related activities involve thinning younger stands to speed the development of late successional old-growth habitat in LSRs and on the Matrix lands. These thinning prescriptions would generally not result in large new openings in the forest canopy. Additionally, where the pipeline would cross remote and steep topography, locations where the permanently cleared operational easement would be visible would be limited. Therefore, we conclude that a cumulative impact would occur, but that this impact would not be significant.

Two projects - the Turkey Hill Solar Project and the transmission line associated with the Swan Lake Hydroelectric Pumped Storage Project - are located in the vicinity of the proposed Klamath Compressor Station. The compressor station would be painted with a color that blends with the hues of the surrounding landscape and the grounds would be landscaped to reduce visual impacts on area residents. Given the distance to the Turkey Hill Solar Project and Swan Lake Hydroelectric Pumped Storage Project transmission line (2.2 miles and 1.9 miles, respectively), and existing topography, we conclude that the impacts of these projects would not contribute to a significant cumulative impact on visual resources.

As described in comments to the Commission about the Project, Coos Bay provides numerous recreational opportunities including boating, fishing, crabbing, hiking, bird watching, and scenic viewing. The cumulative impacts of the Project and the other projects in Coos Bay on water quality, aquatic resources, and transportation, all of which affect recreational use of the bay would not be significant, so the cumulative impact on recreation in Coos Bay would not be significant. Recreational users of Coos Bay may be inconvenienced by delays associated with the increased use of the channel by LNG carriers and other Project-related marine traffic; however, no other additional long-term marine traffic has been identified as occurring in the bay. Dredging activities associated with the other projects in Coos Bay would temporarily increase traffic in the channel, but any cumulative impact would not be significant as the dredging activities would be temporary and periodic. These inconveniences when added to existing marine traffic would contribute to a cumulative impact; but this impact would not significantly impair a user's ability to participate in recreation activities in the bay.

Southern and West-central Oregon provide the public a large number of diverse recreational opportunities including camping, hiking, off-road vehicle trails, hunting, fishing, boating, and wildlife watching. Cumulative impacts along the pipeline route could occur if the Project and one or more other projects affect the same recreational resource (trail, natural area, etc.). However, none of the other projects identified along the pipeline route are expected to significantly reduce overall recreational opportunities for the public. As described previously, the Project would not significantly affect recreation. Based on the impacts of the Project and other projects, we conclude that there would not be a significant cumulative impact on recreation occurring along the pipeline route.

4.14.1.7 Socioeconomics

Constructing the Project would temporarily impact the socioeconomic character of the region as described in section 4.9. The socioeconomic impacts of the Project would occur because of the introduction of a new construction workforce, which would affect total population, available housing, and tax revenue during the period of construction; and would draw on existing public services such as police, fire, and healthcare. We do not anticipate that the other projects occurring in the watersheds affected by the Project would require a significant influx of non-local labor because these projects are common to the region. Therefore, we conclude that the other projects would not meaningfully contribute to a cumulative impact on the socioeconomic character of the region. However, as described in section 4.9, the Project would result in a significant impact on housing in Coos County during construction; therefore, a significant cumulative impact would result.

4.14.1.8 Transportation

The proposed modification of the Coos Bay Federal Navigational Channel as well as other projects in Coos Bay would require the use of marine vessels. As described in section 4.10.1, constructing and operating the Project would increase the number of vessels in Coos Bay as a result of the addition of approximately 70 water deliveries via a mix of ocean-going vessels and barges during the two-year construction period and 120 LNG carriers per year transiting to and from the Jordan Cove LNG terminal during its operation. This increase in marine traffic combined with current deep-draft vessel traffic would be less than historic ship traffic through the channel. In addition, in a Letter of Recommendation for the Project the Coast Guard considers that the Coos Bay channel to be suitable for the proposed type and frequency of LNG carriers traffic (see appendix B). Therefore, we conclude that while some marine traffic might be temporarily inconvenienced, the passage of construction-related and LNG carriers through the channel would not have significant or long-term impacts on other boats in Coos Bay. Numerous commenters have expressed concern that a modified navigational channel would induce additional marine vessel traffic. To our knowledge, additional marine vessel traffic utilizing the modified channel has not been proposed; therefore, we cannot speculate on unknown future impacts. However, the Coast Guard and other authorities would continue to regulate any future marine traffic within the channel.

Of the projects identified in table 4.14-2, timber-related activities may result in use of large, heavy equipment and log trucks on local and regional roadways. Other projects planned for the area are road improvements or other relatively small-scale projects not requiring a significant workforce. As described in section 4.10, the Project would contribute vehicle trips to Project-area roads during construction, and would affect these roads and their users. Together, the Project and other projects would result in a cumulative impact on area roads and traffic; however, the degree of impact would depend on the extent of overlap in time and space during active construction of the projects.

4.14.1.9 Cultural Resources

Cumulative impacts on cultural resources would only occur if other projects were to share (and impact) the same APE as the Project. Several forest- and timber-management projects listed in table 4.14-2 would share the same APE as the Project and could contribute to a cumulative impact on cultural resources. The federal agencies managing these projects would be required to follow the regulatory requirements of 36 CFR Part 800 and/or other implementing regulations. Under these regulations, the lead federal agency, in consultation with the SHPO, would identify historic properties in the project APE, assess potential effects, and resolve adverse effects through an agreement document that outlines a treatment plan.

We received numerous and detailed comments from Indian tribes, particularly the CTCLUSI, expressing and reiterating concern about the Project’s contribution to a cumulative impact on cultural resources. In their comments, the CTCLUSI state that the extensive geotechnical work (e.g., drilling and core sampling) that has occurred at the LNG terminal site over the three iterations of this Project has adversely affected cultural resources. We acknowledge that a considerable amount of geotechnical work has occurred at the LNG terminal site, but we are not aware of any documented impacts on cultural resources resulting from geotechnical work at this site. Ingram Yard and the South Dunes areas were surveyed by archeologists and no historic properties were identified. As described previously, we consider the impacts of past projects as part of the environmental baseline, but are addressing these comments because of the sensitive nature of cultural resources and the significance attributed to them by the CTCLUSI. Once construction of the LNG terminal is complete, the site would be permanently transformed into an industrial facility and would not be subject to impacts from other projects; therefore, a cumulative impact on cultural resources would not occur.

As described previously, the Project would have adverse impacts on historic properties. Further, surveys of both the LNG terminal facilities and pipeline are incomplete and may result in the identification of additional historic properties. Also, an ethnographic study of the Project and the identification of traditional cultural resources is incomplete. One known TCP is present in Coos Bay and overlies the Project facilities. Once evaluations are complete, adverse effects on historic properties would be resolved by implementing the procedures outlined in a Project-specific MOA following completion of the Section 106 process pursuant to the NHPA. The MOA would also include provisions for inventorying areas not yet surveyed to identify historic properties that may be affected by the Project. Although the required review processes are not complete, we conclude, given state and federal laws and regulations protecting cultural resources and the other projects affecting the Project's APE, that any cumulative impact on cultural resources would not be significant.

4.14.1.10 Air Quality, Climate Change, and Noise

Air Quality

Constructing the Project, as well as the other projects listed in table 4.14.2, would temporarily affect air quality due to emissions from the combustion engines used to power construction equipment, vehicle emissions traveling to and from the project sites, deliveries of construction materials, and from fugitive dust emissions resulting from earth-disturbing activities and equipment movement on dirt roads. The potential for cumulative construction emissions impacts would be greatest during site preparation when fugitive dust production would likely be at its peak. Emissions from equipment engines and vehicles operating concurrently would also result in cumulative air quality impacts in the local area. Most of the reasonably foreseeable projects are located outside of the geographic scope for cumulative construction emissions. The only projects that would potentially overlap with the geographic scope for cumulative construction emissions are associated with the non-jurisdictional Project facilities, COE Coos Bay Federal Navigation Channel Maintenance Dredging, the Port's Channel Modification Project, Southwest Oregon Regional Airport Expansion, and various BLM and Forest Service vegetation maintenance projects.

The primary projects in the construction air emissions geographic scope of the Jordan Cove LNG Project with the potential to be constructed in a similar timeframe are the COE Coos Bay Navigation Channel Maintenance Dredging Project and the Southwest Oregon Regional Airport Extension. The COE Maintenance Dredging Project would result in the short-term release of criteria pollutants from the operation of dredges. Estimated emissions of criteria pollutants would not result in exceedances of the NAAQS in the Project area. Furthermore, the cumulative impact analysis conducted as part of the 2015 COE EA (which included the Southwest Oregon Regional Airport Extension and the originally proposed Jordan Cove Project) found that no substantial cumulative effects would occur. Based on this information, and the implementation of mitigation measures discussed above, cumulative air quality impacts during construction of the Jordan Cove LNG Project would not be significant.

The majority of the pipeline would be located in an attainment area for the NAAQS. However, a small portion of the pipeline would be located in a PM10 maintenance area and a PM2.5 nonattainment area. Due to the de minimis construction emissions that would not exceed General Conformity thresholds, and the limited scope of Project construction in the nonattainment area, the Project is not expected to contribute discernable cumulative impacts on the nearby nonattainment areas or maintenance areas. To minimize impacts due to construction emissions during pipeline construction, Pacific Connector would implement mitigation measures to minimize construction impacts on air quality, including implementing a fugitive dust control plan, compliance with applicable EPA mobile source emission performance standards, and use of equipment manufactured to meet air quality standards.

The projects identified within the construction geographic scope of the pipeline include various BLM and Forest Service vegetation maintenance projects and the Klamath Dam Removal. While these projects would likely cause minor short-term air quality impacts, it is unlikely that they would cause significant cumulative impacts when combined with the pipeline.

Operation of the LNG facilities would have long-term effects on air quality due to operational emissions associated with the facilities. Jordan Cove would be required to obtain a Title V Operating Permit for Project operation, and would be required to comply with any operating conditions of this permit, including measures to reduce emissions.

A cumulative ambient air quality analysis was conducted that showed that operation of the LNG facilities, when considered along with existing sources and background air quality, would not result in an exceedance of the NAAQSs. The only project identified within the 50 km geographic scope for cumulative operational air quality impacts is the non-jurisdictional LNG carriers. Emissions and exhaust parameters from the LNG carriers were included in the cumulative modeling analysis starting from the process of transit, berthing, to hoteling and LNG loading, and finally to connecting the towlines and de-berthing. Based on our air quality analysis, operational cumulative impacts associated with the Jordan Cove LNG Project are expected to be minor.

Operation of the Pacific Connector Pipeline Project would have long-term effects on air quality due to emissions from the Klamath Compressor Station. The compressor station would be located in an attainment area for the NAAQS. The compressor station emissions would be below the General Conformity *de minimis* thresholds; therefore, the compressor station would not significantly impact nonattainment or maintenance areas.

Pacific Connector would require an Air Contaminant Discharge Permit from the ODEQ to construct the Klamath Compressor Station and a Title V Operating Permit to operate the compressor station. The permits for this facility would include mitigation measures and operational requirements to ensure that air emissions do not exceed the permit requirements and that the facilities would be operated in compliance with applicable air quality regulations.

Pacific Connector completed air quality modeling for the operational emissions of the Klamath Compressor Station. The results of the air quality modeling are summarized in section 4.12 and provide the estimated facility air quality impacts combined with background air quality concentrations for NO_2, CO_2, PM_{10}, $PM_{2.5}$, and SO_2, and include existing operating air emission sources. Based on this analysis, the operation of Klamath Compressor Station would not result in an exceedance of any of the NAAQS. No projects were identified within the geographic scope of the Klamath Compressor Station that would result in operational air quality impacts. Therefore, the Project would not result in cumulative impacts on air quality from the operation of the Pacific Connector Pipeline Project.

Climate Change and Greenhouse Gas Emissions

Climate change is the variation in climate (including temperature, precipitation, humidity, wind, and other meteorological variables) over time, whether due to natural variability, human activities, or a combination of both, and cannot be characterized by an individual event or anomalous weather pattern. For example, a severe drought or abnormally hot summer in a particular region is not a certain indication of climate change. However, a series of severe droughts or hot summers that statistically alter the trend in average precipitation or temperature over decades may indicate climate change. Recent research has begun to attribute certain extreme weather events to climate change (USGCRP 2018).

The leading U.S. scientific body on climate change is the U.S. Global Change Research Program (USGCRP), composed of representatives from thirteen federal departments and agencies.[231] The Global Change Research Act of 1990 requires the USGCRP to submit a report to the President and Congress no less than every four years that "1) integrates, evaluates, and interprets the findings of the Program; 2) analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and 3) analyzes current trends in global change, both human induced and natural, and projects major trends for the subsequent 25 to 100 years." These reports describe the state of the science relating to climate change and the effects of climate change on different regions of the U.S. and on various societal and environmental sectors, such as water resources, agriculture, energy use, and human health.

In 2017 and 2018, the USGCRP issued its *Climate Science Special Report: Fourth National Climate Assessment*, Volumes I and II (Fourth Assessment Report) (USGCRP, 2017; and USGCRP, 2018, respectively). The Fourth Assessment Report states that climate change has resulted in a wide range of impacts across every region of the country. Those impacts extend beyond atmospheric climate change alone and include changes to water resources, transportation, agriculture, ecosystems, and human health. The U.S. and the world are warming; global sea level is rising and acidifying; and certain weather events are becoming more frequent and more severe. These changes are driven by accumulation of GHG in the atmosphere through combustion of fossil fuels (coal, petroleum, and natural gas), combined with agriculture, clearing of forests, and other natural sources. These impacts have accelerated throughout the end 20th and into the 21st century (USGCRP 2018).

Climate change is a global phenomenon; however, for this analysis, we will focus on the existing and potential cumulative climate change impacts in the Project area. The USGCRP's Fourth Assessment Report notes the following observations of environmental impacts are attributed to climate change in the Northwest region (USGCRP, 2017; USGCRP, 2018):

- the region has warmed nearly 2°F since 1900;
- warmer winters have led to reductions in mountain snowpack, resulting in drought, water scarcity, and large wildfires;
- declines in dissolved oxygen in streams and lakes have caused fish kills and loss of aquatic species diversity; and
- moderate to severe spring and summer drought areas have increased 12 percent to 14 percent.

[231] The USGCRP member agencies are: Department of Agriculture, Department of Commerce, Department of Defense, Department of Energy, Department of Health and Human Services, Department of the Interior, Department of State, Department of Transportation, Environmental Protection Agency, National Aeronautics and Space Administration, National Science Foundation, Smithsonian Institution, and U.S. Agency for International Development.

The USGCRP's Fourth Assessment Report notes the following projections of climate change impacts in the Project region with a high or very high level of confidence[232] (USGCRP, 2018):

- increases in stream temperature indicate a 22 percent reduction in salmon habitat by the late 20th century;
- more frequent severe winter storms, which may contribute to storm surge, large waves, coastal erosion, and flooding in low-lying coastal areas;
- the warming trend is projected to be accentuated in certain mountain areas in the Northwest in late winter and spring, further exacerbating snowpack loss and increasing the risk for insect infestations and wildfires;
- longer periods of time between rainfall events may lead to declines in recharge of groundwater and decreased water availability, and responses to decreased water availability, such as increased groundwater pumping, may lead to stress or depletion of aquifers and strain on surface water sources; and
- increases in evaporation and plant water loss rates may alter the balance of runoff and groundwater recharge, which would likely to lead to saltwater intrusion into shallow aquifers.

It should be noted that while the impacts described above taken individually may be manageable for certain communities, the impacts of compound extreme events (such as simultaneous heat and drought, wildfires associated with hot and dry conditions, or flooding associated with high precipitation on top of saturated soils) can be greater than the sum of the parts (USGCRP 2018).

The GHG emissions associated with construction and operation of the Project are identified in section 4.12.1.1 for the Jordan Cove LNG Project and section 4.12.1.2 for the Pacific Connector Klamath Compressor Station and pipeline. Both the Jordan Cove LNG Project and the Pacific Connector Klamath Compressor Station and pipeline would remain below PSD major source thresholds and are therefore not required to conduct a Best Available Control Technology analysis for mitigating GHG emissions. The construction and operation of the Project would increase the atmospheric concentration of GHGs, in combination with past, current, and future emissions from all other sources globally and contribute incrementally to future climate change impacts. Project emissions would contribute incrementally to future climate change impacts.

Currently, there is no universally accepted methodology to attribute discrete, quantifiable, physical effects on the environment to the Project's incremental contribution to GHGs. We have looked at atmospheric modeling used by the EPA, National Aeronautics and Space Administration, the Intergovernmental Panel on Climate Change, and others and we found that these models are not reasonable for project-level analysis for a number of reasons. For example, these global models are not suited to determine the incremental impact of individual projects, due to both scale and

[232] The report authors assessed current scientific understanding of climate change based on available scientific literature. Each "Key Finding" listed in the report is accompanied by a confidence statement indicating the consistency of evidence or the consistency of model projections. A high level of confidence results from "moderate evidence (several sources, some consistency, methods vary and/or documentation limited, etc.), medium consensus." A *very* high level of confidence results from "strong evidence (established theory, multiple sources, consistent results, well documented and accepted methods, etc.), high consensus." https://science2017.globalchange.gov/chapter/front-matter-guide/

overwhelming complexity. We also reviewed simpler models and mathematical techniques to determine global physical effects caused by GHG emissions, such as increases in global atmospheric CO_2 concentrations, atmospheric forcing, or ocean CO_2 absorption. We could not identify a reliable, less complex model for this task and we are not aware of a tool to meaningfully attribute specific increases in global CO_2 concentrations, heat forcing, or similar global impacts to project-specific GHG emissions. Similarly, it is not currently possible to determine localized or regional impacts from GHG emissions from the Project. Absent such a method for relating GHG emissions to specific resource impacts, we are not able to assess potential GHG-related impacts attributable to this project. Without the ability to determine discrete resource impacts, we are unable to determine the significance of the Project's contribution to climate change.

We have not been able to find any GHG emission reduction goals established at the federal level.[233] The State of Oregon has set GHG reduction goals with a state-wide target of 51 million metric tons of CO_2e by 2020 (a 10 percent reduction from 1990 levels), and 14 million metric tons of CO_2e by 2050 (a 75 percent reduction from 1990 levels) (Oregon Global Warming Commission 2017). The Oregon Global Warming Commission projects that Oregon will fall short of these goals without additional legislative action. Direct emissions from the Jordan Cove LNG and Pacific Connector Pipeline Projects would result in annual CO_2e emissions of about 2.14 million metric tons of CO_2e, which would represent 4.2 percent and 15.3 percent of Oregon's 2020 and 2050 GHG goals, respectively.

Noise

the Project would involve various types of equipment and activities, including pile driving, dredging, and drilling. These activities would temporarily increase noise in the surrounding areas. Projects listed in table 4.14-2 that are located within the geographic scope that could contribute to a cumulative noise impact include non-jurisdictional Project facilities, COE Coos Bay Federal Navigation Channel Maintenance Dredging, the Port's Channel Modification Project, Southwest Oregon Regional Airport Expansion, various BLM and Forest Service vegetation maintenance projects, and the Klamath Dam Removal. Based on the schedule and proximity of the other projects, there may be some cumulative construction noise impacts. The exact level of noise impacts that would occur from the projects identified in table 4.14-2 is not known; however, most construction is expected to take place during daytime hours and would be intermittent rather than continuous. Construction noise would primarily last for short periods and would vary as the equipment moves along the construction spread.

To minimize the Project's contribution to a cumulative impact, Jordan Cove would implement mitigation measures including selecting low-noise alternative equipment, restricting time of day for construction, installing temporary noise barriers, enclosing equipment, and preparing site-specific noise management plans. The HDD or DP crossing method would be used to cross under six waterbodies and a powerline/steep slope location along the BPA Powerline Corridor. Per our recommendation in section 4.12.2, Pacific Connector would be required to ensure that noise attributable to drilling operations does not exceed an 55 L_{dn} dBA. Because construction noise is temporary and would dissipate with distance, and the applicants would implement BMPs and noise

[233] The national emissions reduction targets expressed in the EPA's Clean Power Plan and the Paris climate accord are pending repeal and withdrawal, respectively.

mitigation as well as adhere to our recommendations, we conclude cumulative impacts on noise levels would not be significant.

Operation of the Jordan Cove LNG Project and Pacific Connector's Klamath Compressor Station would result in long-term increases in noise levels in the vicinity of these aboveground facilities. Noise at the Jordan Cove LNG Project would be associated with refrigerant gas turbines/compressors, boil-off gas compressors/motors, various pumps/motors, steam turbine generators, air-cooled condensers, and blow-down events. Operational noise was modeled at four NSAs near the Jordan Cove LNG terminal as discussed in section 4.12. This modeling indicated noise attributable to the LNG terminal at the NSAs would be within the FERC's limit of L_{dn} 55 dBA. Overall predicted noise increases at one of the NSAs would be noticeable but are not likely to be significant. Noise increases at the remaining three NSAs are unlikely to be perceptible. None of the other projects located within 1 mile of the Jordan Cove LNG Project are expected to have any operational noise impacts; therefore, operation of the Project would not contribute to broader cumulative noise impacts.

Underwater noise levels from large commercial ships are fairly consistent, ranging from about 177 to 188 dB re 1 µPA at 1 meter. Considering peak noise levels and cumulative sound exposure, vessel noise is not expected to exceed the NMFS guideline thresholds for the onset of permanent threshold shift for cetaceans and pinnipeds. Total underwater noise from maintenance dredging, LNG carriers, tugs, and other marine vessels would increase during operation of the Project; however this cumulative impact would not be significantly greater than existing underwater noise levels in Coos Bay.

Noise at the Klamath Compressor Station would be associated with gas turbines, compressors, pumps, cooling fans, and blowdown events. Operational noise was modeled at five NSAs near the Klamath Compressor Station. This modeling indicated noise attributable to the compressor station at the NSAs would be within FERC's limit of L_{dn} 55 dBA. Pacific Connector would adopt the acoustic design recommendations for the Klamath Compressor Station outlined in the noise study report. Overall predicted noise increases at NSAs #5 and #6 are unlikely to be perceptible based upon the existing background noise. The predicted noise increases at the remaining NSAs would be noticeable but are not likely to be significant. None of the known existing or future projects located within 1 mile of the Klamath Compressor Station are expected to have any operational noise impacts; therefore, operation of the Pacific Connector Pipeline Project would not contribute to broader cumulative noise impacts.

4.14.2 Cumulative Impact Conclusions

The impacts of the Project when added to those of the other projects would result in cumulative impacts on the environment. For the federal projects, existing laws and regulations protect waterbodies and wetlands, threatened and endangered species, and historic properties, and limit impacts on air and noise. In addition, Federal land-managing agencies, such as the BLM and Forest Service, have requirements in their LRMPs and RMPs to protect resources on their lands. Given the BMPs and impact avoidance, minimization, and mitigation measures that would be implemented; and federal and state laws and regulations protecting the environment; we conclude that with the exception of significant impacts on visual resources and available housing in the Coos Bay area, cumulative impacts on the environment would not be significant.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS OF THE ENVIRONMENTAL ANALYSIS

The conclusions and recommendations presented below are those of the FERC environmental staff. They were prepared in cooperation with the BLM, Forest Service, Reclamation, DOE, COE, EPA, FWS, NOAA, Coast Guard, USDOT, and Coquille Tribe. However, these agencies may present their own conclusions and recommendations in their respective and applicable records of decision. The cooperating agencies can adopt this final EIS consistent with 40 CFR 1501.3 if, after an independent review of the document, they conclude that their requirements have been satisfied. Otherwise, they may elect to conduct their own supplemental environmental analyses.

Based on our review as described in the preceding sections, we conclude that constructing and operating the Project would result in temporary, long-term, and permanent impacts on the environment and a number of significant environmental impacts; however, a majority of impacts would be less than significant due to the implementation of proposed and recommended impact avoidance, minimization, and mitigation measures. As part of our review we developed measures that would appropriately and reasonably further avoid, minimize, or mitigate environmental impacts resulting from construction and operation of the proposed Project. Therefore, we recommend that these measures be attached as conditions to any authorizations issued by the Commission.

5.1.1 Geology

The LNG terminal would be located in Coos Bay within the seismically active CSZ. Numerous comments were received by the Commission about the potential affects to the LNG terminal from a tsunami. Recognizing the concern, and as described in the LNG safety and reliability section, Jordan Cove designed the terminal facilities consistent with maximum tsunami run-up elevations and considered tsunami wave heights and inundation elevations; therefore, FERC staff agrees that the equipment elevations that Jordan Cove provided are suitable for the proposed LNG terminal site. We also conclude that the LNG terminal would be able to withstand without damage a storm surge during a 500-year storm event. Although much of the pipeline would be located in the CSZ, we conclude, based on a review of potential impacts, historical data, seismic hazard mapping, peak horizontal ground acceleration values, pipeline tolerances, and Pacific Connector's proposed impact avoidance and minimization measures, that construction and operation the Project would not be significantly affected by potential geological hazards including ground shaking, surface ruptures, soil liquefaction and lateral spreading, landslides, and slope failures. Additionally, about 90 miles of pipeline would cross the Cascade and Klamath mountain ranges, which increases concerns for erosion, landslides, and slope failures. However, we conclude, based on our evaluation of the Project and Pacific Connector's proposed construction methods including its implementation of erosion control devices and other impact avoidance and minimization measures, that construction and operation of the pipeline would not be significantly affected. To ensure landslides in six moderate risk areas are further minimized, we are recommending that Pacific Connector file final monitoring protocols and mitigation measures. Furthermore, due to the absence of mining and other mineral extraction activities along the pipeline route, we conclude that these activities would also not be affected.

5.1.2 Soils and Sediments

Constructing and operating the LNG terminal would permanently impact underlying soils, including sands, fine sands, silt loams, and dune lands. Erosions control measures compliant with our Plan and Procedures would be implemented to control and minimize erosion and sedimentation. The pipeline would be located across numerous soil types including soils prone to erosion and compaction. The pipeline would also be located across about 149 miles of soils that have been rated as having reclamation sensitivity or poor revegetation potential. Impacts on soils would be reduced by Pacific Connector's implementation of erosion control measures and its use of best management practices including spill prevention and response procedures. Furthermore, Pacific Connector would install permanent erosion control measures and, if necessary, decompact soils (ripping) and implement other soil remediation measures.

To address contaminated soils at the terminal site, Jordan Cove would develop a disposal plan consistent with state requirements. An assessment of these soils concluded that residual contaminants did not exceed ODEQ screening levels for worker exposure. To ensure potential contamination is fully addressed, we are also recommending that Jordan Cove consult with the ODEQ regarding existing soil and groundwater contamination at affected sites.

The marine loading facilities and LNG carrier berth would permanently modify the Coos Bay shoreline and access to the navigational channel. A study of vessel wakes concludes that operating the LNG terminal (and LNG carriers) would not increase shoreline impacts. The marine berth would be constructed to account for concerns about LNG carrier propeller wash affecting the operational ability of the terminal.

Based on our review, we conclude that constructing and operating the Project would temporarily and permanently impact soils; however, based on the proposed construction and operations procedures and methods and the impact avoidance, minimization, and mitigation measures that would be implemented, these impacts would not be significant.

5.1.3 Water Resources and Wetlands

5.1.3.1 Groundwater

Based on the characteristics of groundwater underlying the LNG terminal site, our determination that the Project would not affect nearby (about 3,500 feet north of the terminal) CBNBWB water withdrawal wells, and Jordan Cove's implementation of BMPs and impact avoidance, minimization, and mitigation measures to address potential inadvertent releases of equipment related fluids, we conclude that impacts on groundwater resources at the LNG terminal site may occur, but would be minimized to the extent practicable, and would not be significant. Constructing and operating the pipeline could temporarily and/or permanently affect springs, seeps, and wells. These resources could experience changes in quantity (flow and volume) and quality (contamination due to the inadvertent release of equipment related fluids). To minimize impacts on these resources, Pacific Connector would implement measures described in its *Groundwater Supply Monitoring and Mitigation, SPCC Plan,* and *Contaminated Substances Discovery Plans.* Therefore, we conclude that constructing and operating the Project would not significantly affect groundwater resources.

5.1.3.2 Surface Water

Creating the LNG marine berth and access channel, as well as modifying the navigation channel would temporarily increase turbidity and sedimentation in Coos Bay, affecting overall water quality. The increased turbidity and sedimentation would occur as a result of initial dredging activities over varying distances depending on hydrological conditions and then again periodically in association with maintenance dredging. LNG carriers traversing the navigational channel and operating in the marine berth would not have a measurable effect on water quality other than a minor increase in turbidity along the bottom of the berth due to propeller wash. LNG carrier water withdrawals and discharges associated with ballast and normal engine operations during LNG loading would recirculate over 3 million gallons of water per hour. LNG carrier operations are not expected to significantly affect water quality (e.g., temperature, salinity, or dissolved oxygen levels) in Coos Bay.

The pipeline would be constructed across or in close proximity to 352 waterbodies; 270 intermittent streams and ditches, 69 perennial waterbodies, and several ponds and other surface water features. Pacific Connector developed a *Stream Crossing Risk Analysis* that, in conjunction with following their *Procedures*, would avoid and minimize impacts on waterbodies. Waterbodies would be crossed during low-flow periods whenever possible and within ODFW recommended in-water construction windows.

Pacific Connector would cross five major waterbodies (defined as those over 100 feet wide) including two crossings of Coos Bay and one at the Coos River using HDD methods and two locations on the South Umpqua River using DP and diverted open-cut methods. The Rogue River and Klamath River would also be crossed via HDD methods. Pacific Connector prepared an *HDD Contingency Plan and Failure Procedures* that describes measures to deal with HDD failure and contain an inadvertent release of drilling mud during the HDD process.

Other than the limited number of HDD, DP, bores, and one diverted open cut, all other crossings would use dry open-cut methods (including dam-and-pump and fluming). These methods would reduce the potential for turbidity from flowing water disturbance during active flow construction. Impacts from dry crossings would be temporary and localized, with most construction occurring at a single crossing within a 48-hour period.

The pipeline would cross three rivers listed on the Nationwide Rivers Inventory: the North Fork of the Coquille River, the East Fork of the Coquille River, and the South Umpqua River. The pipeline would cross the North Fork of the Coquille River (at about MP 23) and the East Fork of the Coquille River (at about MP 30) using a dry open-cut method. Pacific Connector proposes to use a DP and diverted open cut, respectively, at the two crossings of the South Umpqua River (at about MPs 71 and 95).

During construction, Pacific Connector would use a total of about 75,000 gallons per day of water for dust control. All required permits would be obtained prior to water use from both private and public water sources, which would stipulate allowable flow rates of withdrawal and discharge. Based on Jordan Cove's proposed dredging and vessel operation methods, Pacific Connector's proposed waterbody crossing and restoration methods, as well as the required impact avoidance and minimization measures (including implementation of erosion controls, water management plans, hazardous substance management procedure, and construction timing), we conclude that the Project would not result in significant impacts on surface water resources.

5.1.3.3 Wetlands

Constructing and operating the LNG terminal would affect about 86.1 acres of wetlands and result in the loss of about 22.3 acres of wetlands. Constructing and operating the pipeline would temporarily affect about 112.2 acres of wetlands and result in long-term impacts on about 5.8 acres of wetlands.

Jordan Cove and Pacific Connector developed a *Compensatory Wetland Mitigation Plan* to address unavoidable impacts on wetlands. Impacts on freshwater wetland resources would be mitigated via the Kentuck project site, and impacts on estuarine wetland resources would be mitigated via the Eelgrass Mitigation site and Kentuck project site (see Jordan Cove and Pacific Connector's *Compensatory Wetland Mitigation Plan*). These mitigation plans are still being reviewed by the COE, ODSL, and applicable federal and state agencies. Approval of these mitigation plans by these agencies would be required prior to the issuance of federal and state wetland permits.

Based on our review of the Project and Jordan Cove and Pacific Connector's implementation of measures to reduce impacts on wetlands, we conclude that constructing and operating the Project would not significantly affect wetlands.

5.1.4 Vegetation

Constructing and operating the Project would affect over 4,000 acres of vegetation. Over 2,000 acres of forested vegetation including about 773 acres of LSOG forest would be cleared and experience long-term and permanent impacts. However, most of the vegetation types affected by the Project are common and widespread in the region. The temporary and permanent clearing of vegetation would affect soils, wildlife, and water resources; would result in the creation of forest "edges"; and could increase the introduction and spread of exotic and invasive species. To reduce the impacts of clearing vegetation along the pipeline route, Pacific Connector would implement erosion control devices and numerous other measures as described in its *ECRP*, *Fire Prevention and Suppression Plan*, and its *Integrated Pest Management Plan.* Based on the types and amounts of vegetation that would be affected by the Project, the measures that would be implemented to avoid, minimize, and mitigate the resulting impacts, our recommendation for Pacific Connector to develop a final *Integrated Pest Management Plan*, and the abundance of similar vegetation in the affected watersheds, we conclude that constructing and operating the Project would have permanent but not significant impacts on vegetation.

5.1.5 Wildlife and Aquatic Resources

Over 600 species of terrestrial and aquatic wildlife including amphibians, reptiles, birds, fish, and mammals occur in the Project area. Constructing and operating the Project would temporarily and permanently affect these species. Wildlife would avoid and be displaced by construction activities and changes to habitat caused by the Project. Avoidance, displacement, and impacts on other behaviors as well as the loss of habitat would increase the rates of stress, injury, and mortality experienced by wildlife. Additionally, we concluded that operational noise from the LNG terminal may affect terrestrial and aquatic wildlife depending on their proximity to the terminal and each species' tolerance for increased noise. We also conclude that the LNG terminal would not significantly affect mammals currently occupying the North Spit. To further minimize impacts on wildlife and aquatic resources from terminal lighting, we are recommending that Jordan Cove document consultations with appropriate resource agencies and develop a final lighting plan, as well as develop a final *Fish Salvage Plan* and a *Hydrostatic Test Plan* that requires that any water withdrawal from a flowing stream does not exceed an instantaneous flow reduction of more than 10 percent of stream flow. Regarding potential impacts on wildlife and aquatic species due to increased marine traffic (and potential fuel and/or equipment fluid releases), we conclude that impacts on migratory birds and aquatic species would be low and not significant. We also conclude that entrainment and impingement from LNG carrier water intakes at the terminal would not have substantial adverse effects on any marine phase of aquatic resources (e.g., the juvenile stage of salmonids) or their food sources. With the exception of forested habitats and associated wildlife, impacts on wildlife and aquatic resources would generally be temporary. To minimize impacts on wildlife and aquatic resources, the applicants would implement numerous best management practices and impact avoidance and minimization measures. Therefore, based on the implementation of these measures, the characteristics of wildlife and aquatic species in the Project area, and the applicant's proposed construction and operation procedures and methods, we conclude that the Project would not significantly impact wildlife and aquatic resources.

5.1.6 Threatened, Endangered, and Other Special Status Species

The Project would be located across lands with habitats supporting 34 federally-listed and proposed threatened and endangered species. Based on surveys conducted by the applicants, our assessment of these species and impacts on them resulting from construction and operation of the Project, and in consultation with the FWS and NMFS, we have determined that the Project is not likely to adversely affect 21 of the 34 identified threatened and endangered species; and is likely to adversely affect 13 of the 34 identified threatened and endangered species. The threatened species MAMU, NSO, green sturgeon (Southern DPS), Pacific eulachon (Southern DPS), coho salmon (SONCC), coho salmon (Oregon Coast ESU), vernal pool fairy shrimp, and Kincaid's lupine are likely to be adversely affected. The endangered species Lost River sucker, shortnose sucker, Applegate's milk-vetch, and Gentner's fritillary are also likely to be adversely affected. The proposed threatened Pacific fisher (West Coast DPS) is also likely to be adversely affected. At this time, the applicants have not proposed measures to mitigate these impacts.

To ensure impacts on federally listed threatened and endangered species are sufficiently minimized, we are making several recommendations concerning noise, construction methods, and workspace. Whales may be affected by construction-related noise; therefore, we are recommending that Jordan Cove prepare a Marine Mammal Monitoring Plan that identifies the measures that would be implemented to reduce noise impacts and to ensure compliance with NMFS underwater noise criteria pertaining to listed whales. We are also recommending that Pacific Connector adhere to FWS-recommended timing restrictions concerning MAMU stands and NSO activity centers. Lastly, we are recommending that Pacific Connector prepare a Klamath Basin suckers fish salvage plan, and that workspace be eliminated to avoid impacts on Gentner's fritillary.

In compliance with Section 7 of the ESA, we are preparing a BA. This BA will be submitted to the FWS and the NMFS prior to the issuance of the final EIS. Along with the BA, we will request the initiation of formal consultation with the FWS and NMFS. The BA will be appended to the final EIS. The BA will request formal consultation with the FWS and NMFS. In response to our BA, the FWS and NMFS would then issue biological opinions where they will determine if the Project would likely jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. To ensure compliance with the ESA, we are recommending that construction not occur until consultation is complete. Concerning state-listed species and other species of concern, we conclude that constructing and operating the Project would not significantly affect these species.

5.1.7 Land Use

The Project would temporarily and permanently affect numerous land uses including managed and unmanaged forest, industrial/commercial (including utility), unmanaged (open), residential, agricultural (pasture, row crop, and other), recreational, timber, transportation (roads and highways), and range. The Project would also cross lands managed by the COE, Forest Service, BLM, and Reclamation. The LNG terminal site comprises primarily privately controlled land consisting of a combination of brownfield decommissioned industrial facilities, an existing landfill requiring closure, and open land. With the exception of a COE easement and BLM land crossed by the industrial wastewater pipeline (within an existing utility corridor), no federal lands would be affected at the LNG terminal site. The nearest residence to the LNG terminal is about 1.1 miles away. The pipeline would cross a mix of private and public lands, with privately owned lands making up about two-thirds and federal lands accounting for about one-third, with some state lands also crossed. The pipeline and/or associated workspaces would be located within 50 feet of seven residences. Impacts on residences would be minimized by the implementation of residential best management practices. Following construction, lands temporarily affected would be able to resume previous land uses. Some permanently affected lands would also be able to resume previous land uses (agriculture, unmanaged, and range), and other lands would be permanently converted to industrial/commercial use, precluding the resumption of previous land uses. Based on the impacts on land uses, we conclude that constructing and operating the Project would not significantly affect land use.

The Jordan Cove LNG Project as well as approximately 50 miles of the pipeline route would be within Oregon's Designated Coastal Zone. The Project would need to obtain a finding from the ODLCD that the Project components within the coastal zone are consistent with the CZMA. To ensure compliance with the CZMA, we are recommending that construction not occur until the Project receives a consistency determination.

5.1.8 Recreation and Visual Resources

5.1.8.1 Recreation

Constructing and operating the Project could temporarily affect recreational use of areas located near the LNG terminal and pipeline. The Project could also affect nearby recreational services. Recreational areas near the LNG terminal could experience a temporary increase in noise. Some views from these areas would now include the LNG terminal and carriers. Individuals using recreational resources in the area could experience increased traffic and greater travel times. Visitors could also find that temporary accommodations (e.g., hotels, camp sites, and RV parks) in the Coos Bay area have less vacancy. During operation, recreational boaters may experience delays due to LNG carriers transiting to and from the LNG terminal; otherwise, no significant impacts are expected to occur to water-based recreation.

Visitors to recreation areas crossed by the pipeline would likely find construction to be an annoyance and an inconvenience; but this impact would be temporary. Recreational service providers may be affected if visitors avoid construction areas. However, due to the assembly line nature of pipeline construction, impacts on a specific area would generally be temporary as pipeline work in an area is completed and activities then move onto another area. Based on the expected impacts to recreation areas and services, we conclude that constructing and operating the Project would affect recreation; however, this effect would not be significant.

5.1.8.2 Visual Resources

The LNG terminal would be visible from numerous viewpoints within the North Bend/Coos Bay area. The most visible components of the LNG terminal would be the LNG storage tanks (180 feet tall) and nighttime lighting. Although adjacent properties have been developed and are currently being used for commercial purposes, the LNG terminal would be a major industrial facility considerably different from adjacent uses, and would permanently and significantly affect the visual character of Coos Bay's northern shoreline. Construction of the pipeline (use of heavy equipment and ground disturbance) and its impact on the viewshed would be temporary. Operation of the pipeline and the maintenance of an easement would permanently affect the viewshed; however, due to the remoteness of the Project area and the presence of other linear infrastructure, powerlines, highways, and roads, which have a similar impact on the viewshed, we conclude that construction and operation of the pipeline would not significantly affect visual resources.

5.1.9 Socioeconomics

Constructing and operating the Project would generate tax revenues for local and state governments. The Project would also create considerable temporary employment opportunities many of which may be filled by local workers. In addition, the purchasing of supplies and materials as well as use of other services would result in a temporary positive impact for local businesses. Constructing the Project would temporarily impact demand for housing (rental housing, hotel and motel rooms, and RV spaces) in the Project area. In the Coos Bay area, constructing both the LNG terminal and the pipeline would significantly impact demand for housing and could result in rent increases and displacement. To reduce this impact, Jordan Cove is constructing a temporary housing facility for contractors. However, we conclude that housing impacts in Coos Bay would experience a temporary significant impact. In other Project areas, housing would also be affected, but this effect would not be significant. The influx of an outside workforce into the Project area during construction would temporarily increase pressure on law enforcement (by increasing crime rates), fire protection, and medical services. Based on the temporary nature of the Project's impacts, we conclude that constructing and operating the Project would not significantly affect the socioeconomic character of the Project area.

With the applicant's proposed construction and operations procedures and mitigation measures in place, we conclude that constructing and operating the LNG and pipeline facilities are not expected to result in significant impacts on socioeconomic resources or services, with the exception of temporary housing availability during construction.

5.1.10 Transportation

Constructing the LNG terminal would require delivery vessels over a 2-year period via a mix of ocean-going vessels and barges. Once construction is complete, LNG carriers would transit to and from the terminal, increasing the total number of deep-draft vessels calling at Coos Bay. The anticipated increases in marine traffic combined with current deep-draft vessel traffic would be less than historic ship traffic through the channel and are, therefore, not expected to significantly affect other marine traffic in Coos Bay. During construction, motor vehicle traffic in the Coos Bay area would increase and, as a result, traffic and commute times in the area would also likely increase. To reduce these increases, Jordan Cove conducted a traffic study of the Coos Bay area and would implement numerous measures to reduce impacts on roadways and facilitate an efficient flow of vehicles. Additionally, during construction, work shifts would be staggered, permanent improvements to a key intersection would be made, manual flagging would be used, and off-site parking lots would be utilized (with workers transported to the site by bus). We have recommended that Jordan Cove entered into traffic development agreements with ODOT, Coos County, and the City of North Bend, as recommended in the *Traffic Impact Analysis* report Furthermore, the use of existing roads along the pipeline route to access construction work areas and to move construction equipment, materials, and personnel would temporarily affect these roadways; however, we conclude that, with mitigation measures in place to reduce impacts on roads and users, constructing and operating the Project would not result in significant impacts on transportation.

5.1.11 Cultural Resources

Cultural resource investigations for the Project are currently incomplete. Surveys that have been completed have identified sites in the vicinity that require monitoring during construction. Additionally, further testing has been recommended for some sites if avoidance cannot be achieved by the Project.

The FERC staff and the applicants have contacted Indian tribes that may attach religious or cultural importance to sites in the APE. We received comments from the CTCLUSI, Coquille, Cow Creek, Grand Ronde, Karuk, Klamath, and Yurok Tribes. The Coquille Tribe is a cooperating agency, while the others have filed motions to intervene. For both Projects (i.e., the Jordan Cove LNG Project and Pacific Connector Pipeline Project), a finalized ethnographic study is in the process of being completed by the applicants.

We have not yet completed the process of complying with Sections 101 and 106 of the NHPA. Additional cultural resource inventories, evaluations, and associated reports are yet to be completed. Consultations with tribes, SHPO, and applicable federal land-managing agencies have also not been concluded. We are recommending that Jordan Cove and Pacific Connector not construct or use any of their proposed facilities, including related ancillary areas for staging, storage, temporary work areas, and new or to-be-improved access roads, until all studies and consultations necessary to complete compliance with the NHPA have been completed. It is expected that the resolution of adverse effects through an MOA and implementation of treatment plans would mitigate impacts at affected historic properties to a less-than-significant finding, should the Project be approved by the Commission.

5.1.12 Air Quality and Noise

5.1.12.1 Air Quality

Air pollutants would be emitted as a result of both construction and operation of LNG marine traffic, the LNG terminal, the Pacific Connector pipeline, and aboveground facilities. During construction, a temporary reduction in ambient air quality may result from emissions and fugitive dust generated by construction equipment. Emissions from construction equipment would be temporary and would not result in a significant impact on regional air quality or result in any exceedance of applicable ambient air quality standards.

The Jordan Cove LNG Project is located in an air attainment area for federal air quality standards. In September 2017, Jordan Cove submitted an air quality permit application to the ODEQ. The Project's Type B state-only NSR permit application demonstrates that applicable requirements have been met. For all pollutants, the impacts at the points of highest concentration during operation of the Jordan Cove facilities are well below the applicable NAAQS and the PSD increments when combined with ambient air quality concentrations.

The Klamath Compressor Station and most of the pipeline route would be located in areas designated as attainment for all federal air quality standards, except for approximately 325 feet of pipeline route that would be located within the Klamath Falls PM_{10} maintenance area. Pacific Connector submitted a standard ACDP initial application to the ODEQ in May 2015, and submitted a revised application in September 2017. For all pollutants, the combined impacts at the points of highest concentration during operation of the Klamath Compressor Station are less than the applicable NAAQS.

Constructing and operating the Project would result in impacts on air quality; however, with implementation of BMPs, we conclude that these impacts would not be significant.

5.1.12.2 Noise

Noise would be generated as a result of both construction and operation of the LNG terminal and aboveground facilities associated with the Pacific Connector pipeline. The NSAs closest to the Jordan Cove LNG terminal are single-family homes in the city of North Bend (NSA1) about 1.3 miles south and directly across Coos Bay from the center of the proposed LNG terminal site and the Horsfall campground located approximately 1.2 miles northeast of the LNG terminal. Based on the large number of residents who live across Coos Bay, the impulsive (i.e., short and intense) noise impacts associated with pile-driving activities, the predicted and perceptible noise impacts on nearby NSAs, the duration of pile-driving activities, as well as the lack of noise mitigation measures proposed by Jordan Cove, we have recommended that Jordan Cove implement additional measures to minimize the noise impacts of pile driving on NSAs. With the implementation of the mitigation measures proposed, in addition to our recommendation, effects resulting from construction of the Jordan Cove LNG terminal would be temporary and would not result in significant impacts on nearby communities.

Operational noise from operating the LNG terminal is predicted to have a sound level below the FERC requirement of 55 dBA L_{dn}. However, we are recommending that Jordan Cove document that its facilities meet our noise standards by filing the results of a noise survey during operation that shows compliance with our noise requirement.

During the construction of the Pacific Connector Project, construction noise would be audible to NSAs near the construction right-of-way. Pipeline construction activities generally would be limited to daytime hours. Due to the assembly-line nature of pipeline construction, activities in any area could occur intermittently over a period lasting from several weeks to a few months. Noise from HDD drilling activities may be above our requirement of 55 dBA L_{dn} at some NSAs without mitigation. To make certain that the mitigation measures implemented at the HDD locations minimize noise at nearby NSAs, we recommend that Pacific Connector file a noise mitigation plan, monitor noise levels, and file weekly noise reports documenting compliance with our noise standard during the drilling activities.

Operation of the Klamath Compressor Station would result in noise impacts on nearby NSAs. In order to reduce these impacts, Pacific Connector would implement mitigation measures to reduce noise from the compressor station to meet our requirement of 55 dBA L_{dn} at nearby NSAs. To ensure that actual operational noise is at or below the predicted noise, and that there would be no significant impact to noise quality at the nearest NSAs, we are recommending that Pacific Connector file the results of a noise survey no later than 60 days after the compressor station is placed in service to demonstrate that noise at nearby NSAs does not exceed our standards. If that level is exceeded, Pacific Connector would need to install additional noise controls to meet that level.

Constructing and operating the Project would result in noise-related impacts; however, with implementation of mitigation measures as well as inclusion of the recommendations made in this EIS, we conclude that the Project would not result in significant noise-related impacts.

5.1.13 Reliability and Safety

As part of the NEPA review, Commission staff must assess whether the proposed facilities would be able to operate safely and securely. As a result of our technical review of the preliminary engineering design and our recommended mitigation, we believe that the facility design proposed by Jordan Cove includes acceptable layers of protection or safeguards that would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public.

As a cooperating agency, the USDOT assists the FERC by determining whether Jordan Cove's proposed design would meet the USDOT's 49 CFR 193 Subpart B siting requirements. USDOT will provide a Letter of Determination on the Project's compliance with 49 CFR 193 Subpart B. This determination will be provided to the Commission as further consideration to the Commission on its decision to authorize or deny the Project. If the Project is authorized and constructed, the facility would be subject to the USDOT's inspection and enforcement program and final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by the USDOT staff.

As a cooperating agency, the Coast Guard analyzed the suitability of the waterway for LNG marine traffic. Based on its review and its own independent risk assessment, the Coast Guard has determined that the waterway could be made suitable for the type and frequency of LNG marine traffic associated with the proposed Jordan Cove LNG facility. This opinion was contingent upon the availability of additional measures necessary to responsibly manage the maritime safety and security risks. If appropriate resources are not in place prior to LNG carrier movement along the waterway, then the Coast Guard would consider at that time what, if any, vessel traffic and/or facility control measures would be appropriate to adequately address navigational safety and maritime security considerations.

Pacific Connector's pipeline would be built and inspected according to USDOT standards. These standards ensure pipeline safety.

5.1.14 Cumulative Impacts

Construction of the Project, in addition to other projects within the same geographic scopes crossed by the pipeline, would have cumulative impacts on a range of environmental resources, as discussed in section 4.14. We provided information about Project-related impacts and mitigation measures for specific environmental resources and were able to make some general assumptions about other federal projects identified in table 4.14.2.3-1. For the federal projects, there are laws and regulations in place that protect waterbodies and wetlands, threatened and endangered species, and historic properties, and limit impacts from air and noise pollution. Federal land-managing agencies, such as the BLM and Forest Service, have requirements in their LMPs to protect resources on the lands they manage. We have limited information about potential or foreseeable private projects in the region. For some resources, there are also state laws and regulations that apply to private projects. While there would be cumulative impacts on resources when all of the foreseeable projects are combined, the magnitude of that impact would be minimal at the landscape scale. Given the Project BMPs and design features, mitigation measures that would be implemented, federal and state laws and regulations protecting resources, and permitting requirements, we conclude that when added to other past, present, and reasonably foreseeable future actions, the Project, with two exceptions, would not result in significant cumulative impacts on environmental resources. Constructing the Project would result in a temporary significant cumulative impact on housing availability in Coos County and would also result in a permanent significant cumulative impact on the visual character of Coos Bay.

5.2 FERC STAFF'S RECOMMENDED MITIGATION

If the Commission authorizes the Project, we are recommending that the following measures be included as specific conditions in the Commission's Order. These measures would further mitigate the environmental impacts associated with the construction and operation of the proposed Project. The section number in parentheses at the end of a condition corresponds to the section number in which the measure and related resource impact analysis appears in the EIS.

1. Jordan Cove and Pacific Connector shall follow the construction procedures and mitigation measures described in its applications and supplemental filings (including responses to staff data requests), and as identified in the EIS, unless modified by the Order. Jordan Cove and Pacific Connector must:

    a. request any modification to these procedures, measures, or conditions in a filing with the Secretary;

    b. justify each modification relative to site-specific conditions;

    c. explain how that modification provides an equal or greater level of environmental protection than the original measure; and

    d. receive approval in writing from the Director of OEP **before using that modification**.

2. For the LNG terminal, the Director of OEP, or the Director's designee, has delegated authority to address any requests for approvals or authorizations necessary to carry out the conditions of the Order, and take whatever steps are necessary to ensure the protection of life, health, property, and the environment during construction and operation of the Jordan Cove LNG Project. This authority shall include:

    a. the modification of conditions of the Order;

    b. stop-work authority and authority to cease operation; and

    c. the imposition of any additional measures deemed necessary to ensure continued compliance with the intent of the conditions of the Order as well as the avoidance or mitigation of unforeseen adverse environmental impact resulting from project construction and operation.

3. For the pipeline facilities, the Director of OEP, or the Director's designee, has delegated authority to address any requests for approvals or authorizations necessary to carry out the conditions of the Order, and take whatever steps are necessary to ensure the protection of environmental resources during construction and operation of the Pacific Connector Pipeline Project. This authority shall allow:

    a. the modification of conditions of the Order;

    b. stop-work authority; and

    c. the imposition of any additional measures deemed necessary to ensure continued compliance with the intent of the conditions of the Order as well as the avoidance or mitigation of unforeseen adverse environmental impact resulting from project construction and operation activities.

4. **Prior to any construction,** Jordan Cove and Pacific Connector shall file an affirmative statement with the Secretary, certified by a senior company official, that all company personnel, EIs, and contractor personnel will be informed of the EI's authority and have been or will be trained on the implementation of the environmental mitigation measures appropriate to their jobs **before** becoming involved with construction and restoration activities.

5. The authorized facility locations shall be as shown in the EIS, as supplemented by filed site plans and alignment sheets, and shall include the route variations identified in conditions 16-19 below. **As soon as they are available, and before the start of construction,** Jordan Cove and Pacific Connector shall file with the Secretary any revised detailed site plan drawings and survey alignment maps/sheets at a scale not smaller than 1:6,000 with station positions for all facilities approved by the Order. All requests for modifications of environmental conditions of the Order or site-specific clearances must be written and must reference locations designated on these site plan drawings.

   For the pipeline, Pacific Connector's exercise of eminent domain authority granted under NGA Section 7(h) in any condemnation proceedings related to the Order must be consistent with these authorized facilities and locations. Pacific Connector's right of eminent domain granted under NGA Section 7(h) does not authorize it to increase the size of its natural gas pipeline or facilities to accommodate future needs or to acquire a right-of-way for a pipeline to transport a commodity other than natural gas.

6. Jordan Cove and Pacific Connector shall file with the Secretary detailed site plan drawings, alignment maps/sheets, or aerial photographs at a scale not smaller than 1:6,000, identifying all route realignments, facility relocations, changes in site plan layout, staging areas, pipe storage yards, new access roads and other areas that would be used or disturbed and have not been previously identified in filings with the Secretary. Approval for each of these areas must be explicitly requested in writing. For each area, the request must include a description of the existing land use/cover type, documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area. All areas shall be clearly identified on the maps/sheets/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area.**

   This requirement does not apply to route variations required by the Order, extra workspace allowed by the Commission's *Upland Erosion Control, Revegetation, and Maintenance Plan* and/or minor field realignments per landowner needs and requirements which do not affect other landowners or sensitive environmental areas such as wetlands.

   Examples of alterations requiring approval include all route realignments and facility location changes resulting from:

   a. implementation of cultural resources mitigation measures;

   b. implementation of endangered, threatened, or special concern species mitigation measures;

   c. recommendations by state regulatory authorities; and

d. agreements with individual landowners that affect other landowners or could affect sensitive environmental areas.

7. **Within 60 days of the acceptance of the Authorization/Certificate and before construction begins**, Jordan Cove and Pacific Connector shall each file an Implementation Plan with the Secretary for review and written approval by the Director of OEP. Jordan Cove and Pacific Connector must file revisions to the plan as schedules change. The plan shall identify:

   a. how Jordan Cove and Pacific Connector will implement the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests), identified in the EIS, and required by the Order;

   b. how Jordan Cove and Pacific Connector will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to onsite construction and inspection personnel;

   c. the number of EIs assigned, and how the company will ensure that sufficient personnel are available to implement the environmental mitigation;

   d. company personnel, including EIs and contractors, who will receive copies of the appropriate material;

   e. the location and dates of the environmental compliance training and instructions Jordan Cove and Pacific Connector will give to all personnel involved with construction and restoration (initial and refresher training as the Project progresses and personnel change), with the opportunity for OEP staff to participate in the training session(s);

   f. the company personnel (if known) and specific portion of Jordan Cove's and Pacific Connector's organization having responsibility for compliance;

   g. the procedures (including use of contract penalties) Jordan Cove and Pacific Connector will follow if noncompliance occurs; and

   h. for each discrete facility, a Gantt or PERT chart (or similar Project scheduling diagram), and dates for:

      1. the completion of all required surveys and reports;

      2. the environmental compliance training of onsite personnel;

      3. the start of construction; and

      4. the start and completion of restoration.

8. Jordan Cove shall employ at least one EI for the LNG terminal and Pacific Connector shall employ a team of EIs for the pipeline facilities (i.e., at least one per construction spread or as may be established by the Director of OEP). The EIs shall be:

   a. responsible for monitoring and ensuring compliance with all mitigation measures required by the Order and other grants, permits, certificates, or authorizing documents;

b. responsible for evaluating the construction contractor's implementation of the environmental mitigation measures required in the contract (see condition 7 above) and any other authorizing document;

c. empowered to order correction of acts that violate the environmental conditions of the Order, and any other authorizing document;

d. a full-time position separate from all other activity inspectors;

e. responsible for documenting compliance with the environmental conditions of the Order, as well as any environmental conditions/permit requirements imposed by other federal, state, or local agencies; and

f. responsible for maintaining status reports.

9. Beginning with the filing of its Implementation Plan, Jordan Cove shall file updated status reports with the Secretary on a **monthly** basis for the LNG terminal and Pacific Connector shall file updated status reports with the Secretary on a **biweekly** basis for the pipeline facilities until all construction and restoration activities are complete. Problems of a significant magnitude shall be reported to the FERC **within 24 hours.** On request, these status reports will also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include:

   a. an update on Jordan Cove's and Pacific Connector's efforts to obtain the necessary federal authorizations;

   b. Project schedule, including current construction status of the LNG terminal/each pipeline spread, work planned for the following reporting period, and any schedule changes for stream crossings or work in other environmentally-sensitive areas;

   c. a listing of all problems encountered, contractor nonconformance/deficiency logs, and each instance of noncompliance observed by the EI during the reporting period (both for the conditions imposed by the Commission and any environmental conditions/permit requirements imposed by other federal, state, or local agencies);

   d. a description of the corrective and remedial actions implemented in response to all instances of noncompliance, nonconformance, or deficiency;

   e. the effectiveness of all corrective and remedial actions implemented;

   f. a description of any landowner/resident complaints which may relate to compliance with the requirements of the order, and the measures taken to satisfy their concerns; and

   g. copies of any correspondence received by Jordan Cove and Pacific Connector from other federal, state, or local permitting agencies concerning instances of noncompliance, and Jordan Cove's and Pacific Connector's response.

10. Pacific Connector shall develop and implement an environmental complaint resolution procedure, and file such procedure with the Secretary, for review and approval by the Director of OEP. The procedure shall provide landowners with clear and simple

directions for identifying and resolving their environmental mitigation problems/concerns during construction of the Project and restoration of the right-of-way. This procedure shall be in effect throughout the construction and restoration periods and two years thereafter. Prior to construction, Pacific Connector shall mail the complaint procedures to each landowner whose property will be crossed by the Project.

a. In its letter to affected landowners, Pacific Connector shall:

1. provide a local contact that the landowners should call first with their concerns; the letter should indicate how soon a landowner should expect a response;
2. instruct the landowners that if they are not satisfied with the response, they should call Pacific Connector's Hotline; the letter should indicate how soon to expect a response; and
3. instruct the landowners that if they are still not satisfied with the response from Pacific Connector's Hotline, they should contact the Commission's Landowner Helpline at 877-337-2237 or at LandownerHelp@ferc.gov.

b. In addition, Pacific Connector shall include in its status report a copy of a table that contains the following information for each problem/concern:

1. the identity of the caller and date of the call;
2. the location by milepost and identification number from the authorized alignment sheet(s) of the affected property;
3. a description of the problem/concern; and
4. an explanation of how and when the problem was resolved, will be resolved, or why it has not been resolved.

11. Jordan Cove and Pacific Connector must receive written authorization from the Director of OEP before commencing construction of any Project facilities. To obtain such authorization, Jordan Cove and Pacific Connector must file with the Secretary documentation that it has received all applicable authorizations required under federal law (or evidence of waiver thereof).

12. Jordan Cove must receive written authorization from the Director of OEP **prior to introducing hazardous fluids into the Project facilities**. Instrumentation and controls, hazard detection, hazard control, and security components/systems necessary for the safe introduction of such fluids shall be installed and functional.

13. Jordan Cove must receive written authorization from the Director of OEP **before placing into service** the LNG terminal and other components of the Jordan Cove LNG Project. Such authorization will only be granted following a determination that the facilities have been constructed in accordance with the FERC approval, can be expected to operate safely as designed, and the rehabilitation and restoration of the areas affected by the Project are proceeding satisfactorily.

14. Pacific Connector must receive written authorization from the Director of OEP **before placing the pipeline into service.** Such authorization will only be granted following a

determination that rehabilitation and restoration of the right-of-way and other areas affected by the Pacific Connector Gas Pipeline Project are proceeding satisfactorily.

15. **Within 30 days of placing the authorized facilities in service**, Jordan Cove and Pacific Connector shall each file an affirmative statement with the Secretary, certified by a senior company official:

    a. that the facilities have been constructed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or

    b. identifying which of the conditions of the Order Jordan Cove and Pacific Connector have complied with or will comply with. This statement shall also identify any areas affected by the Project where compliance measures were not properly implemented, if not previously identified in filed status reports, and the reason for noncompliance.

16. **Prior to construction,** Pacific Connector shall file with the Secretary, for review and written approval by the Director of OEP, revised alignment sheets that incorporate the Blue Ridge Variation into its proposed route between MP 11 and 25. (*section 3.4.2.2*)

17. **Prior to construction,** Pacific Connector shall file with the Secretary, for review and written approval by the Director of OEP, revised alignment sheets that incorporate the Survey and Manage Species Variation into the proposed route between MPs 111.5 and 111.6, and provide documentation of consultation with the Forest Service. (*section 3.4.2.7)*

18. **Prior to construction,** Pacific Connector shall file with the Secretary, for review and written approval by the Director of OEP, revised alignment sheets that incorporate the East Fork Cow Creek Variation into its proposed route between MPs 109.6 and 109.9, and provide documentation of consultation with the Forest Service. (*section 3.4.2.8)*

19. **Prior to construction,** Pacific Connector shall file with the Secretary, for review and written approval by the Director of OEP, revised alignment sheets that incorporate the Pacific Crest Trail Variation into the proposed route between MPs 166.4 and 168.1, and provide documentation of consultation with the Forest Service. (*section 3.4.2.9)*

20. **Prior to construction,** Pacific Connector shall file with the Secretary, for review and written approval by the Director of OEP, the final monitoring protocols and/or mitigation measures for all landslide areas that were not accessible during previous studies. (*section 4.1.2.4*)

21. **Prior to the end of the draft EIS comment period,** Pacific Connector shall consult with the ODEQ regarding existing soil and groundwater contamination at the sites listed in appendix G, and file the results of this consultation, along with any proposed site-specific soil or groundwater handling, management, and disposal procedures. *(section 4.2.2.2)*

22. **Prior to construction,** Pacific Connector shall file a revised *Integrated Pest Management Plan* with the Secretary, for review and written approval by the Director of

the OEP, that specifies that construction equipment will be cleaned after leaving areas of noxious weed infestations and prior to entering BLM-managed lands regardless of contiguous land owner. The revised plan shall also address BLM and Forest Service requirements related to monitoring of invasive plant species on federally managed lands, and documentation that the revised plan was found acceptable by the BLM and Forest Service. (*section 4.4.3.4*)

23. **Prior to construction,** Jordan Cove shall file with the Secretary, for review and written approval by the Director of OEP, its lighting plan. The plan shall include measures that will reduce lighting to the minimal levels necessary to ensure safe operation of the LNG facilities and any other measures that will be implemented to minimize lighting impacts on fish and wildlife. Along with its lighting plan, Jordan Cove shall file documentation that the plan was developed in consultation with the FWS, NMFS, and ODFW. This lighting plan shall also be in compliance with recommendation 59. (*section 4.5.1.1)*

24. **Prior to construction,** Pacific Connector shall file with the Secretary, for review and written approval by the Director of OEP, its final *Fish Salvage Plan*, that addresses methods suitable to collect and salvage all lamprey life stages, to the extent practical, together with documentation that the final *Fish Salvage Plan* was developed in consultations with interested tribes, ODFW, FWS and NMFS. The revised *Fish Salvage Plan* shall also incorporate the applicable measures of the Handling Guidelines for Klamath Basin Suckers. (*section 4.5.2.3*)

25. **Prior to construction**, Pacific Connector shall file with the Secretary, for review and written approval by the Director of OEP, a revised *Hydrostatic Test Plan* that requires that any water withdrawal from a flowing stream does not exceed an instantaneous flow reduction of more than 10 percent of stream flow. (*section 4.5.2.3*)

26. **Prior to construction**, Jordan Cove shall file with the Secretary, for review and written approval by the Director of OEP, a *Marine Mammal Monitoring Plan* that identifies how the presence of listed whales will be determined during construction, and measures Jordan Cove will take to minimize potential noise effects on whales and other marine mammals, and ensure compliance with NMFS underwater noise criteria for the protection of listed whales. *(section 4.6.1.1)*

27. **Prior to construction,** Pacific Connector shall file with the Secretary its commitment to adhere to FWS-recommended timing restrictions within threshold distances of MAMU and NSO stands **during construction, operations, and maintenance** of the pipeline facilities. *(section 4.6.1.2)*

28. **Prior to end of the draft EIS comment period,** Pacific Connector shall file with the Secretary revised alignment sheets that eliminate or relocate TEWA 128.01-W, TEWA 128.96-N, TEWA 142.07-N, and EAR-128.05. *(section 4.6.1.6)*

29. Jordan Cove and Pacific Connector **shall not begin construction until**:

    a. the Commission staff completes formal ESA consultations with the NMFS and FWS; and

b. Jordan Cove and Pacific Connector have received written notification from the Director of OEP that construction and/or implementation of conservation measures may begin. (*section 4.6.1.7*)

30. Jordan Cove and Pacific Connector **shall not begin construction** of the Project **until** they file with the Secretary a copy of the determination of consistency with the Coastal Zone Management Plan issued by the State of Oregon. (*section 4.7.1.2*)

31. **Prior to construction,** Jordan Cove shall file documentation that it has entered into development agreements with ODOT, Coos County, and the City of North Bend, as recommended in the *Traffic Impact Analysis* report. (*section 4.10.1.2*)

32. **Prior to construction of facilities and/or use of any staging, storage, temporary work areas, or new or to-be-improved access roads,** Jordan Cove and Pacific Connector shall file with the Secretary a revised Ethnographic Report describing sites of religious and cultural significance to Indian Tribes and other tribal information as outlined in the FERC staff's October 23, 2018 environmental information request #14, for the review of interested Indian tribes and the FERC staff, and for written approval by the Director of OEP. *(section 4.11.3.1)*

33. Jordan Cove and Pacific Connector shall **not begin construction of facilities and/or use** any staging, storage, or temporary work areas and new or to-be-improved access roads **until**:

    a. Jordan Cove and Pacific Connector each file with the Secretary:

        1. remaining cultural resources inventory reports for areas not previously surveyed;
        2. site evaluations and monitoring reports, as necessary;
        3. final HPMP with avoidance plans;
        4. final UDP; and
        5. comments on the cultural resources reports and plans from the SHPO, applicable federal land managing agencies, and interested Indian tribes.

    b. FERC affords the ACHP an opportunity to comment on the undertaking; and

    c. FERC staff reviews and the Director of OEP approves all cultural resources reports and plans, and notifies Jordan Cove and Pacific Connector in writing that treatment plans may be implemented and/or construction may proceed.

    All materials filed with the Commission containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: "**CUI//PRIV - DO NOT RELEASE**." *(section 4.11.5*)

34. **Following the start of pile-driving activities,** Jordan Cove shall monitor daytime pile-driving and file **weekly** noise data reports with the Secretary that identify the noise impact on the nearest NSAs. If any measured daytime noise impacts (L_{max}) at the nearest NSAs are greater than 10 dBA over the L_{eq} ambient levels, Jordan Cove shall:

a. cease pile-driving activities and implement noise mitigation measures; and

b. file with the Secretary evidence of noise mitigation installation and request written notification from the Director of OEP that pile driving may resume. *(section 4.12.2.3)*

35. Jordan Cove shall conduct all pile-driving activities between the hours of 7 a.m. and 7 p.m. **throughout the duration of construction**. *(section 4.12.2.3)*

36. Jordan Cove shall file a full power load noise survey with the Secretary for the LNG terminal **no later than 60 days after** each liquefaction train is placed into service. If the noise attributable to operation of the equipment at the LNG terminal exceeds an L_{dn} of 55 dBA at the nearest NSA, **within 60 days** Jordan Cove shall modify operation of the liquefaction facilities or install additional noise controls until a noise level below an L_{dn} of 55 dBA at the NSA is achieved. Jordan Cove shall confirm compliance with the above requirement by filing a second noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. *(section 4.12.2.3)*

37. Jordan Cove shall file a full power load noise survey with the Secretary **no later than 60 days after placing the entire LNG terminal into service**. If a full load noise survey is not possible, Jordan Cove shall file an interim survey at the maximum possible horsepower load **within 60 days** of placing the LNG terminal into service and file the full operational surveys **within 6 months**. If the noise attributable to the operation of all the equipment of the LNG terminal exceeds 55 dBA L_{dn} at any nearby NSAs, under interim or full load conditions, Jordan Cove shall file a report on what changes are needed and install additional noise controls to meet the level **within 1 year** of the in-service date. Jordan Cove shall confirm compliance with this requirement by filing a second full power noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. *(section 4.12.2.3)*

38. **Prior to drilling activities at HDD sites,** Pacific Connector shall file a site-specific noise mitigation plan with the Secretary, for review and written approval by the Director of OEP. During any drilling operations, Pacific Connector shall implement the approved plan, monitor noise levels, and file in its biweekly reports documentation that the noise levels attributable to the drilling operations at NSAs does not exceed 55 L_{dn} dBA. (*section 4.12.2.4*)

39. Pacific Connector shall file a noise survey with the Secretary **no later than 60 days after placing the Klamath Compressor Station in service**. If a full load condition noise survey is not possible, Pacific Connector shall provide an interim survey at the maximum possible horsepower load and provide the full load survey **within six months**. If the noise attributable to the operation of all of the equipment at the Klamath Compressor Station under interim or full horsepower load conditions exceeds an L_{dn} of 55 dBA at any nearby NSAs, Pacific Connector shall file a report on what changes are needed and shall install the additional noise controls to meet the level **within one year** of the in-service date. Pacific Connector shall confirm compliance with the above requirement by filing a second noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. *(section 4.12.2.4)*

40. **Prior to end of the draft EIS comment period**, Jordan Cove shall file with the Secretary documentation of consultation with USDOT PHMSA staff as to whether the design wind speed for other non-hazardous buildings and structures would be subject USDOT PHMSA requirements. *(section 4.13.1.6)*

41. **Prior to the end draft EIS comment period**, Jordan Cove shall file with the Secretary an analysis that demonstrates the flammable vapor dispersion from design spills would be prevented from dispersing underneath the elevated LNG storage tanks, or the LNG storage tanks would be able to withstand an overpressure due to ignition of the flammable vapor dispersion cloud that disperses underneath the elevated LNG storage tanks. *(section 4.13.1.6)*

42. **Prior to initial site preparation**, Jordan Cove shall file with the Secretary documentation demonstrating it has received a determination of no hazard (with or without conditions) by USDOT FAA for all permanent structures, temporary construction equipment, and mobile objects that exceed the height requirements in 14 CFR 77.9. *(section 4.13.1.6)*

43. **Prior to construction of final design**, Jordan Cove shall file with the Secretary the following information, stamped and sealed by the professional engineer-of-record, registered in Oregon:

    a. site preparation drawings and specifications;

    b. LNG terminal structures, LNG storage tank, and foundation design drawings and calculations (including prefabricated and field constructed structures);

    c. seismic specifications for procured Seismic Category I equipment prior to the issuing of request for quotations;

    d. quality control procedures to be used for civil/structural design and construction; and

    e. a determination of whether soil improvement is necessary to counteract soil liquefaction.

    In addition, Jordan Cove shall file, in its Implementation Plan, the schedule for producing this information. *(section 4.13.1.6)*

44. **Prior to construction of final design,** Jordan Cove shall file with the Secretary consultation with USDOT PHMSA staff as to whether the use of normally closed valves to remove stormwater from curbed areas would meet USDOT PHMSA requirements. *(section 4.13.1.6)*

45. **Prior to commencement of service**, Jordan Cove shall file with the Secretary a monitoring and maintenance plan, stamped and sealed by the professional engineer-of-record registered in Oregon, which ensures the facilities are protected for the life of the LNG terminal considering settlement, subsidence, and sea level rise. *(section 4.13.1.6)*

Conditions 46 through 133 shall apply to the Jordan Cove LNG terminal. Information pertaining to these specific conditions shall be filed with the Secretary for review and written approval by the Director of OEP either: <u>prior to initial site preparation</u>; <u>prior to</u>

construction of final design; prior to commissioning; prior to introduction of hazardous fluids; or prior to commencement of service, as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, shall be submitted as critical energy infrastructure information (CEII) pursuant to 18 CFR 388.112. See Critical Energy Infrastructure Information, Order No. 683, 71 Fed. Reg. 58,273 (October 3, 2006), FERC Stats. & Regs. ¶ 31,228 (2006). Information pertaining to items such as offsite emergency response; procedures for public notification and evacuation; and construction and operating reporting requirements will be subject to public disclosure. All information shall be filed a minimum of 30 days before approval to proceed is required.

46. **Prior to initial site preparation**, Jordan Cove shall file an overall Project schedule, which includes the proposed stages of the commissioning plan. *(section 4.13.1.6)*

47. **Prior to initial site preparation**, Jordan Cove shall file procedures for controlling access during construction. *(section 4.13.1.6)*

48. **Prior to initial site preparation**, Jordan Cove shall file quality assurance and quality control procedures for construction activities for both the Engineering Procurement Contractor and Jordan Cove to monitor construction activities. *(section 4.13.1.6)*

49. **Prior to initial site preparation**, Jordan Cove shall specify a spill containment system around the Warm Flare Knockout Drum. *(section 4.13.1.6)*

50. **Prior to initial site preparation**, Jordan Cove shall develop an ERP (including evacuation) and coordinate procedures with the Coast Guard; state, county, and local emergency planning groups; fire departments; state and local law enforcement; and appropriate federal agencies. This plan shall include at a minimum:

    a. designated contacts with state and local emergency response agencies;

    b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;

    c. procedures for notifying residents and recreational users within areas of potential hazard;

    d. evacuation routes/methods for residents and public use areas that are within any transient hazard areas along the route of the LNG marine transit;

    e. locations of permanent sirens and other warning devices; and

    f. an "emergency coordinator" on each LNG marine vessel to activate sirens and other warning devices.

    Jordan Cove shall notify the FERC staff of all planning meetings in advance and shall report progress on the development of its ERP **at 3-month intervals**. *(section 4.13.1.6)*

51. **Prior to initial site preparation**, Jordan Cove shall file a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs

that would be imposed on state and local agencies. This comprehensive plan shall include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. Jordan Cove shall notify FERC staff of all planning meetings in advance and shall report progress on the development of its Cost Sharing Plan at **3-month intervals**. *(section 4.13.1.6)*

52. **Prior to construction of final design**, Jordan Cove shall file change logs that list and explain any changes made from the FEED provided in Jordan Cove LNG Project's application and filings. A list of all changes with an explanation for the design alteration shall be provided and all changes shall be clearly indicated on all diagrams and drawings. *(section 4.13.1.6)*

53. **Prior to construction of final design**, Jordan Cove shall file information/revisions pertaining to Jordan Cove's response numbers 8c, 13, 15, 21, 22, 23, 24, 26, 27, 28, and 31 of its December 20, 2018 filing and 6, 9, 10, 11, 17, 19, 32, 34, and 36 of its February 6, 2019 filing which indicated features to be included or considered in the final design. *(section 4.13.1.6)*

54. **Prior to construction of final design**, Jordan Cove shall file drawings and specifications for crash rated vehicle barriers at each facility entrance for access control. *(section 4.13.1.6)*

55. **Prior to construction of final design**, Jordan Cove shall file drawings of the security fence. The fencing drawings shall provide details of fencing that demonstrates it would restrict and deter access around the entire facility and has a setback from exterior features (e.g., power lines, trees, etc.) and from interior features (e.g., piping, equipment, buildings, etc.) that does not allow the fence to be overcome. *(section 4.13.1.6)*

56. **Prior to construction of final design**, Jordan Cove shall file drawings of internal road vehicle protections, such as guard rails, barriers, and bollards to protect transfer piping, pumps, compressors, hydrants, monitors, etc. to ensure that they are located away from roadway or protected from inadvertent damage from vehicles. *(section 4.13.1.6)*

57. **Prior to construction of final design**, Jordan Cove shall file security camera and intrusion detection drawings. The security camera drawings shall show the locations, areas covered, and features of each camera (e.g., fixed, tilt/pan/zoom, motion detection alerts, low light, mounting height, etc.) to verify camera coverage of the entire perimeter with redundancies for cameras interior to the facility to enable rapid monitoring of the facility, including a camera at the top of each LNG storage tank, and coverage within pretreatment areas, within liquefaction areas, within truck transfer areas, within marine transfer areas, and buildings. The drawings shall show or note the location of the intrusion detection to verify it covers the entire perimeter of the facility. *(section 4.13.1.6)*

58. **Prior to construction of final design**, Jordan Cove shall file lighting drawings. The lighting drawings shall show the location, elevation, type of light fixture, and lux levels of the lighting system and shall be in accordance with API 540 and provide illumination along the perimeter of the facility, process equipment, mooring points, and along

paths/roads of access and egress to facilitate security monitoring and emergency response operations. *(section 4.13.1.6)*

59. **Prior to construction of final design**, Jordan Cove shall file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems. This lighting plan shall also be in compliance with recommendation 23. *(section 4.13.1.6)*

60. **Prior to construction of final design**, Jordan Cove shall file three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion. *(section 4.13.1.6)*

61. **Prior to construction of final design**, Jordan Cove shall file up-to-date process flow diagrams (PFDs) and piping and instrument diagrams (P&IDs) including vendor P&IDs. The PFDs shall include heat and material balances. The P&IDs shall include the following information:

    a. equipment tag number, name, size, duty, capacity, and design conditions;

    b. equipment insulation type and thickness;

    c. storage tank pipe penetration size and nozzle schedule;

    d. valve high pressure side and internal and external vent locations;

    e. piping with line number, piping class specification, size, and insulation type and thickness;

    f. piping specification breaks and insulation limits;

    g. all control and manual valves numbered;

    h. relief valves with size and set points; and

    i. drawing revision number and date. *(section 4.13.1.6)*

62. **Prior to construction of final design**, Jordan Cove shall file P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect subsequently constructed facilities with the operational facilities. *(section 4.13.1.6)*

63. **Prior to construction of final design**, Jordan Cove shall file a car seal philosophy and a list of all car-sealed and locked valves consistent with the P&IDs. *(section 4.13.1.6)*

64. **Prior to construction of final design**, Jordan Cove shall file information to demonstrate the EPC contractor has verified that all FEED HAZOP and LOPA recommendations have been addressed. *(section 4.13.1.6)*

65. **Prior to construction of final design**, Jordan Cove shall file a hazard and operability review prior to issuing the P&IDs for construction. A copy of the review, a list of the recommendations, and actions taken on the recommendations shall be filed. *(section 4.13.1.6)*

66. **Prior to construction of final design**, Jordan Cove shall provide a check valve upstream of the amine contractor column to prevent backflow or provide a a dynamic simulation that shows that upon plant shutdown, the swan neck would be sufficient for this purpose. *(section 4.13.1.6)*

67. **Prior to construction of final design**, Jordan Cove shall specify how Mole Sieve Gas Dehydrator support and sieve material would be prevented from migrating to the piping system. *(section 4.13.1.6)*

68. **Prior to construction of final design**, Jordan Cove shall specify how the regeneration gas heater tube design temperature would be consistent with the higher shell side steam temperatures. *(section 4.13.1.6)*

69. **Prior to construction of final design**, Jordan Cove shall specify a cold gas bypass around the defrost gas heater to prevent defrost gas heater high temperature shutdown during low flow and startup conditions. *(section 4.13.1.6)*

70. **Prior to construction of final design**, Jordan Cove shall demonstrate that the differential pressure (dp) level transmitters on the LNG flash drum would not result in an excess number of false high-high-high level shutdowns. *(section 4.13.1.6)*

71. **Prior to construction of final design**, Jordan Cove shall specify a means to stop LNG flows to the BOG suction drum when the BOG compressor is shutdown to prevent filling the BOG suction drum with LNG. *(section 4.13.1.6)*

72. **Prior to construction of final design**, Jordan Cove shall specify a low instrument air pressure shutdown to prevent loss of control to air operated valves. *(section 4.13.1.6)*

73. **Prior to construction of final design**, Jordan Cove shall evaluate and, if applicable, address the potential for cryogenic feed gas back flow in the event relief valve 30-PSV-01002A/B is open. *(section 4.13.1.6)*

74. **Prior to construction of final design**, Jordan Cove shall include LNG tank fill flow measurement with high flow alarm. *(section 4.13.1.6)*

75. **Prior to construction of final design**, Jordan Cove shall specify a discretionary vent valve on each LNG storage tank that is operable through the Distributed Control System (DCS). In addition, a car sealed open manual block valve shall be provided upstream of the discretionary vent valve. *(section 4.13.1.6)*

76. **Prior to construction of final design**, Jordan Cove shall file the safe operating limits (upper and lower), alarm and shutdown set points for all instrumentation (e.g., temperature, pressures, flows, and compositions). *(section 4.13.1.6)*

77. **Prior to construction of final design**, Jordan Cove shall file cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices shall include alarms and shutdown functions, details of the voting and shutdown logic, and set points. *(section 4.13.1.6)*

78. **Prior to construction of final design**, Jordan Cove shall file an up-to-date equipment list, process and mechanical data sheets, and specifications. The specifications shall include:

    a. building specifications (e.g., control buildings, electrical buildings, compressor buildings, storage buildings, pressurized buildings, ventilated buildings, blast resistant buildings);
    b. mechanical specifications (e.g., piping, valve, insulation, rotating equipment, heat exchanger, storage tank and vessel, other specialized equipment);
    c. electrical and instrumentation specifications (e.g., power system, control system, safety instrument system [SIS], cable specifications, other electrical and instrumentation); and
    d. security and fire safety specifications (e.g., security, passive protection, hazard detection, hazard control, firewater). *(section 4.13.1.6)*

79. **Prior to construction of final design**, Jordan Cove shall file a list of all codes and standards and the final specification document number where they are referenced. *(section 4.13.1.6)*

80. **Prior to construction of final design**, Jordan Cove shall file complete specifications and drawings of the proposed LNG tank design and installation. *(section 4.13.1.6)*

81. **Prior to construction of final design**, Jordan Cove shall file an evaluation of emergency shutdown valve closure times. The evaluation shall account for the time to detect an upset or hazardous condition, notify plant personnel, and close the emergency shutdown valve(s). *(section 4.13.1.6)*

82. **Prior to construction of final design**, Jordan Cove shall file an evaluation of dynamic pressure surge effects from valve opening and closure times and pump startup and shutdown operations. *(section 4.13.1.6)*

83. **Prior to construction of final design**, Jordan Cove shall demonstrate that, for hazardous fluids, piping and piping nipples 2 inches or less in diameter are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators. *(section 4.13.1.6)*

84. **Prior to construction of final design**, Jordan Cove shall clearly specify the responsibilities of the LNG tank contractor and the EPC contractor for the piping associated with the LNG storage tank. *(section 4.13.1.6)*

85. **Prior to construction of final design**, Jordan Cove shall file the sizing basis and capacity for the final design of the flares and/or vent stacks as well as the pressure and vacuum relief valves for major process equipment, vessels, and storage tanks. *(section 4.13.1.6)*

86. **Prior to construction of final design**, Jordan Cove shall file an updated fire protection evaluation of the proposed facilities. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations shall be filed. The evaluation shall justify the type, quantity, and location of hazard detection and

hazard control, passive fire protection, emergency shutdown and depressurizing systems, firewater, and emergency response equipment, training, and qualifications in accordance with NFPA 59A (2001). The justification for the flammable and combustible gas detection and flame and heat detection systems shall be in accordance with ISA 84.00.07 or equivalent methodologies and would need to demonstrate 90 percent or more of releases (unignited and ignited) that could result in an off-site or cascading impact would be detected by two or more detectors and result in isolation and de inventory within 10 minutes. The analysis shall take into account the set points, voting logic, wind speeds, and wind directions. The justification for firewater shall provide calculations for all firewater demands based on design densities, surface area, and throw distance as well as specifications for the corresponding hydrant and monitors needed to reach and cool equipment. *(section 4.13.1.6)*

87. **Prior to construction of final design**, Jordan Cove shall file spill containment system drawings with dimensions and slopes of curbing, trenches, impoundments, and capacity calculations considering any foundations and equipment within impoundments, as well as the sizing and design of the down-comers. The spill containment drawings shall show containment for all hazardous fluids including all liquids handled above their flashpoint, from the largest flow from a single line for 10 minutes, including de-inventory, or the maximum liquid from the largest vessel (or total of impounded vessels) or otherwise demonstrate that providing spill containment would not significantly reduce the flammable vapor dispersion or radiant heat consequences of a spill. *(section 4.13.1.6)*

88. **Prior to construction of final design**, Jordan Cove shall file electrical area classification drawings. *(section 4.13.1.6)*

89. **Prior to construction of final design**, Jordan Cove shall provide documentation demonstrating adequate ventilation, detection, and electrical area classification based on the final selection of the batteries, and associated hydrogen off-gassing rates. *(section 4.13.1.6)*

90. **Prior to construction of final design**, Jordan Cove shall file drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system meet the requirements of NFPA 59A (2001). *(section 4.13.1.6)*

91. **Prior to construction of final design**, Jordan Cove shall file details of an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap shall vent to a safe location and be equipped with a leak detection device that shall continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems. *(section 4.13.1.6)*

92. **Prior to construction of final design**, Jordan Cove shall file complete drawings and a list of the hazard detection equipment. The drawings shall clearly show the location and elevation of all detection equipment. The list shall include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment. *(section 4.13.1.6)*

93. **Prior to construction of final design**, Jordan Cove shall file a technical review of facility design that:

    a. identifies all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and

    b. demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices would isolate or shutdown any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency. *(section 4.13.1.6)*

94. **Prior to construction of final design**, Jordan Cove shall file a design that includes hazard detection suitable to detect high temperatures and smoldering combustion products in electrical buildings and control room buildings. *(section 4.13.1.6)*

95. **Prior to construction of final design**, Jordan Cove shall file an evaluation of the voting logic and voting degradation for hazard detectors. *(section 4.13.1.6)*

96. **Prior to construction of final design**, Jordan Cove shall file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of the hazard detectors when determining the lower flammable limit set points for methane, ethylene, propane, isopentane, and condensate. *(section 4.13.1.6)*

97. **Prior to construction of final design**, Jordan Cove shall file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of hazard detectors when determining the set points for toxic components such as condensate and hydrogen sulfide. *(section 4.13.1.6)*

98. **Prior to construction of final design**, Jordan Cove shall file a drawing showing the location of the emergency shutdown buttons. Emergency shutdown buttons shall be easily accessible, conspicuously labeled, and located in an area which would be accessible during an emergency. *(section 4.13.1.6)*

99. **Prior to construction of final design**, Jordan Cove shall file facility plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Plan drawings shall clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers and shall demonstrate the spacing of extinguishers meet prescribed NFPA 10 travel distances. The list shall include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units and shall demonstrate they meet NFPA 59A. *(section 4.13.1.6)*

100. **Prior to construction of final design**, Jordan Cove shall file drawings and specifications for the structural passive protection systems to protect equipment and supports from cryogenic releases. *(section 4.13.1.6)*

101. **Prior to construction of final design**, Jordan Cove shall file calculations or test results for the structural passive protection systems to protect equipment and supports from cryogenic releases. *(section 4.13.1.6)*

102. **Prior to construction of final design**, Jordan Cove shall file drawings and calculations that demonstrate passive protection is provided in areas where jet fires may result in failure of structural supports. *(section 4.13.1.6)*

103. **Prior to construction of final design**, Jordan Cove shall file a detailed quantitative analysis to demonstrate that adequate thermal mitigation would be provided for each significant component within the 4,000 Btu/ft^2-hr zone from an impoundment, or provide an analysis that assesses the consequence of pressure vessel bursts and boiling liquid expanding vapor explosions. Trucks at the truck transfer station shall be included in the analysis. A combination of passive and active protection shall be provided and demonstrate the effectiveness and reliability. Effectiveness of passive mitigation shall be supported by calculations for the thickness limiting temperature rise and effectiveness of active mitigation shall be justified with calculations demonstrating flow rates and durations of any cooling water would mitigate the heat absorbed by the vessel. *(section 4.13.1.6)*

104. **Prior to construction of final design**, Jordan Cove shall file an evaluation and associated specifications and drawings of how they would prevent cascading damage of transformers (e.g., fire walls or spacing) in accordance with NFPA 850 or equivalent. *(section 4.13.1.6)*

105. **Prior to construction of final design**, Jordan Cove shall file facility plan drawings showing the proposed location of the firewater and any foam systems. Plan drawings shall clearly show the location of firewater and foam piping, post indicator valves, and the location and area covered by, each monitor, hydrant, hose, water curtain, deluge system, foam system, water-mist system, and sprinkler. All areas of the pretreatment area shall have adequate coverage. The drawings shall also include piping and instrumentation diagrams of the firewater and foam systems. *(section 4.13.1.6)*

106. **Prior to construction of final design**, Jordan Cove shall specify that the firewater pump shelter is designed to allow removal of the largest firewater pump or other component for maintenance with an overhead or external crane. *(section 4.13.1.6)*

107. **Prior to construction of final design**, Jordan Cove shall demonstrate that the firewater storage tanks are in compliance with NFPA 22 or demonstrate how API Standard 650 provides an equivalent or better level of safety. *(section 4.13.1.6)*

108. **Prior to construction of final design**, Jordan Cove shall specify that the firewater flow test meter is equipped with a transmitter and that a pressure transmitter is installed upstream of the flow transmitter. The flow transmitter and pressure transmitter shall be connected to the DCS and recorded. *(section 4.13.1.6)*

109. **Prior to construction of final design**, Jordan Cove shall file the settlement results during hydrostatic tests of the LNG storage containers and periodically thereafter to verify settlement is as expected and does not exceed the applicable criteria in API 620, API 625, API 653, and ACI 376. *(section 4.13.1.6)*

110. **Prior to construction of final design**, Jordan Cove shall file drawings of the storage tank piping support structure and support of horizontal piping at grade including pump columns, relief valves, pipe penetrations, instrumentation, and appurtenances. *(section 4.13.1.6)*

111. **Prior to construction of final design**, Jordan Cove shall file the structural analysis of the LNG storage tank and outer containment demonstrating they are designed to withstand all loads and combinations. *(section 4.13.1.6)*

112. **Prior to construction of final design**, Jordan Cove shall file an analysis of the structural integrity of the outer containment of the full containment LNG storage tank demonstrating it can withstand the radiant heat from a roof tank top fire or adjacent tank roof fire. *(section 4.13.1.6)*

113. **Prior to construction of final design**, Jordan Cove shall file a projectile analysis to demonstrate that the outer concrete impoundment wall of a full-containment LNG storage tank could withstand projectiles from explosions and high winds. The analysis shall detail the projectile speeds and characteristics and method used to determine penetration or perforation depths. *(section 4.13.1.6)*

114. **Prior to commissioning**, Jordan Cove shall file a detailed schedule for commissioning through equipment startup. The schedule shall include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids and during commissioning and startup. Jordan Cove shall file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued. *(section 4.13.1.6)*

115. **Prior to commissioning**, Jordan Cove shall file detailed plans and procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service. *(section 4.13.1.6)*

116. **Prior to commissioning**, Jordan Cove shall file settlement results from the hydrostatic tests of the LNG storage containers and shall file a plan to periodically verify settlement is as expected and does not exceed the applicable criteria set forth in API 620, API 625, API 653, and ACI 376. The program shall specify what actions would be taken after various levels of seismic events. *(section 4.13.1.6)*

117. **Prior to commissioning**, Jordan Cove shall file the operation and maintenance procedures and manuals, as well as safety procedures, hot work procedures and permits, abnormal operating conditions reporting procedures, simultaneous operations procedures, and management of change procedures and forms. *(section 4.13.1.6)*

118. **Prior to commissioning**, Jordan Cove shall file a plan for clean-out, dry-out, purging, and tightness testing. This plan shall address the requirements of the American Gas Association's Purging Principles and Practice, and shall provide justification if not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing. *(section 4.13.1.6)*

119. **Prior to commissioning**, Jordan Cove shall tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves. *(section 4.13.1.6)*

120. **Prior to commissioning**, Jordan Cove shall file a plan to maintain a detailed training log to demonstrate that operating, maintenance, and emergency response staff have completed the required training. *(section 4.13.1.6)*

121. **Prior to commissioning**, Jordan Cove shall file the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3. The procedures shall include a line list of pneumatic and hydrostatic test pressures. *(section 4.13.1.6)*

122. **Prior to introduction of hazardous fluids**, Jordan Cove shall complete and document a pre-startup safety review to ensure that installed equipment meets the design and operating intent of the facility. The pre-startup safety review shall include any changes since the last hazard review, operating procedures, and operator training. A copy of the review with a list of recommendations, and actions taken on each recommendation, shall be filed. *(section 4.13.1.6)*

123. **Prior to introduction of hazardous fluids**, Jordan Cove shall complete and document all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the DCS and SIS that demonstrates full functionality and operability of the system. *(section 4.13.1.6)*

124. **Prior to introduction of hazardous fluids**, Jordan Cove shall develop and implement an alarm management program to reduce alarm complacency and maximize the effectiveness of operator response to alarms. *(section 4.13.1.6)*

125. **Prior to introduction of hazardous fluids**, Jordan Cove shall complete and document clean agent acceptance tests. *(section 4.13.1.6)*

126. **Prior to introduction of hazardous fluids**, Jordan Cove shall complete and document a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant shall be shown on facility plot plan(s). *(section 4.13.1.6)*

127. **Prior to introduction of hazardous fluids**, Jordan Cove shall complete and document foam system and sprinkler system acceptance tests. *(section 4.13.1.6)*

128. Jordan Cove shall file a request for written authorization from the Director of OEP **prior to unloading or loading the first LNG commissioning cargo**. After production of first LNG, Jordan Cove shall file weekly reports on the commissioning of the proposed systems that detail the progress toward demonstrating the facilities can safely and reliably operate at or near the design production rate. The reports shall include a summary of activities, problems encountered, and remedial actions taken. The weekly reports shall also include the latest commissioning schedule, including projected and actual LNG production by each liquefaction train, LNG storage inventories in each storage tank, and the number of anticipated and actual LNG commissioning cargoes, along with the

associated volumes loaded or unloaded. Further, the weekly reports shall include a status and list of all planned and completed safety and reliability tests, work authorizations, and punch list items. Problems of significant magnitude shall be reported to the FERC within 24 hours. *(section 4.13.1.6)*

129. **Prior to commencement of service**, Jordan Cove shall file a request for written authorization from the Director of OEP. Such authorization will only be granted following a determination by the Coast Guard, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the MTSA of 2002, and the Security and Accountability For Every Port Act, that appropriate measures to ensure the safety and security of the facility and the waterway have been put into place by Jordan Cove or other appropriate parties. *(section 4.13.1.6)*

130. **Prior to commencement of service**, Jordan Cove shall notify the FERC staff of any proposed revisions to the security plan and physical security of the plant. *(section 4.13.1.6)*

131. **Prior to commencement of service**, Jordan Cove shall label piping with fluid service and direction of flow in the field, in addition to the pipe labeling requirements of NFPA 59A (2001). *(section 4.13.1.6)*

132. **Prior to commencement of service**, Jordan Cove shall provide plans for any preventative and predictive maintenance program that performs periodic or continuous equipment condition monitoring. *(section 4.13.1.6)*

133. **Prior to commencement of service**, Jordan Cove shall develop procedures for offsite contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by Jordan Cove staff. *(section 4.13.1.6)*

In addition, conditions 134 through 137 shall apply throughout the life of the Jordan Cove LNG Project.

134. The facility shall be subject to regular FERC staff technical reviews and site inspections on at least an **annual** basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Jordan Cove shall respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed P&IDs reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, shall be submitted. *(section 4.13.1.6)*

135. **Semi-annual** operational reports shall be filed with the Secretary to identify changes in facility design and operating conditions; abnormal operating experiences; activities (e.g., ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil off/flash gas); and plant modifications, including future plans and progress thereof. Abnormalities shall include, but not be limited to, unloading/loading/shipping problems, potential hazardous conditions from offsite vessels, storage tank stratification or rollover, geysering, storage tank pressure

excursions, cold spots on the storage tank, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluids releases, fires involving hazardous fluids and/or from other sources, negative pressure (vacuum) within a storage tank, and higher than predicted boil off rates. Adverse weather conditions and the effect on the facility also shall be reported. Reports shall be submitted **within 45 days after each period ending June 30 and December 31**. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" shall be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance at the LNG facilities. *(section 4.13.1.6)*

136. In the event the temperature of any region of the LNG storage container, including any secondary containment and imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission shall be notified **within 24 hours** and procedures for corrective action shall be specified. *(section 4.13.1.6)*

137. Significant non-scheduled events, including safety-related incidents (e.g., LNG, condensate, refrigerant, or natural gas releases; fires; explosions; mechanical failures; unusual over pressurization; and major injuries) and security-related incidents (e.., attempts to enter site, suspicious activities) shall be reported to the FERC staff. In the event that an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made **immediately**, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification shall be made to the FERC staff **within 24 hours**. This notification practice shall be incorporated into the liquefaction facility's emergency plan. Examples of reportable hazardous fluids-related incidents include:

   a. fire;

   b. explosion;

   c. estimated property damage of $50,000 or more;

   d. death or personal injury necessitating in-patient hospitalization;

   e. release of hazardous fluids for 5 minutes or more;

   f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

   g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

   h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure-limiting or control devices;

i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;

j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;

l. safety-related incidents from hazardous fluids transportation occurring at or en route to and from the LNG facility; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property, or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, the FERC staff would determine the need for a separate follow-up report or follow up in the upcoming semi-annual operational report. All company follow-up reports shall include investigation results and recommendations to minimize a reoccurrence of the incident. *(section 4.13.1.6)*