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Retrospective Case Study in Southwestern Pennsylvania

STUDY OF THE POTENTIAL IMPACTS OF HYDRAULIC FRACTURING ON DRINKING WATER RESOURCES

United States Environmental Protection Agency
Office of Research and Development

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Table of Contents

List of Tables

List of Figures

Acronyms and Abbreviations

ADQ	audit of data quality
AMD	acid mine drainage
ATSDR	Agency for Toxic Substances and Disease Registry
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CH_4	methane
CLP	Contract Laboratory Program
CO_2	carbon dioxide
CRDS	cavity ring-down spectrometry
DIC	dissolved inorganic carbon
DOC	dissolved organic carbon
DOI	(U.S.) Department of the Interior
DRO	diesel-range organics
$\delta^{18}O_{H2O}$	oxygen-18/oxygen-16 isotopic ratio in water
$\delta^{2}H_{H2O}$	deuterium/hydrogen isotopic ratio in water
$\delta^{13}C_{CH4}$	carbon-13/carbon-12 isotopic ratio in methane
$\delta^{2}H_{CH4}$	deuterium/hydrogen isotopic ratio in methane
$\delta^{13}C_{DIC}$	carbon-13/carbon-12 isotopic ratio in DIC
EPA	(U.S.) Environmental Protection Agency
EDR	Environmental Data Resources, Inc.
GC/MS	gas chromatography/mass spectrometry
GPS	global positioning system
GRO	gasoline-range organics
GWERD	Ground Water and Ecosystems Restoration Division
H_2SO_4	sulfuric acid
HPLC	high-performance liquid chromatography
IRMS	isotope ratio mass spectrometry
LC-MS-MS	liquid chromatography–tandem mass spectrometry
LLNL	Lawrence Livermore National Laboratory

LMWL	local meteoric water line
MCL	maximum contaminant level
MDL	method detection limit
mL	milliliters
mV	millivolts
µg/L	micrograms per liter
µS/cm	microsiemens per centimeter
mg/L	milligrams per liter
mmol/L	millimoles per liter
mol/L	moles per liter
NaCl	sodium chloride
$NaHCO_3$	sodium bicarbonate
NIST	National Institute of Standards and Technology
NLCD	National Land Cover Database
NRMRL	National Risk Management Research Laboratory
NTU	nephelometric turbidity unit
NURE	National Uranium Resource Evaluation
NWIS	National Water Information System
ORD	Office of Research and Development
ORP	oxidation-reduction potential
PA DCNR	Pennsylvania Department of Conservation and Natural Resources
PA DEP	Pennsylvania Department of Environmental Protection
pC_i/L	picocuries per liter
permil	‰, parts per thousand
ppm	parts per million
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QL	quantitation limit

RCRA	Resource Conservation and Recovery Act
RSKERL	Robert S. Kerr Environmental Research Laboratory
SLAP	Standard Light Antarctic Precipitation
SMCL	secondary maximum contaminant level
SPC	specific conductance
STORET	STOrage and RETrieval
SVOC	semivolatile organic compound
TDS	total dissolved solids
TIC	tentatively identified compound
USGS	U.S. Geological Survey
VOC	volatile organic compound
VPDB	Vienna Pee Dee Belemnite
VSMOW	Vienna Standard Mean Ocean Water

Preface

The U.S. Environmental Protection Agency (EPA) is conducting a study of the potential impacts of hydraulic fracturing for oil and gas on drinking water resources. This study was initiated in Fiscal Year 2010 when Congress urged the EPA to examine the relationship between hydraulic fracturing and drinking water resources in the United States. In response, EPA developed a research plan (*Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources*) that was reviewed by the Agency's Science Advisory Board (SAB) and issued in 2011. A progress report on the study (*Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources: Progress Report)*, detailing the EPA's research approaches and next steps, was released in late 2012 and was followed by a consultation with individual experts convened under the auspices of the SAB.

The EPA's study includes the development of several research projects, extensive review of the literature and technical input from state, industry, and non-governmental organizations as well as the public and other stakeholders. A series of technical roundtables and in-depth technical workshops were held to help address specific research questions and to inform the work of the study. The study is designed to address research questions posed for each stage of the hydraulic fracturing water cycle:

- Water Acquisition: What are the possible impacts of large volume water withdrawals from ground and surface waters on drinking water resources?
- Chemical Mixing: What are the possible impacts of surface spills of hydraulic fracturing fluid on or near well pads on drinking water resources?
- Well Injection: What are the possible impacts of the injection and fracturing process on drinking water resources?
- Flowback and Produced Water: What are the possible impacts of surface spills of flowback and produced water on or near well pads on drinking water resources?
- Wastewater Treatment and Waste Disposal: What are the possible impacts of inadequate treatment of hydraulic fracturing wastewaters on drinking water resources?

This report, *Retrospective Case Study in Southwestern Pennsylvania*, is the product of one of the research projects conducted as part of the EPA's study. It has undergone independent, external peer review in accordance with Agency policy, and all of the peer review comments received were considered in the report's development.

The EPA's study will contribute to the understanding of the potential impacts of hydraulic fracturing activities for oil and gas on drinking water resources and the factors that may influence those impacts. The study will help facilitate and inform dialogue among interested stakeholders, including Congress, other Federal agencies, states, tribal government, the international community, industry, non-governmental organizations, academia, and the general public.

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Executive Summary

In December 2009, Congress urged the U.S. Environmental Protection Agency (EPA) to study the relationship between hydraulic fracturing and drinking water resources. This report provides the results of one of five retrospective case studies conducted as part of the resulting national study (US EPA, 2012). The retrospective case studies focused on investigating reported instances of drinking water contamination in areas where hydraulic fracturing had already occurred. This report describes the retrospective case study for southwestern Pennsylvania, which was conducted in Amwell, Cross Creek, Hopewell, and Mount Pleasant Townships in Washington County, locations that have witnessed unconventional gas production from the Devonian-age Marcellus Shale.

The Marcellus Shale is an unconventional shale-gas reservoir within the Appalachian Basin, a northeast-to-southwest oriented basin that extends from New York in the northeast to northern Georgia and Alabama in the southwest. In Washington County, the Marcellus Shale ranges in thickness from less than 50 to about 150 feet, and varies in depth from about 5,000 to over 7,000 feet below land surface. Gas production from the Marcellus Shale depends on recent advances in horizontal drilling and hydraulic fracturing technologies to enhance and create fracture porosity and permeability to facilitate gas flow. Oil and gas exploration and production has a long history in Washington County, extending back to the late 1800s. Much of the early resource extraction in Washington County occurred at much shallower depths compared to present-day gas development from the Marcellus Shale. In this study, water quality samples were collected from 16 domestic wells, three springs, and three surface water locations during three events in July 2011, March 2012, and May 2013. The sampling locations were selected based upon public recommendations and concerns of landowners about deteriorated water quality potentially linked to nearby drilling, hydraulic fracturing, and the related use of pits and impoundments for storing drilling wastes and flowback/produced water from the Marcellus Shale. The domestic wells sampled in Washington County ranged in depth from 50 to 160 feet below land surface, with a median depth of 95 feet below land surface.

The geochemistry of water samples was investigated by analysis of major ions, trace metals, dissolved methane/ethane gas concentrations, volatile organic compounds (VOCs), low-molecular-weight acids, semivolatile organic compounds (SVOCs), glycol ethers, diesel-range organics (DRO), gasoline-range organics (GRO), radiometric constituents, strontium isotope ratios, and selected stable isotopes ($\delta^{18}O_{H2O}$, $\delta^{2}H_{H2O}$, $\delta^{13}C_{DIC}$, $\delta^{13}C_{CH4}$, and $\delta^{2}H_{CH4}$) (see Appendices A and B of this report). Major ion data collected for this study were compared to historical water quality data obtained from the literature and national water quality databases, including the U.S. Geological Survey (USGS) National Water Information System (NWIS) and National Uranium Resource Evaluation (NURE) databases. These data sources provide water quality data for samples collected before 2005, and therefore before Marcellus Shale gas recovery. Statistical comparisons (ANOVA and Kruskal-Wallis) were made between the data collected for this study and historical data on a countywide basis and on a reduced-area (3-mile-radius) basis in order to specifically focus on historical water quality samples collected near the sampling locations of this study. To help determine whether hydraulic fracturing or processes related to hydraulic fracturing had caused or contributed to alleged impacts on water quality, other potential contaminant sources were identified through detailed environmental record searches (see Appendix C of this report).

Three ground water types were identified in this study based on major ion chemistry: the calcium-bicarbonate, sodium-bicarbonate, and calcium-chloride types. These ground water types generally coincide with major ion types identified in historical water quality data, with the exceptions that the calcium-chloride water type was unique to this study and the sodium-sulfate and calcium-sulfate water types prevalent in the NWIS database were not identified at the sampling locations of this study. Elevated concentrations of chloride relative to historical water quality data and time-dependent concentration behavior indicate that a recent ground water impact occurred at sampling locations of this study near the Yeager impoundment in Amwell Township. Based on background assessment and evaluation of existing data, candidate causes for the issues concerning ground water chemistry at these sampling locations include historical land use, current drilling processes and practices, historical drilling practices, naturally occurring sources, and road salt. These potential causes are examined using available geochemical data, land use information, and data obtained from environmental record searches. The water quality trends with time suggest that the chloride anomaly is linked to sources associated with the impoundment site; site-specific data are unavailable to provide more definitive assessments of the primary causes(s) and longevity of the ground water impact.

Methane occurs naturally in ground water in southwestern Pennsylvania and is present within subsurface glacial deposits, Permian- and Pennsylvania-age coal seams/sedimentary deposits, as well as underlying Devonian-age strata, including the Marcellus Shale. Methane dissolved in water is odorless and tasteless; at high concentrations, dissolved methane can outgas and produce flammable or explosive environments. In this study, dissolved methane was detected in 24% of the ground water and spring water samples collected; detected concentrations ranged from about 0.002 to 15.5 milligrams per liter (mg/L), with a median value of 0.045 mg/L. One domestic well sampled in this study had a methane concentration above the Pennsylvania Department of Environmental Protection (PA DEP) action level of 7 mg/L. Concentrations of methane were sufficient at this and one other location for measurement of the C and H isotope signatures, which ranged from -76.0 to -52.5 permil (‰) and -239 to -161 permil, respectively. The most negative values, characteristic of biogenic sources, were also associated with the highest methane concentration observed in this study. The combined C and H isotope signatures in domestic well waters were distinct from the reported thermogenic composition of Marcellus Shale gas ($\delta^{13}C_{CH4}$ = -38.1 to -28.7 permil; $\delta^{2}H_{CH4}$ = -167 to -157 permil). Evaluations of $^{87}Sr/^{86}Sr$, $\delta^{13}C_{DIC}$, $\delta^{18}O_{H2O}$, $\delta^{2}H_{H2O}$, [Cl/Br], and [SO_4/Cl] ratio data from the sampling locations selected for this study provide no clear evidence of contamination of shallow ground water by flowback or produced water from Marcellus Shale gas wells, Upper Devonian sands, and/or other deep brines.

Water samples were analyzed for organic chemicals, including VOCs, SVOCs, glycol ethers, low-molecular-weight acids, DRO, and GRO; these analyses evaluated up to 133 organic compounds in total. The purpose of these analyses was to evaluate ground water and surface water for the potential occurrence of chemicals documented as components of hydraulic fracturing fluids, and specifically the chemicals in fracturing fluids that have been applied in Pennsylvania. There were no detections of glycol ethers, GRO compounds, or acetate in ground water and surface water samples. VOCs (toluene, benzene, chloroform, and acetone), SVOCs (2-butoxyethanol, phenol, and phthalates), and DRO compounds were detected at some locations during some of the sampling rounds. Detected concentrations of VOCs were 1.9 to 4.0 orders of magnitude below EPA's drinking water standards (maximum contaminant levels [MCLs], where available) and included: (i) toluene at two locations during the first and last sampling rounds; (ii) benzene at one location during the last sampling round; (iii) acetone at three locations during the last sampling round; and (iv) chloroform at two locations during the last sampling round. Detected concentrations of SVOCs were below EPA MCLs, where available, and included: (i) phthalates at eight locations mainly during the first round of sampling; (ii) 2-butoxyethanol at eight locations during the first round of sampling; and (iii) phenol at two locations during the first round of sampling. Detection of individual SVOCs were not repeated at any location during the multiple sampling rounds of this case study. Lack of correlation with other potential chemical indicators in ground water samples with low-level concentrations of VOCs and/or SVOCs, such as elevated chloride and other organic compounds such as glycol ethers, indicates that the infrequent detections of organic compounds likely did not originate from hydraulic fracturing activities.

A total of 24 ground water and four surface water samples were collected for radionuclide measurements during the latter two sampling events. Previous studies have shown high levels of radium (73 to 6,540 picocuries per liter, pC_i/L) in produced water from the Marcellus Shale. The isotopes of radium (^{226}Ra and ^{228}Ra) were not detected in any of the surface water or shallow ground water samples collected in this study above 1 pC_i/L. The EPA MCL for gross α activity is 15 pC_i/L. In this study, gross α and gross β were detected above method reporting limits in one sample collected from a domestic well in May 2013 at activities of 6.3 and 10.3 pC_i/L, respectively. The gross α activity determined in the ground water from this well was below the EPA MCL. The radionuclide results are consistent with the isotope data for water, dissolved inorganic carbon, and strontium and suggest that shallow ground water and surface water from the selected sampling locations of this study were not impacted by flowback or produced water from Marcellus Shale gas wells or other deep brines enriched in radioactive substances.

Primary MCL exceedances were observed in this study at one location for nitrate and at two locations for total lead. Sources of nitrate to ground water include septic systems, animal manure, and fertilizers applied to lawns and crops; nitrate is not typically considered to be associated with hydraulic fracturing operations. The mobility of lead in ground water is limited due to the low solubility of lead carbonates and hydroxy carbonates, and because of the tendency for lead to sorb to mineral surfaces. Lead is not typically considered to be associated with hydraulic fracturing operations but can be derived from weathering of natural lead-containing minerals and drinking water can potentially be contaminated by lead pipes or copper pipes with lead solder.

Water quality data collected for this study are consistent with historical observations showing the common occurrence and wide-ranging concentrations of iron and manganese in ground water in Washington County, Pennsylvania. Many of the accounts conveyed by local residents about the quality of water from their wells related to episodic turbidity and discolored water; in many cases these descriptions were suggestive of the presence of particulate iron and/or manganese. Concentrations of iron and manganese in ground water systems are predominantly controlled by oxidation–reduction (redox) reactions. In this study, these elements showed negative correlations with redox potential (E_H), that is, higher concentrations of iron and manganese were associated with lower E_H, or more reducing conditions. While the occurrences of iron and manganese in ground water of Washington County likely stem from geology and geochemical processes that result in the natural enrichment of these elements in regional aquifers, this water quality issue may be amplified in areas of active drilling. Previous studies in Pennsylvania showed that some water wells sampled before and after drilling activities had increased levels of iron and manganese. Such impacts may be related to vibrations and energy pulses put into the ground during drilling and/or other operations. These energy inputs may cause naturally formed particles containing iron and manganese to mobilize and possibly increase turbidity and may explain temporally isolated instances of reduced water quality. Such transient water quality events were not captured at any location during the sampling conducted for this case study.

Key observations/findings from this study are summarized below.

- Elevated concentrations of chloride relative to historical water quality data and time-dependent concentration behavior indicate that a recent ground water impact occurred at sampling locations near the Yeager impoundment in Amwell Township. The impact resulted in chloride concentrations in a drinking water supply that exceeded the secondary MCL and a shift in ground water chemistry toward a calcium-chloride composition. The impoundment site was used to store drilling wastes and wastewater associated with the hydraulic fracturing water cycle.

- Dissolved methane was detected in 24% of the ground water and spring water samples collected in this study at concentrations that ranged from about 0.002 to 15.5 mg/L. Carbon and hydrogen isotope signatures of methane in domestic well waters were distinct from the reported thermogenic composition of Marcellus Shale gas. Methane occurs naturally in ground water in southwestern Pennsylvania and is present within subsurface glacial deposits, Permian- and Pennsylvania-age coal seams/sedimentary deposits, as well as underlying Devonian-age strata, including the Marcellus Shale.

- There were no detections in this study of glycol ethers, GRO compounds, or acetate in ground water and surface samples collected in Washington County. Detections of VOCs and SVOCs were infrequent, below EPA's drinking water MCLs, and did not correlate with other potential indicators of hydraulic fracturing fluids, such as elevated chloride and/or the presence of glycol ethers.

- Primary MCL exceedances were observed in this study at one location for nitrate and at two locations for total lead; the occurrences of nitrate and lead in ground water are not considered to be associated with hydraulic fracturing operations.

- Secondary MCL exceedances for manganese and iron were common in homeowner wells; increased concentrations of these elements correlate with moderately reducing ground water conditions and are consistent with historical observations that demonstrate the natural enrichment of these elements in regional aquifers. Transient episodes of decreased water quality from increased concentrations of iron and/or manganese and increased turbidity may be amplified in areas of active drilling.

1. Introduction

Recent advances in drilling technologies (horizontal drilling) and well stimulation (hydraulic fracturing) have resulted in large-scale development of vast, unconventional reserves of oil and gas across a wide range of geographic regions and geologic formations in the United States. These reserves are considered unconventional, because they are bound up in low-permeability reservoirs such as shale, tight sands, limestone, and coal beds, and recovery of these reserves was previously uneconomical. While some of this new development is occurring in areas with mature oil and gas fields, areas with very little or no previous oil and gas development also are now being developed. As a result, there are rising concerns over potential impacts on human health and the environment, including potential effects on drinking water resources. Environmental concerns include the potential for contamination of shallow ground water by stray gases (methane), fracturing chemicals associated with unconventional gas development, and formation waters (brines).

In December 2009, Congress urged the U.S. Environmental Protection Agency (EPA) to study the relationship between hydraulic fracturing and drinking water. The study was to be conducted using an approach that relied on the best available science as well as independent sources of information, and through a transparent, peer-reviewed process that would ensure the validity and accuracy of the data. EPA consulted with other federal agencies and appropriate state and interstate regulatory agencies in carrying out the study (US EPA, 2010a). In February 2011, EPA issued the *Draft Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources* (US EPA, 2011a). The final *Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources* was released in November 2011 (US EPA, 2011b).

In 2011, EPA began to research the potential impacts of hydraulic fracturing on drinking water resources, if any, and to identify the driving factors that could affect the severity and frequency of any such impacts. EPA scientists focused primarily on hydraulic fracturing of shale formations, with some study of other oil- and gas-producing formations, including coal beds. EPA designed the scope of the research around five stages of the hydraulic fracturing water cycle (US EPA, 2012).

Each stage of the cycle is associated with a primary research question:

- Water acquisition: What are the potential impacts of large-volume water withdrawals from ground water and surface waters on drinking water resources?
- Chemical mixing: What are the potential impacts of hydraulic fracturing fluid surface spills on or near well pads on drinking water resources?
- Well injection: What are the potential impacts of the injection and fracturing process on drinking water resources?
- Flowback and produced water: What are the potential impacts of flowback and produced water (collectively referred to as "hydraulic fracturing wastewater") surface spills on or near well pads on drinking water resources?
- Wastewater treatment and waste disposal: What are the potential impacts of inadequate treatment of hydraulic fracturing wastewater on drinking water resources?

Prior to the release of the study plan, EPA invited the public to nominate specific regions of the United States for inclusion as potential sites for retrospective case studies. The plan identified 41 potential sites. The studies were to focus on investigating reported instances of drinking water resource contamination in areas where hydraulic fracturing had already occurred and were intended to inform several of the primary research questions related to chemical mixing, well injection, and flowback and produced water. Of the 41 sites nominated during the stakeholder process, EPA selected five sites across the United States at which to conduct the retrospective case studies. The sites were deemed illustrative of the types of problems that were reported to EPA during stakeholder meetings held in 2010 and 2011. Additional information on site selection can be found in US EPA (2011b). EPA's plan for the retrospective case studies was to make a determination of the presence and extent of drinking water resource contamination, if any, as well as whether hydraulic fracturing or related processes contributed to the contamination. Thus, the retrospective sites were expected to provide EPA with information regarding key factors that may be associated with drinking water contamination from hydraulic fracturing activities (US EPA, 2011b).

In 2011, EPA began conducting investigations at the five selected sites in Washington County, Pennsylvania (southwestern Pennsylvania); Bradford County, Pennsylvania (northeastern Pennsylvania); Wise County, Texas; Las Animas and Huerfano Counties, Colorado (Raton Basin); and Dunn County, North Dakota (Killdeer). This report presents the results of the retrospective case study in southwestern Pennsylvania that was conducted in Amwell, Cross Creek, Hopewell, and Mount Pleasant Townships in Washington County, locations where hydraulic fracturing has already occurred and may continue to occur (see Figure 1). Hydraulic fracturing activities in these areas mainly focus on recovering natural gas from the Marcellus Shale, a large reservoir of natural gas in the Appalachian Basin.

The sampling locations selected for this study were based primarily on homeowner concerns regarding potential adverse impacts on their well water and possible association with the drilling or processes related to hydraulic fracturing in the vicinity of their homes. The study specifically focused on two areas in Washington County: the northern area and southern area (see Figure 2). In the northern area, homeowner reports included recent changes in water quality (e.g., turbidity, staining properties, taste, and odors) of the drinking water in their homes and concerns regarding the use of impoundments (specifically the Carter impoundment). In the southern area, homeowner concerns focused on changes in water quality and the possibility that water quality issues were related to the collection and storage of flowback and other water in an impoundment (the Yeager impoundment) and drill cuttings in a reserve pit on the Yeager Unit 7H well pad (see Figure 3). The 7H well (horizontal Marcellus well) was completed in December 2009. Well records indicate that in 2011 the well was activated and began producing natural gas, and it continued to produce through the first quarter of 2013 (PA DEP, 2013). A plan for closure and reclamation of the Yeager impoundment site was submitted to the Pennsylvania Department of Environmental Protection (PA DEP) in February 2014.

The following sections of this report provide the purpose and scope of this case study, an overview of the case study site background, study methods, historical water quality data, analysis of the study sample data, a discussion of site-specific topics, and a summary of the case study findings.

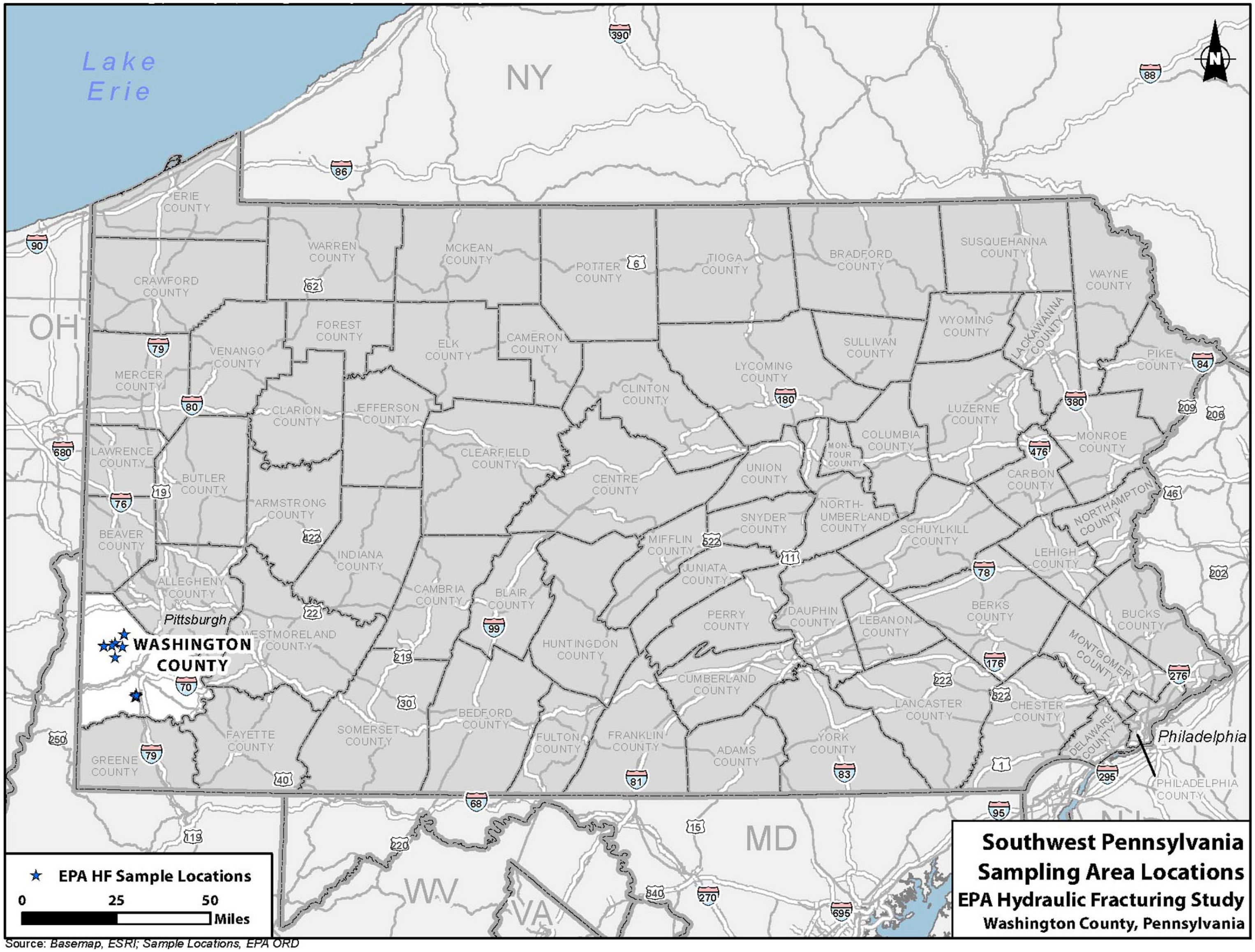


Figure 1. Location map of Washington County in southwestern Pennsylvania.

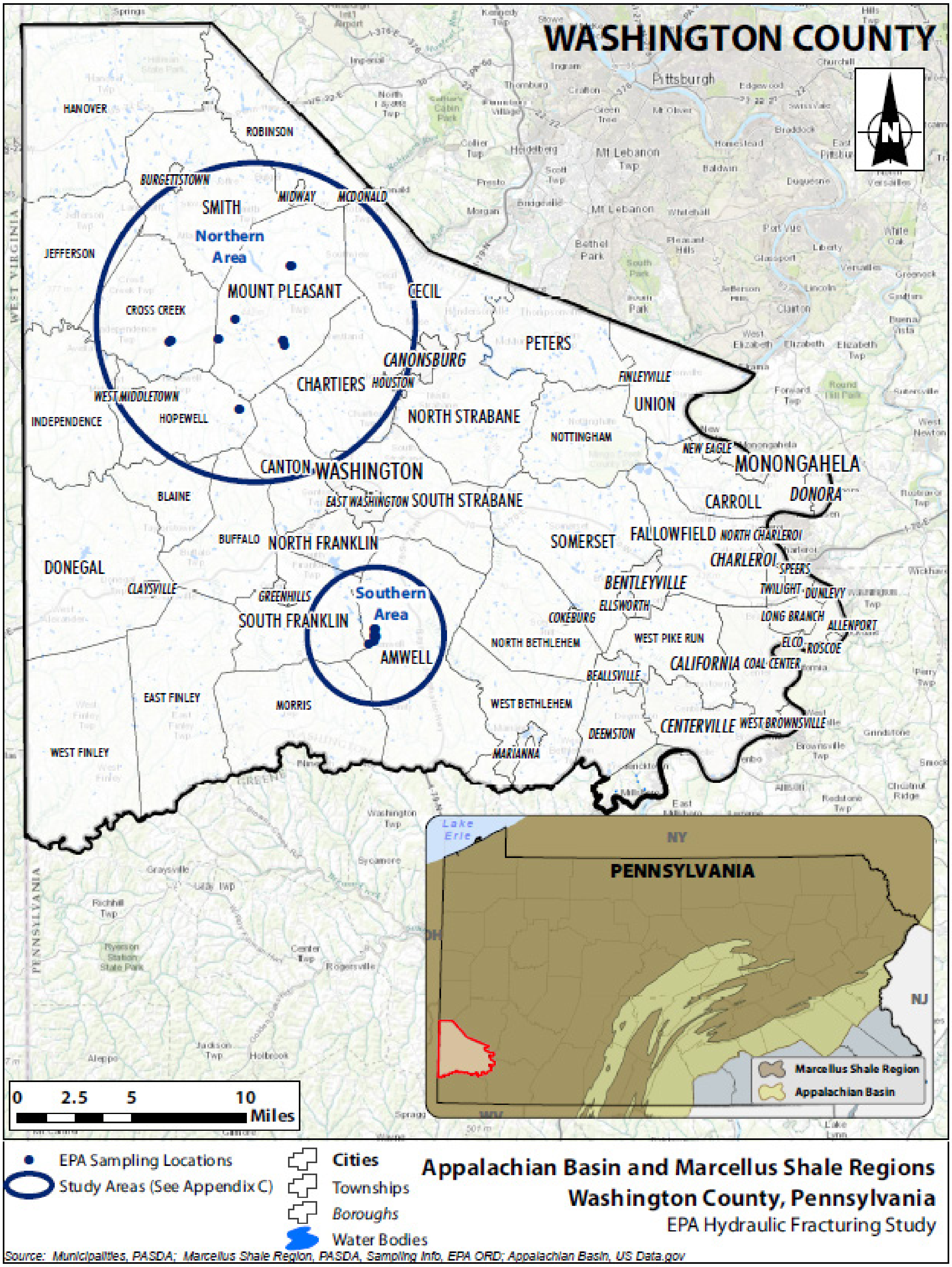


Figure 2. Map of the study areas for the southwestern Pennsylvania retrospective case study within the Appalachian Basin. The blue circles show the northern and southern study areas.

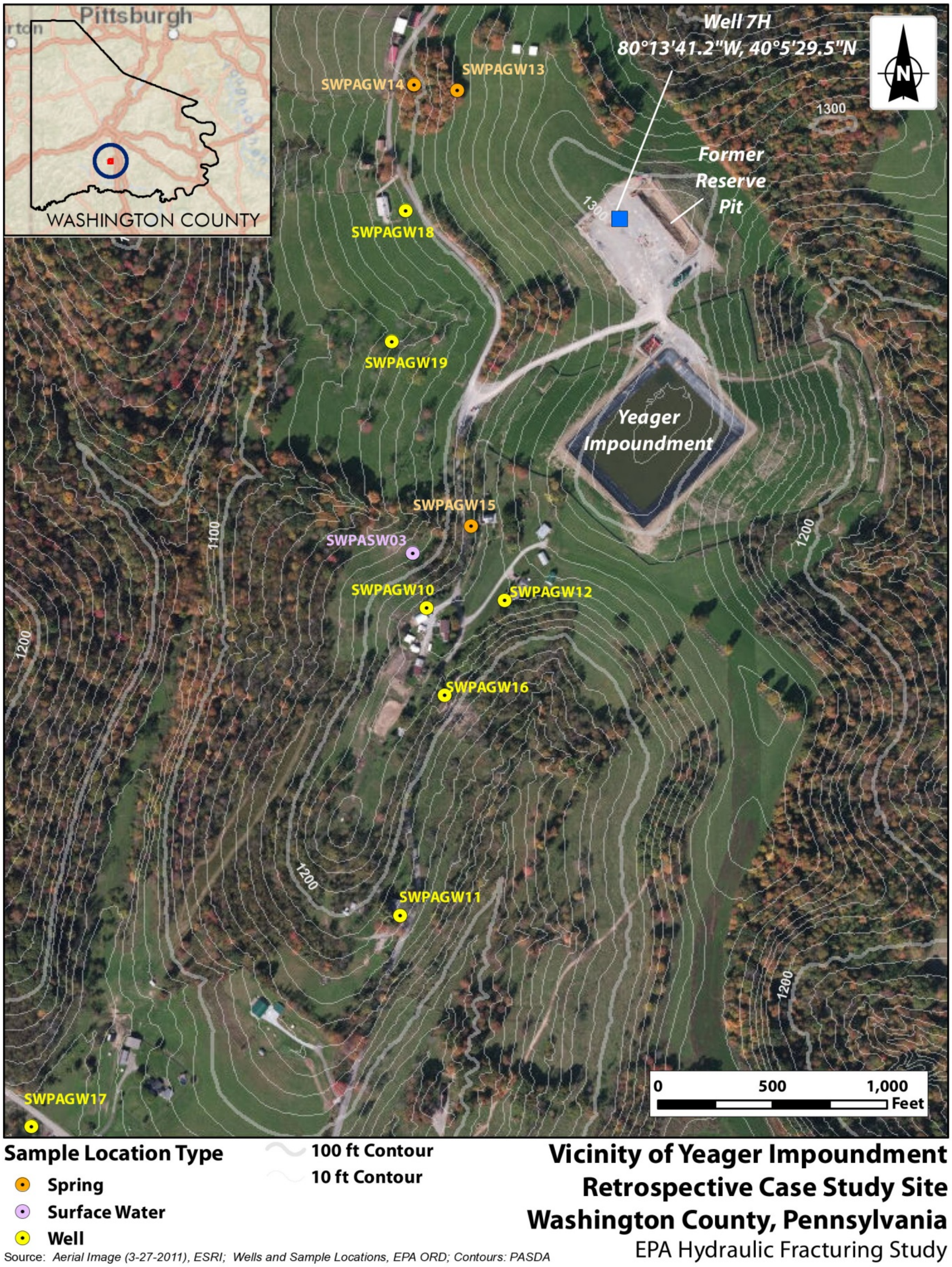


Figure 3. Map of the Yeager impoundment area and nearby sampling locations, southern area.

2. Purpose and Scope

As a component of EPA's *National Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources* (US EPA, 2012), five retrospective case studies were conducted to investigate reported instances of drinking water resource contamination in areas of natural gas development and use of hydraulic fracturing technology. These studies were intended to inform primary research questions related to the hydraulic fracturing water cycle (US EPA, 2012).

This report provides the results of the retrospective case study conducted in southwestern Pennsylvania and describes the general water quality and geochemistry of shallow ground water and surface water in Washington County, Pennsylvania. This area has been the focus of natural gas extraction from the Devonian-age Marcellus Shale. Water quality results are used to evaluate the potential impacts on drinking water resources, if any, from various land use activities not restricted to shale-gas drilling and production. The evaluation of potential impacts includes consideration of the chemicals commonly used in hydraulic fracturing, analyses of dissolved gases and their isotopic compositions, deep brine geochemistry in relation to shallow ground water geochemistry, historical ground water quality in Washington County, and time-dependent geochemical trends. Potential causes of water quality impairment that were evaluated include: industrial/commercial land use, historical land use (e.g., farming and mining), current drilling processes/practices, historical drilling practices, and naturally occurring sources of contamination.

This report presents analytical data for water samples from 22 locations representing domestic wells, springs, and surface water bodies that were sampled at least once during three rounds spanning 22 months (July 2011, March 2012, and May 2013) in Amwell, Cross Creek, Hopewell, and Mount Pleasant Townships. The water samples were analyzed for over 235 constituents, including organic compounds, nutrients, major ions, metals and trace elements, gross radioactivity and radioisotopes, dissolved gases, and selected stable isotopes. Ground water quality data and summary statistics are presented for sampled constituents. In addition to chemical data collected specifically for this study, the report includes analysis of literature data, historical data from the U.S. Geological Survey (USGS) National Water Information System (NWIS) database, and other sources of water quality data for Washington County.

Each of the retrospective case study sites differs in geologic and hydrologic characteristics; however, generally similar research approaches were followed at the case study locations to assess potential drinking water impacts. As described in US EPA (2012), a tiered approach was followed to guide the progress of the retrospective case studies. The tiered scheme uses the results of successive steps or tiers to refine research activities. This report documents progress through the Tier 2 stage and includes the results of water sampling activities and evaluation of water quality impacts. The approach for Tier 2 efforts included a literature review of background geology and hydrology; the choice of sampling locations and the development of a site-specific Quality Assurance Project Plan (QAPP); sampling and analysis of water wells, springs, and surface water; analysis of historical background data and evaluation of new results against background data; statistical and geochemical evaluation of water quality data; evaluation of potential drinking water contamination; and identification of potential sources of identified contamination, if applicable. Further evaluation of identified contaminant sources and contaminant transport and fate, including the collection of site-specific hydrogeologic information, is not part of the scope of this report.

3. Study Area Background

Washington County is in the southwest corner of Pennsylvania, about 28 miles southwest of downtown Pittsburgh (Figure 1). The county covers about 857 square miles. According to the census results of 2010, the population density in Washington County was about 240 people per square mile. Mean temperatures range from about 27 to 70 degrees Fahrenheit in winter and summer months, respectively. Average annual precipitation is about 40 inches, with the highest precipitation levels typically occurring in May. The study area is in the Appalachian Plateau physiographic province, which is characterized by rolling hills, valleys, and sharp terrain in some areas. Stream erosion has created an incised landscape with up to 750 feet of relief between stream valleys and hilltops (Newport, 1973).

3.1. Geology

The geology of Washington County consists of thick sequences of Paleozoic-era (542 to 251 million years ago) sedimentary strata, which have accumulated in the Appalachian Basin, a northeast-to-southwest-oriented basin that extends from New York in the northeast to northern Georgia and Alabama in the southwest (Shultz, 1999). In this basin, sedimentary rocks generally dip and thicken to the southeast, toward the basin axis. The rocks of the Appalachian Basin represent both clastic and biochemical sedimentary deposits from a variety of paleoenvironments including terrestrial swamps, near-shore environments, and deep marine basins. The basement rocks of Washington County are Precambrian in age and they are not known to have been penetrated by drilling activities. Based on data from a few deep wells in the northwestern part of Pennsylvania, basement rocks consist of granitic gneiss and amphibolite (Shultz, 1999).

Bedrock geology in Washington County consists of rocks of Pennsylvanian and Permian age. The Pennsylvanian rocks are represented by the Conemaugh and Monongahela Group formations (see Figures 4 and 5). The geologic units of this time period mainly consist of limestones, sandstones, shales, mudstones, and coal (Lentz and Neubaum, 2005; Ryder et al., 2012). Well records show these formations to be approximately 1,515 feet below land surface to 180 feet below land surface, with a thickness of approximately 1,335 feet (Wagner, 1969). Within the Monongahela Group are the non-marine Pittsburgh coal beds, which are regionally continuous in Pennsylvania (Markowski, 1998). Underground mining techniques were heavily used to recover the coal from these beds, and evidence of mining activity still exists throughout the county (Lentz and Neubaum, 2005). The Permian period is represented by the Dunkard Group formations, including the Washington and Greene formations. These units are described as sandstones, siltstones, mudstones, and claystones, with thin coal beds (Shultz, 1999; Ryder et al., 2012). The base of the Permian lies about 180 feet below land surface (Wagner, 1969). An unconformity at the top of the Permian rocks represents a period of non-deposition of material. Lying on top of the Permian rocks are the regional soils of the area (Shultz, 1999).

Soils in Washington County consist of Quaternary alluvial deposits, predominantly in stream valleys of the county. Alluvial deposits are generally less than 60 feet thick and consist of clay, silt, sand, and gravel derived from local bedrock. The uppermost soils can be described as well drained to poorly drained, very shallow to deep, nearly level to steeply sloping, clays, silts, and loams with some stones (USDA, 1983).

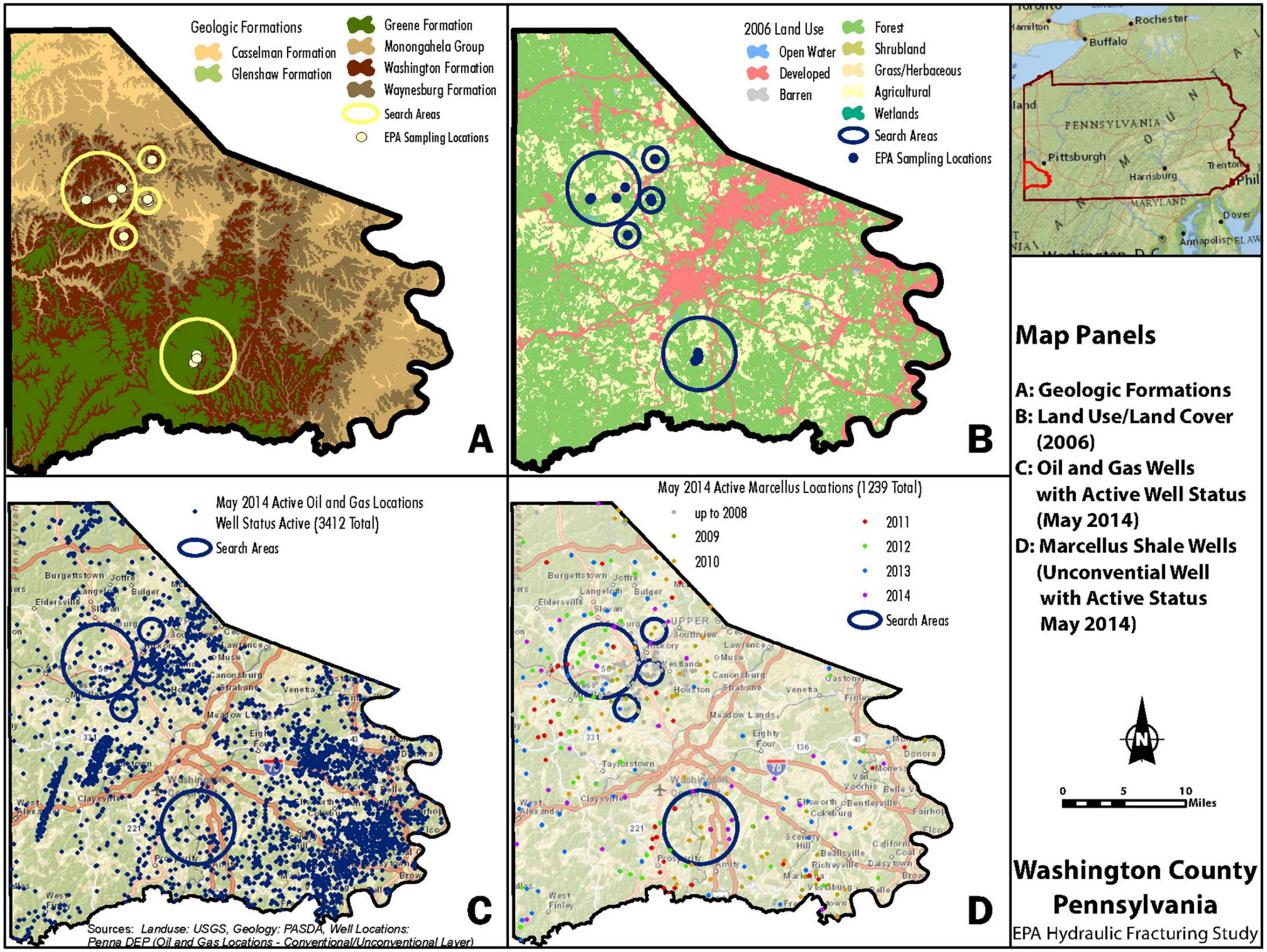


Figure 4. Panel map showing geology, land use, locations of active oil and gas wells, and Marcellus Shale wells in Washington County, Pennsylvania. The indicated search areas (blue circles) were used for the analysis of land use and environmental record searches (see Appendix C).

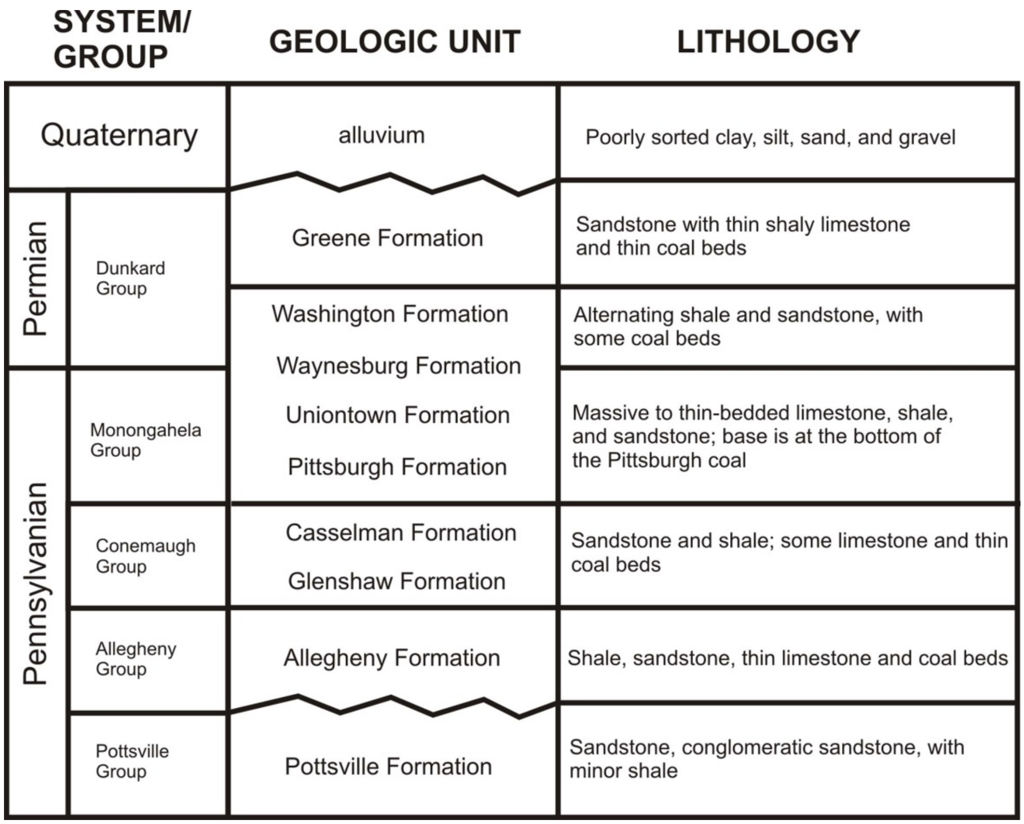


Figure 5. Stratigraphic chart for the bedrock of Washington County, Pennsylvania.

Of particular interest are Devonian-age strata which are present below the sedimentary formations shown in Figure 5 (Roen, 1984). The Devonian strata occur in the subsurface of Washington County and are represented in the geologic record of Pennsylvania as a group of 14 rock formations. These formations, from oldest to youngest, are the Corriganville, Mandata Shale, Licking Creek Limestone, Oriskany Sandstone, Bois Blanc, Onondaga Limestone, Hamilton Group formations (including the Marcellus Shale), Tully Limestone, Genesee, Sonyea, West Falls, Brallier, Chadakoin, and the Venango Group formations. These formations consist mainly of shales, limestones, and sandstones (Shultz, 1999; see also Carter, 2007). Devonian sedimentary units lie between about 7,990 and 2,215 feet below land surface and have an overall thickness of about 5,775 feet in Washington County (Wagner, 1969). The Murrysville Sandstone (a member of the Venango Group) of the Upper Devonian is a historical shallow natural gas reservoir in the county (Shultz, 1999). Recent gas exploration and production focuses on the black carbonaceous shales of the Marcellus Shale. The maximum depth of the Marcellus Shale is about 7,432 feet below land surface, and it has an average thickness of approximately 102 feet (Wagner, 1969).

The Marcellus Shale, also referred to as the Marcellus Formation, is a Middle Devonian-age (about 390 million years), black, low-density, organic-carbon-rich shale that occurs in the subsurface beneath much of Ohio, West Virginia, Pennsylvania, and New York (Roen, 1984; see Figure 2). Smaller areas of Maryland, Kentucky, Tennessee, and Virginia are also underlain by the Marcellus Shale. The Marcellus Shale is part of a transgressive sedimentary package that was deposited in a deepening basin. It is underlain by limestone (Onondago Formation) and overlain by siltstones and shales (Mahantango

Formation). These sediments were deposited under a sea that covered the Appalachian Basin. It is believed that very little oxygen was present at the bottom of the ocean during deposition of the Devonian black shales (e.g., Rimmer, 2004). Thus, organic detritus was preserved in the deposited sediments. Subsequent burial of the carbon-rich sediments ultimately led to the formation of gas that became trapped in the rock. Natural gas occurs within the Marcellus Shale in three ways: (1) within the pore spaces of the shale; (2) within vertical fractures (joints) that break through the shale; and, (3) adsorbed on mineral grains and organic material. The most productive zones for natural gas extraction are located in areas where fracturing and brecciation produce space for gas accumulation (Engelder et al., 2009). An assessment conducted by the USGS suggested that the Marcellus Shale contained an estimated 1.9 trillion cubic feet of undiscovered recoverable natural gas (USGS, 2003). Estimated volumes have increased significantly in more recent assessments of the gas reserves (Milici and Swezey, 2006). In Washington County, the Marcellus Shale ranges from approximately <50 to about 150 feet in thickness (Lash and Engelder, 2011), and its depth ranges from about 5,000 feet below land surface in the northwest corner of Washington County to over 7,000 feet below land surface in the southeastern portion of the county (MCOR, 2013).

3.2. Hydrology

Background information on the geology and hydrology of Washington County is summarized from reports published by Newport (1973) and Williams et al. (1993). Washington County is in the Ohio River Basin. In the northern portion of the county, streams drain into the Ohio River; in the southern part of the county, flow is into the Monongahela River, which subsequently flows into the Ohio River near Pittsburgh. A majority of the public drinking water supply in this county is derived from the Monongahela River in Allegheny County; however, rural residents often rely on private supply wells for potable water. Potable ground water is typically located within aquifers less than 300 feet below land surface (Carter et al., 2011). Ground water below these depths is sometimes found as brine as a result of elevated salt content. Natural brine in Pennsylvania generally increases in concentration with increasing age of the geologic formations; for example, Poth (1962) showed solute concentrations as total dissolved solids (TDS) that ranged from about 6,000 mg/L in Pennsylvanian-age sandstones to 299,000 mg/L in Cambrian-age carbonate aquifers. The depth to ground water in Washington County is generally less than 100 feet and commonly less than 40 feet, depending on topographic setting (Newport, 1973; Battelle, 2013). As noted above, the geologic units in Washington County include sedimentary rocks of Pennsylvanian (Monongahela and Conemaugh Groups) and Permian (Dunkard Group) age, including sandstone, siltstone, limestone, shale, and coal, and unconsolidated Quaternary deposits. The Quaternary deposits consist of alluvium, which overlies bedrock in some of the major stream valleys of the county. The alluvium is generally less than 60 feet thick and is made up of clay, silt, sand, gravel, and cobbles derived primarily from local bedrock. The unconsolidated alluvial deposits in Washington County are often the source of high-yield wells, especially near rivers and streams.

Ground water in Washington County occurs in both artesian and water-table aquifers. Well yields range from a fraction of a gallon per minute to over 350 gallons per minute (Newport, 1973). Ground water flow in the shallow aquifer system generally follows topography, moving from recharge areas near hilltops to discharge areas in valleys. Ground water is also derived from bedrock aquifers (see Figure 5), including the Dunkard Group, Monongahela Group, and Conemaugh Group formations. The Conemaugh Group generally provides the greatest yield, although the median yield for wells in this aquifer is 5 gallons per minute (Williams et al., 1993). Carter et al. (2011) estimated that 10% to 30% of the population in Washington County relies on private wells for drinking water.

The quality of ground water in Washington County is variable and depends on factors such as formation lithology and residence time. For example, recharge ground water sampled from hilltops and hillsides is typically calcium-bicarbonate type and usually low in TDS (~500 mg/L; Newport, 1973). Ground water from valley settings in areas of discharge is typically sodium-bicarbonate type with higher values of TDS (up to 2,000 mg/L). Williams et al. (1993) reported that concentrations of iron and manganese in the ground water from Washington County are frequently above EPA's secondary maximum contaminant levels (SMCLs). In their study, over 33% of water samples had iron concentrations greater than the SMCL (300 μg/L), and 30% of water samples had manganese concentrations above the SMCL (50 μg/L). Hard water was also reported as being a common problem in the county. TDS concentrations in more than one third of the wells sampled by Williams et al. (1993) exceeded 500 mg/L. The concentrations of arsenic, cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc were below the drinking water standards established by EPA (Williams et al., 1993). In some areas, ground water quality in Washington County has been degraded, in part, because of drainage from coal mining operations (Williams et al., 1993). Additionally, freshwater aquifers in some locations have been contaminated by brine from deeper, non-potable aquifers through historical oil and gas wells that were improperly abandoned or have corroded casings (Newport, 1973).

3.3. Oil and Gas Production

Washington County is currently experiencing extensive natural gas exploration and production targeting the Marcellus Shale. Resource development uses horizontal and vertical drilling and hydraulic fracturing technologies to stimulate gas production. The first test well into the Marcellus play was drilled in Mount Pleasant Township in Washington County in 2003 by Range Resources (Renz #1 well); the well was hydraulically fractured in 2004 (Carter et al., 2011). Since that time drilling has proceeded at a rapid rate in Washington County. Data provided by the Pennsylvania Department of Environmental Protection (PA DEP) indicate that the numbers of permitted wells per year in the Marcellus Shale increased rapidly from 2005 to 2009 (from 10 to 205 wells per year; see Figure 6). Since 2009, the rate of increase in the number of well permits approved for unconventional wells decreased, although the number of well permits issued continued to increase year by year. The highest number of wells (310) was approved in 2013. From 2005 to 2008, more permits were issued in Washington County than were issued anywhere else in the state (Carter et al., 2011).

Oil and gas exploration and production has a long history in southwestern Pennsylvania. In Washington County, most of the early drilling activity occurred in the late 1800s and early 1900s. According to Ashley and Robinson (1922), the first oil well in Washington County (the Gantz well) was completed in 1885 in the shallowest sand of the Upper Devonian Venango Group. In 1917, the deepest well in the United States at that time was completed to a depth of 7,248 feet near McDonald, Pennsylvania in Washington County (Ashley and Robinson, 1922). Note that many of the wells drilled in the late nineteenth and early twentieth centuries produced both oil and gas at depths much shallower than present-day gas development from the Marcellus Shale. The primary oil fields in Washington County are the McDonald Field in the northern part of the county (oil struck in 1890), and the Washington-Taylorstown Field (oil struck in 1885), near the city of Washington in the center of the county. Following the early oil boom, oil and gas production in Washington County expanded to exploit the Allegheny sandstone (Middle Pennsylvanian), Pottsville sandstone (Lower and Middle Pennsylvanian), Big Injun sandstone (Lower Mississippian), and Berea sandstone (Upper Devonian). More recently, coalbed methane resource potential in Washington County has been examined in coal seams within the Conemaugh Group formations (e.g., Markowski, 1998).

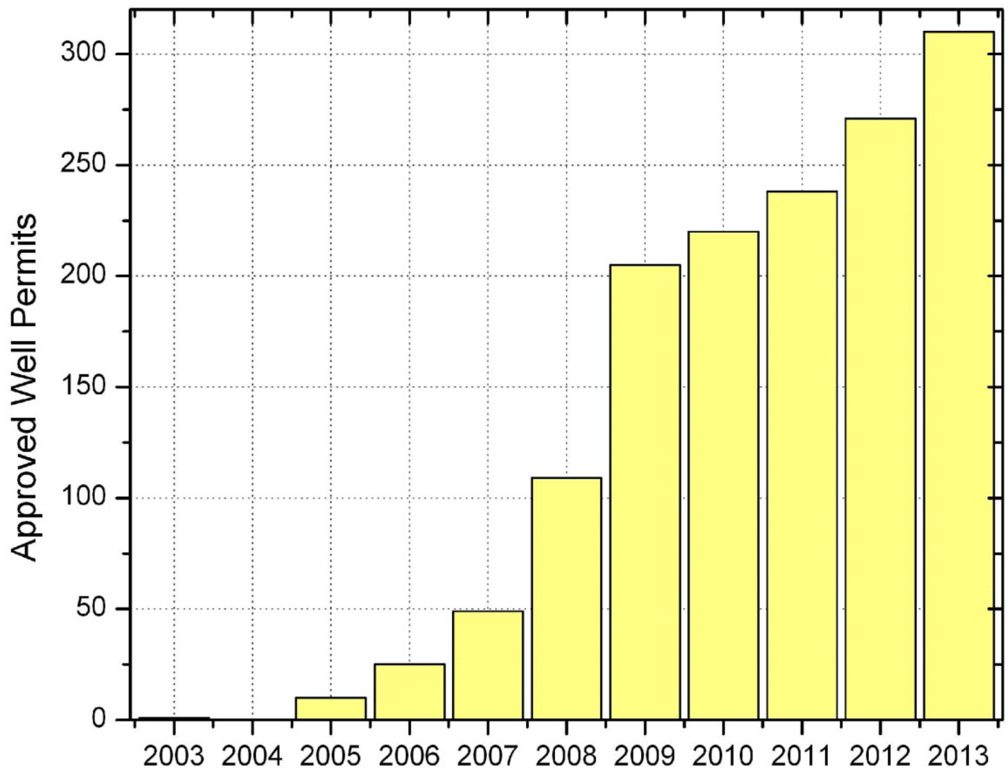


Figure 6. The number of approved well permits for the Marcellus Shale in Washington County by year through 2013 (data from Marcellus.org, accessed 3/7/2014).

Battelle (2013) mapped the locations of over 11,600 conventional oil and gas wells drilled in Washington County (active and inactive). Well numbers and locations are necessarily uncertain because of incomplete historical records. With passage of the Oil and Gas Act in 1984, Pennsylvania modernized environmental controls and resource management for development of crude oil and natural gas. This Act, following previous laws, required that all new wells be permitted by the state prior to drilling. Similar to other regions of the United States with long histories of oil and gas production, little is known about well construction and abandonment practices for historical oil and gas wells. Early wells are known to provide potential conduits for gas and brine migration into shallow aquifers (e.g., Newport, 1973; Vidic et al., 2013). Vidic et al. (2013) stated that methane detection in domestic wells in northeastern Pennsylvania is common (80% to 85%) and contrasts with the lower number of methane detections in southwestern Pennsylvania (24%). Vidic et al. (2013) also suggested that the hydrogeological regime in the northeastern part of Pennsylvania is more prone to gas migration. Brantley et al. (2014) proposed that geomorphic and hydrogeologic processes in fractured rocks of the upper Devonian Lock Haven and Catskill formations of northeastern Pennsylvania could have facilitated fast migration of ground water and methane over long distances, possibly in the presence of natural or gas-well-induced pressure gradients. In any case, the southwestern and northeastern regions of

Pennsylvania have very different histories with respect to oil and gas production. For several decades before any significant water quality testing programs were in place, a much higher density of potential subsurface conduits has been present in southwestern Pennsylvania than in the northeastern part of the state due to historical oil and gas activities (see PA DCNR, 2007).

3.4. Land Use

Although much of Washington County has historically been devoted to agriculture and forestry, the county's economic development in the nineteenth and twentieth centuries was derived in great part from coal mining and industries that relied on that coal. At their peak, the steel mills in the county employed tens of thousands of workers. The county also experienced a brief oil boom in the early part of the twentieth century, and natural gas has been extracted in the county for many decades. The industrial portion of the county's economy fell into decline in the 1970s and 1980s, and many industrial plants closed (Washington County, 2005).

Figure 7 shows land use maps for Washington County in 1992 and 2006 based on the National Land Cover Database (NLCD); land use data are presented in Table 1. The NLCD uses 30-meter-resolution data from the Landsat satellite (USGS, 2012a). The 2006 dataset was the most recent land-use information available at the time of this study.

Table 1. Land use in Washington County in 1992 and 2006.

Land Use	1992		2006	
	Square Miles	% of Total	Square Miles	% of Total
Forest	479	55.4%	484	56.0%
Planted/cultivated	332	38.4%	234	27.1%
Developed	42	4.9%	124	14.4%
Barren	9	1.0%	4	0.5%
Water	3	0.3%	5	0.6%
Others	0	0.0%	13	1.5%
Total	**865**	**100%**	**864**	**100%**

Note: Totals may not sum exactly due to rounding. Source: USGS (2012a).

The NLCD data indicate that, in 1992 and 2006, forest cover was the largest land use in the county, followed by planted/cultivated land, and that these two categories accounted for a majority of the land use in the county. Because of methodological differences, quantitative comparisons between the 1992 and 2006 datasets are not recommended. Qualitative comparisons suggest very little change in the predominant land use patterns (Multi-Resolution Land Characteristics Consortium, 2013). This lack of change in land use is consistent with the relative stability of the county's population (i.e., an indicator of the intensity of land use) over decades as indicated by US census data (Appendix C). Additional land-use analysis, with particular focus in the areas adjacent to the sampling locations of this study, is presented in Appendix C.

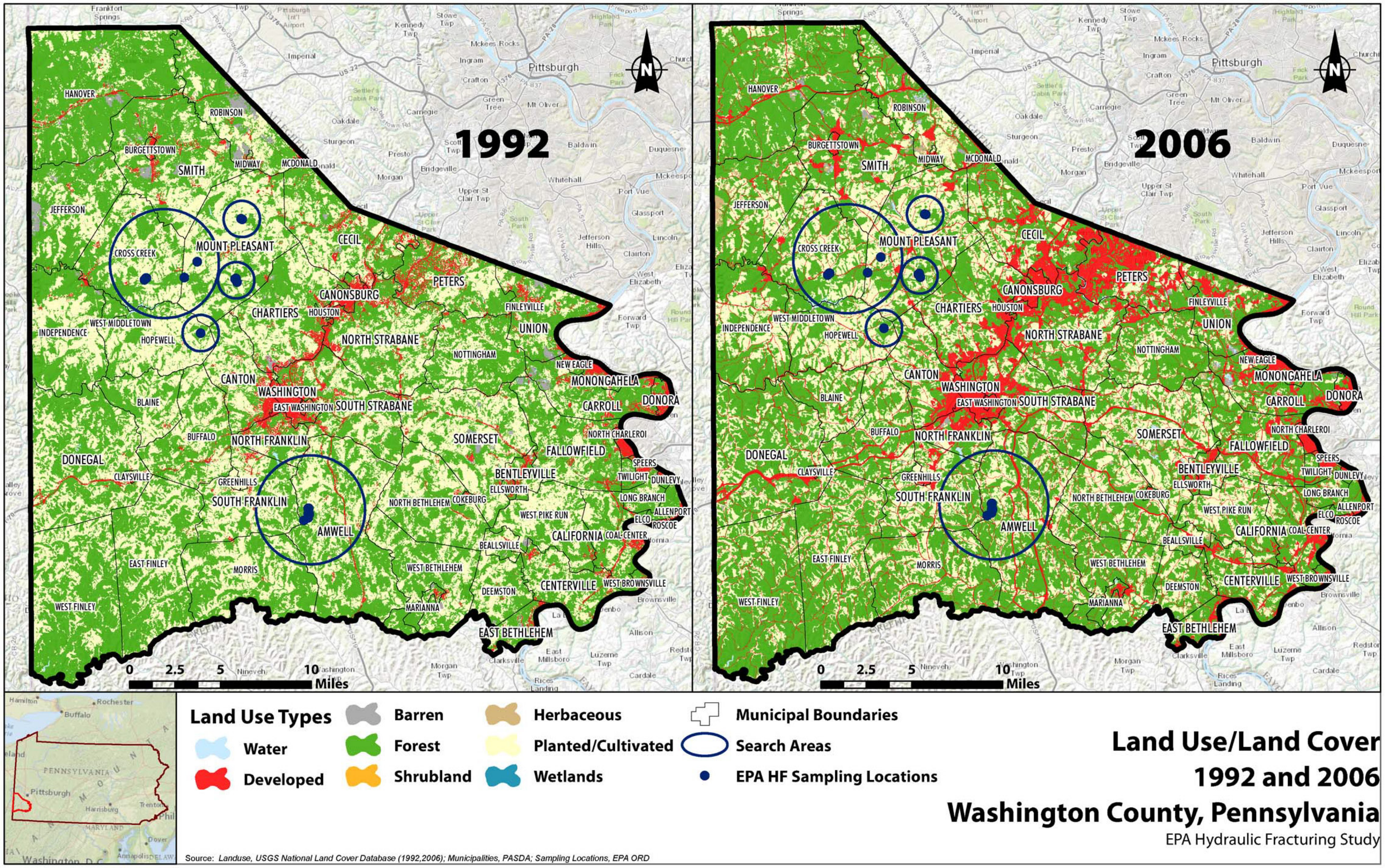


Figure 7. Washington County, Pennsylvania – land use in 1992 and 2006. The indicated search areas were used for the analysis of land use and environmental record searches (see Appendix C; data source USGS, 2012a).

Table 2 provides an estimate of the land area potentially affected by active well pads in Washington County. The PA DEP website provided the number of permitted unconventional well pads as of May 19, 2014 (PA DEP, 2014a, 2014b). The “unconventional” classification indicates that a well is completed in the Marcellus Shale and has been stimulated using hydraulic fracturing. The number of permitted conventional well pads was based on the total number of active conventional oil and gas wells in Washington County as reported on the Pennsylvania Spatial Data Access site by the PA DEP. Each conventional well was assumed to have one well pad. As shown in Figure 4C, there were a total of 3,412 active oil and gas wells in Washington County in May 2014. Approximately 36% of these wells were unconventional shale-gas wells (Figure 4D). The estimates of the areas affected per type of well pad were taken from a USGS study of the landscape impacts of natural gas extraction in Pennsylvania (USGS, 2012b). Using these estimates for the land area per type of well pad and the number of conventional and unconventional well pads described above, approximately 23 square miles (2.6% of the land area in the county) are estimated to be affected by pad development; 25% of this estimated area is associated with unconventional gas development (see Table 2).

Table 2. Area potentially affected by active well pads in Washington County.

Item	
Number of wells (1)	
Conventional	2,173
Unconventional	1,239
Number of pads	
Conventional[a]	2,173
Unconventional[b]	351
Affected acres per well pad[c] (2)	
Conventional	4.9
Unconventional	10.6
Affected area in square miles[d]	
Conventional	16.8
Unconventional	5.8
Total	22.6
Total area of county in square miles (3)	857
% of County Area Affected by Well Pads	**2.6%**

Sources:
(1) PA DEP (2014a; Oil and Gas Locations – Conventional/Unconventional Layer).
(2) USGS (2012b).
(3) U.S. Census Bureau (2012).

Notes:
[a] Includes all active conventional oil and gas wells as of May 2014.
[b] Includes all active unconventional well pads as of May 2014.
[c] Original source in hectares converted to acres (2.471 acres per hectare).
[d] 640 acres per square mile.

3.5. Potential Contaminant Sources

To help determine whether hydraulic fracturing or processes related to hydraulic fracturing had caused or contributed to alleged impacts on water quality, a consistent approach was adopted for evaluating potential contaminant sources using causal assessment. Causal assessment is defined as the organization and analysis of available evidence to evaluate links between apparent environmental impacts and potential causes, and the assessment of the level of confidence in these causal links.

A list of candidate causes—that is, hypothesized causes of an environmental impairment that are sufficiently credible to be analyzed (US EPA, 2000a)—was developed for the northern and southern areas of this retrospective case study. Each environmental stressor was evaluated through an examination of potential causes and effects. Candidate causes included potential sources that could impact the environment and contribute to any detected levels of surface and/or ground water contamination. Candidate causes were categorized as follows: industrial/commercial land use, historical land use (e.g., farming and mining), current drilling processes/practices, historical drilling practices, and naturally occurring sources.

In order to identify potential sources of contamination, in addition to drilling and hydraulic fracturing processes, a background assessment was performed using the following databases:

- Environmental records search: Environmental record searches were performed by obtaining environmental record reports from Environmental Data Resources, Inc. (EDR). EDR provides a service for searching publically available databases and provides data from its own proprietary databases.
- Well inventory: Existing oil and gas well inventories were prepared on the same search areas used for the EDR reports using PA DEP's oil and gas well database.
- State record summary: The PA DEP Web site containing Pennsylvania's Environment Facility Application Compliance Tracking System (eFACTS at http://www.ahs.dep.pa.gov/eFACTSWeb/criteria_site.aspx) was used to find up-to-date well records for the study areas. This database provides information on inspection and pollution prevention visits, including a listing of all inspections that have occurred at each well on record, whether violations were noted, and any enforcement that may have resulted. The system provides multiple options to search for records.

Appendix C provides the results of these background assessments. The issues concerning ground water and surface water as reported by landowners in the northern area included concerns about changes in water quality (e.g., turbidity, staining properties, and odor) believed to be associated with recent gas drilling and the use of impoundments (Carter impoundment). Although many gas wells have been recently drilled and continue to be drilled in this area, no specific gas well was considered as a potential candidate cause at the initiation of the study. Other candidate causes for observed changes in water quality included land use, historical drilling practices, and naturally occurring sources (see Appendix C).

Landowners reported similar issues concerning ground water and surface water in the southern area, possibly related to practices and procedures near an impoundment area. For example, water quality impacts could be related to potential leaks in the reserve pit and/or Yeager impoundment, discharge from former coal mines, migration of landfill fluids, migration of brine from underlying formations along well bores due to poor casing cement integrity, migration of brine from underlying formations along natural fractures, and road salt infiltration (see Appendix C).

Battelle (2013) concluded that potential impacts to water resources in Washington County include contaminant sources from agriculture, mining, steel production, manufacturing, and conventional oil and gas extraction. They suggested that the major causes of water quality impairment in southwestern Pennsylvania are acid mine drainage (AMD), agricultural, urban and storm water runoff, and waste handling. For example, a total of 1,759 miles of streams are impacted by one or more of these activities. Deep coal mining has occurred under approximately 53% of the county (Battelle, 2013). More than 11,600 oil and gas wells have been completed in the county over approximately 130 years of resource development, a majority of them within 2,500 feet of land surface (whereas unconventional wells target depths greater than 5,000 feet). The analysis in Appendix C identifies potential contaminant sources within the areas surrounding the sampling locations of this study; this analysis of potential contaminant sources is integrated into the evaluation of the water quality data, where appropriate, in the following sections of this report.

4. Study Methods

Water quality sampling locations within the northern and southern areas included 16 domestic wells, three springs, and three surface water locations. Sampling events occurred in July 2011, March 2012, and May 2013 (see Table 3). Domestic wells ranged in depth from 50 to 160 feet below land surface, with a median depth of 95 feet below land surface. Wherever possible, ancillary data for each well were collected during or near the time of sample collection and included latitude and longitude (recorded with a handheld GPS device), topographic setting, depth, diameter, screened interval, casing material, and static water level (depth to water). Samples were analyzed for over 235 constituents, including field parameters, major ions, nutrients, trace metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), diesel-range organics (DRO), gasoline-range organics (GRO), glycol ethers (diethylene, triethylene, and tetraethylene glycol), low-molecular-weight acids (lactate, formate, acetate, propionate, isobutyrate, and butyrate), dissolved gases (methane, ethane, propane, and butane), radioactivity (gross alpha/beta, ^{226}Ra, ^{228}Ra), strontium isotope ratios (^{87}Sr/^{86}Sr), and selected stable isotopes ($\delta^{13}C_{CH4}$, $\delta^{2}H_{CH4}$, $\delta^{13}C_{DIC}$, $\delta^{18}O_{H2O}$, $\delta^{2}H_{H2O}$). Descriptions of the sampling methods, analytical methods, and QA/QC are provided in the QAPP for this study (Wilkin, 2013). The results of QA/QC samples and assessments of data usability are provided in Appendix A and analytical results for the sample measurements are tabulated in Appendix B.

Table 3. Information on wells sampled in Washington County.

Sample Identification	Type of Location	Area	Latitude	Longitude	Rounds Sampled	Depth (feet BLS)
SWPAGW01	Well	Northern	N40 16.430	W80 18.161	1, 3	50
SWPAGW02	Well	Northern	N40 16.579	W80 18.285	1, 3	98
SWPAGW03	Well	Northern	N40 17.409	W80 20.636	1, 2, 3	100
SWPAGW04	Well	Northern	N40 19.463	W80 17.778	1, 2, 3	80
SWPAGW05	Well	Northern	N40 16.666	W80 21.464	1, 2, 3	95
SWPAGW06	Well	Northern	N40 16.654	W80 23.824	1, 2, 3	88
SWPAGW07	Well	Northern	N40 16.653	W80 23.853	1, 3	91
SWPAGW08	Well	Northern	N40 13.992	W80 20.456	1, 2, 3	130
SWPAGW09	Well	Northern	N40 16.573	W80 23.949	1, 3	160
SWPAGW10	Well	Southern	N40 05.278	W80 13.825	1, 2	130
SWPAGW11	Well	Southern	N40 05.109	W80 13.844	1, 2	unknown
SWPAGW12	Well	Southern	N40 05.282	W80 13.769	1, 2	80
SWPAGW13	Spring	Southern	N40 05.562	W80 13.803	1, 2, 3	--
SWPAGW14	Spring	Southern	N40 05.565	W80 13.834	2, 3	--
SWPAGW15	Spring	Southern	N40 05.323	W80 13.793	2	--
SWPAGW16	Well	Southern	N40 05.230	W80 13.812	2	70
SWPAGW17	Well	Southern	N40 04.993	W80 14.109	2	102
SWPAGW18	Well	Southern	N40 05.496	W80 13.840	3	unknown

Table 3. Information on wells sampled in Washington County.

Sample Identification	Type of Location	Area	Latitude	Longitude	Rounds Sampled	Depth (feet BLS)
SWPAGW19	Well	Southern	N40 05.424	W80 13.850	3	unknown
SWPASW01	Surface water	Northern	N40 16.608	W80 18.233	1, 3	--
SWPASW02	Surface water	Northern	N40 19.453	W80 17.792	1, 2, 3	--
SWPASW03	Surface water	Southern	N40 05.308	W80 13.835	1, 2	--

4.1. Sampling Locations

Water samples from ground water and surface water resources were collected within the northern and southern areas that are designated in Figure 2. A general summary of sampling activities is as follows:

- Round 1 (July 2011 sampling event): Water samples were collected from 13 domestic wells/springs and three surface water locations.
- Round 2 (March 2012 sampling event): Water samples were collected from 13 domestic wells/springs and two surface water locations.
- Round 3 (May 2013 sampling event): Water samples were collected from 13 domestic wells/springs and two surface water locations.

The samples collected provide analytical data for a broad range of compounds and chemical indicators that are potentially linked to hydraulic fracturing activities and/or that aid in providing a conceptual framework for evaluating potential impacts. Some locations in the study were sampled once, some twice, and some during all three rounds (see Table 3). Reasons for retaining or excluding a location during a sampling round included access issues and quality assurance/quality control (QA/QC) constraints (such as well functionality issues). The completion depths of domestic wells sampled in this study were, in some cases, uncertain and based on homeowner knowledge of their wells.

4.2. Water Collection

Sample bottles for each location were uniquely labeled prior to each sampling round, and all labels were color-coded by analytical parameter. See Table A1 (Appendix A) for pre-cleaned bottle types and number of sample bottles needed for each laboratory analysis.

Water samples were collected as close to the ground water pump as possible and processed using methods designed to yield samples that were representative of environmental conditions and unaffected by contamination during sample collection. Teflon-lined polyethylene tubing was connected to the pump output at each sample location; clean tubing was used prior to sampling and filtration and discarded after use.

Unfiltered samples were collected first and included the following parameters: dissolved gases, VOCs, SVOCs, DRO, GRO, glycol ethers, low-molecular-weight acids, total metals, gross alpha, gross beta, ^{226}Ra, ^{228}Ra, $\delta^{13}C_{CH4}$, and $\delta^{2}H_{CH4}$. Samples for dissolved metals, anions, nutrients, dissolved inorganic carbon (DIC), $\delta^{13}C_{DIC}$, dissolved organic carbon (DOC), $\delta^{18}O_{H2O}$, $\delta^{2}H_{H2O}$, and Sr isotope analyses were filtered onsite using 0.45-micron pore-size, disposable-capsule filters (Millipore). Approximately 100 milliliters (mL) of ground water were passed through the filter, to waste, before sample bottles were filled. The date, time, and initials of the sampler were recorded at each location. Sample preservation and holding time requirements for each sample type are described in Table A1 (Appendix A).

4.3. Purging and Sampling at Domestic Wells and Springs

A well volume approach, combined with the monitoring of stabilization parameters, was used for purging domestic wells (Yeskis and Zavala, 2002). Domestic wells were sampled using downhole pumps via homeowner taps, or by accessing the wells directly using a submersible pump (Proactive Monsoon) fitted with Teflon-lined polyethylene tubing. When possible, the ground water level was measured using a Solinist® water level indicator and tracked every 10 to 15 minutes during well purging. In general, wells were purged for about an hour prior to sample collection. Water samples were collected upstream of pressure tanks before any water treatment. Initial flow rates were obtained at each location; wells were then purged at flow rates of about 0.4 to 10 gallons per minute, depending on the well volume and recharge rate. The rate of purging was determined by measuring the volume of water collected after a unit of time into a large metered pail or graduated cylinder. Spring samples were collected by placing inlet tubing to a peristaltic pump (Pegasus Pump Company Alexis®) at the point of ground water discharge. Water quality parameters were continuously monitored and recorded using a YSI 556 multi-parameter probe system to track the stabilization of pH (≤0.02 standard units per minute), oxidation-reduction potential (ORP) (≤2 millivolts per minute), specific conductance (≤1% per minute), dissolved oxygen (DO), and temperature. Water flow through the cell containing the multi-parameter probe was maintained at about 0.25 to 0.50 gallons per minute, with the excess flow valved to waste. Sample collection began after parameter stabilization occurred. All samples were stored on ice before being processed for shipping.

4.4. Sampling at Surface Water Locations

Surface water samples were collected from flowing water bodies (<0.5 meters deep), in some cases down gradient from spring discharges. Geochemical parameters and samples were collected simultaneously; parameters were recorded every 2 minutes for up to 40 minutes at each surface water site, or until parameter stabilization was attained. Sample bottles were submerged into the surface water just below the surface and filled as grab samples for unfiltered samples. Sampling of surface waters was performed to minimize capture of sediment. Filtered samples were obtained by pumping surface water through Teflon-lined polyethylene tubing and a 0.45-micron, high-capacity filter using a peristaltic pump. Approximately 100 mL of water was passed through the filter, to waste, before sample bottles were filled. Samples were stored on ice before being processed for shipping.

4.5. Sample Shipping/Handling

At the conclusion of each day, samples were organized by analytical parameter, placed together into sealed Ziploc plastic bags, and transferred to coolers filled with ice. Glass bottles were packed with bubble wrap to prevent breakage. A temperature blank and a chain-of-custody form were placed in each cooler. Coolers were sealed, affixed with a custody seal, and sent to the appropriate lab via express delivery, generally within 24 hours of collection, depending on sample holding time requirements. Sample bottles for $\delta^{13}C_{CH4}$ and $\delta^{2}H_{CH4}$ analyses were placed in an inverted position in coolers and maintained in the inverted position throughout shipment to the analytical laboratory.

4.6. Water Analysis

4.6.1. Field Parameters

Temperature, specific conductance, pH, ORP, and dissolved oxygen were continuously monitored during well purging using a YSI 556 multi-parameter probe and flow-cell assembly. Electrode measurements of specific conductance were correlated to the concentration of total dissolved solids (TDS). YSI electrodes were calibrated every morning before sampling according to the manufacturer's instructions. Performance checks were conducted at midday and at the end of each day, and the electrodes were re-calibrated if necessary. A National Institute of Standards and Technology (NIST)-traceable 1,413 µS/cm specific conductance standard was used for calibration and performance checks. NIST-traceable buffer solutions (4.00, 7.00 and 10.01) were used for pH calibration and performance checks. An Orion ORP standard was used for calibration and performance checks of redox potential measurements. Note that field determinations of the ORP provide an approximate measure of redox conditions, but ORP values do not necessarily correspond to equilibrium E_H values (US EPA, 2002). Dissolved oxygen sensors were calibrated with air, and low-oxygen measurement performance was tested with a zero-oxygen solution (sodium sulfite). Zero-oxygen solutions consistently read below 0.25 mg/L. The probe assembly was stored in pH 4.00 buffer solution when not in use.

After geochemical parameters stabilized in each well, a 500-mL sample was collected for field determinations of alkalinity, turbidity, ferrous iron, and dissolved sulfide. Alkalinity measurements were determined by titrating water samples with 1.6N sulfuric acid (H_2SO_4) to the bromcresol green-methyl red endpoint using a Hach titrator (EPA Method 310.1). Turbidity measurements (EPA Method 180.1) made use of a Hach 2100Q portable meter. Ferrous iron concentrations were determined using the 1,10-phenanthroline colorimetric method (Hach DR/890 colorimeter, Standard Method 3500-FeB for Wastewater). Dissolved sulfide measurements were made using the methylene blue colorimetric method (Hach DR/2700 spectrophotometer, Standard Method 4500-S^{2-}D for Wastewater).

Hach spectrophotometers (for ferrous iron and sulfide) and turbidimeters (for turbidity) were inspected before going into the field, and their functions were verified using performance calibration check solutions. The ferrous iron accuracy was checked through triplicate measurements of a 1 mg Fe/L standard solution (Hach Iron Standard solution, using Ferrover reagent); the results were between 0.90 and 1.10 mg Fe/L. The accuracy of dissolved sulfide measurements was checked by measuring standard solutions prepared in the laboratory by purging dilute sodium hydroxide solution (0.0001 M) with 1.0% H_2S gas (balance N_2); the results of spectrophotometric measurements were within 20% of expected concentrations. Turbidity was checked against formazin turbidity standards supplied by Hach. Titrant cartridges used for alkalinity measurements were checked using a 100 mg/L standard prepared from sodium bicarbonate ($NaHCO_3$). Blank solutions (deionized water) were measured at the beginning of the day, at midday, and at the end of the day for each parameter (see Appendix A).

4.6.2. Analytical Methods for Ground Water and Surface Water

Water samples were collected and analyzed using the methods identified in Table A1 of Appendix A. The laboratories that performed the analyses, per sampling round, are also identified in Table A1. A total of 1,304 samples (not including duplicates of glass containers) were collected and delivered to up to 10 laboratories for analysis.

Anions, nutrients, DIC, and DOC samples were analyzed for all sampling events (rounds 1, 2, and 3). Quantitative analysis of the major anions bromide (Br^-), chloride (Cl^-), fluoride (F^-) and sulfate (SO_4^{2-}) was performed by capillary ion electrophoresis (EPA Method 6500) with a Waters Quanta 4000 Capillary Ion Analyzer. During the first two rounds of sampling, bromide concentrations up to about 2.5 mg/L were detected in samples containing low to moderate levels of chloride (2–228 mg/L) using EPA Method 6500. During the third round of sampling, bromide analysis was also conducted using flow injection analysis on a Lachat QuickChem 8000 Series flow injection analyzer and bromide levels were consistent with the first two rounds of sampling. Nutrients ($NO_3 + NO_2$, NH_3, total Kjeldahl Nitrogen) were measured by flow injection analysis (EPA Method 350.1, 353.1, and 351.2). The concentration of carbon in DIC and DOC in aqueous samples was determined via acidification and combustion followed by infrared detection (EPA Method 9060A) on a Shimadzu TOC-VCPH Analyzer.

Samples for dissolved gases, low-molecular-weight acids, and stable isotopes of water (δ^2H_{H2O} and $\delta^{18}O_{H2O}$) were analyzed by Shaw Environmental for rounds 1 and 2 and by CB&I for round 3. Dissolved gases were measured by gas chromatography (Agilent Micro 3000 gas chromatograph) using a modification of the method described by Kampbell and Vandegrift (1998). Two methods were used to collect dissolved gas samples in round 3. Only the results for the first method (filled bucket submersion method) are presented in this report, as this method was used consistently in all rounds of sampling. The concentrations of low-molecular-weight acids were determined using high-performance liquid chromatography (Dionex Ics-3000). Hydrogen and oxygen isotope ratios for aqueous samples collected during round 1 were determined by isotope ratio mass spectrometry (Finnigan TC/EA, Finnigan Delta Plus XP IRMS); cavity ring-down spectrometry (CRDS) was used to measure isotope ratios in samples collected during rounds 2 and 3 (Picarro L2120i CRDS). The oxygen and hydrogen isotope ratio values are reported in terms of permil (‰) notation with respect to the Vienna Standard Mean Ocean Water (VSMOW) standard. For consistency of methodology and analytical results, data collected using CRDS from rounds 2 and 3 are used in the data analysis.

The analysis of DRO, GRO, and SVOCs in water samples collected during rounds 1, 2, and 3 was completed by the EPA Region 8 Laboratory. DRO and GRO concentrations were determined by gas chromatography using a gas chromatograph equipped with a flame ionization detector (EPA Method 8015B; Agilent 6890N GC). The concentrations of SVOCs were determined by gas chromatography (GC)/mass spectrometry (MS) (EPA Method 8270D; HP 6890 GC and HP 5975 MS).

VOCs were analyzed by Shaw Environmental for samples collected during rounds 1 and 2; samples were analyzed using automated headspace GC/MS (EPA Methods 5021A and 8260C; Agilent 6890/5973 Quadrupole GC/MS). Following round 3, samples were analyzed for VOCs by the Southwest Research Institute using purge-and-trap GC/MS (EPA Method 8260B; Agilent 6890N GC/MS).

Glycols (2-butoxyethanol, diethylene, triethylene, and tetraethylene glycol) were measured by the EPA Region 3 Laboratory for samples collected during rounds 1, 2, and 3. The samples were analyzed by high-performance liquid chromatography (HPLC) coupled with positive electrospray ionization tandem mass spectrometry (MS/MS; Waters HPLC/MS/MS with a Waters Atlantis dC18 3µm, 2.1 × 150mm column). Over the course of this case study, the glycol method was in development. A verification study of the method was completed using volunteer federal, state, municipal, and commercial analytical laboratories. The study indicated that the HPLC/MS/MS method was robust, had good accuracy and precision, and exhibited no matrix effects for several water types that were tested (Schumacher and Zintek, 2014).

For samples collected in July 2011 and March 2012 (rounds 1 and 2), major cations and trace metals were determined on filtered (dissolved metals) and unfiltered (total metals) samples by Shaw Environmental. Major cations were analyzed using inductively coupled plasma–optical emission spectroscopy (ICP–OES; EPA Method 200.7; Optima 3300 DV ICP–OES); trace metals were determined by inductively coupled plasma–mass spectroscopy (ICP–MS; EPA Method 6020A; Thermo X Series II ICP–MS). Unfiltered samples were prepared before analysis by microwave digestion (EPA Method 3015A). Total and dissolved trace metals were also analyzed through EPA's Contract Laboratory Program (CLP) for samples collected in round 2. The samples were prepared and analyzed following CLP methodology (Method ISM01.3). Total and dissolved metal analyses for samples collected in May 2013 (round 3) were conducted by the Southwest Research Institute in accordance with EPA Methods 6020A (ICP–MS) and 200.7 (ICP–OES). Unfiltered samples were digested prior to analysis (EPA Method 200.7). Mercury concentrations were determined by cold-vapor atomic absorption (EPA Method 7470A; Perkin Elmer FIMS 400A).

Following all sampling rounds, samples were submitted to Isotech Laboratories, Inc., for analysis of stable isotope ratios of DIC and methane ($\delta^{13}C_{DIC}$, $\delta^{13}C_{CH4}$, $\delta^{2}H_{CH4}$). The $\delta^{13}C_{DIC}$ was determined using gas stripping and isotope ratio mass spectrometry (IRMS). Elemental analyses, coupled to an isotope ratio mass spectrometer, were used to obtain methane ($\delta^{13}C_{CH4}$, $\delta^{2}H_{CH4}$) isotope ratios. The carbon isotope ratio value is reported in terms of permil (‰) notation with respect to the Vienna Pee Dee Belemnite (VPDB) standard. The hydrogen isotope ratio value is reported in terms of permil notation with respect to the VSMOW standard.

Strontium isotopes ($^{87}Sr/^{86}Sr$) and rubidium (Rb) and strontium (Sr) concentrations were measured by USGS for samples collected during all sampling events. High precision ($2\sigma = \pm 0.00002$) strontium isotope ratio results were obtained using thermal ionization mass spectrometry (TIMS; Finngan MAT 262) using methods described in Peterman et al. (2012). The activity concentrations of gross alpha and gross beta were measured simultaneously using a gas proportional counter following EPA Method 900.0 at ALS Environmental. Isotopes of radium were determined by ALS Environmental using EPA Methods 903.1 and 904.0.

4.7. QA/QC

Field QC samples for ground water and surface water sampling are summarized in Table A2 (Appendix A; see Wilkin, 2013). These QC samples included several types of blanks and duplicate samples. In addition, adequate volumes were collected to allow for laboratory matrix spike samples to be prepared, where applicable. All of the QC sample types were collected, preserved, and analyzed using methodologies identical to those used for water samples collected in the field. Appendix A presents detailed QA practices and the results of QC samples, including discussions of chain of custody, holding times, blank results, field duplicate results, laboratory QA/QC results, data usability, Quality Assurance Project Plan (QAPP) additions and deviations, field QA/QC, application of data qualifiers, tentatively identified compounds (TICs), audits of data quality (ADQ), and the laboratory and field Technical System Audits (TSA). All reported data met project requirements unless otherwise indicated by application of data qualifiers. In rare cases, data not meeting project requirements were rejected as unusable and not reported (see Appendix A). Detection and reporting limits for all analytes, per sample type, are provided in Tables B1–B7 in Appendix B.

4.8. Data Handling and Analysis

For each sampling location from this study, geochemical parameters and the water quality data for major ions and other selected inorganic ions collected over the multiple sampling events were averaged. This approach ensures that more frequently sampled locations are given equivalent weight in the data analysis (Battelle, 2013); however, a shortcoming of this method is that potential temporal variability in concentration data at a single location is not captured. Intra-site variability of the data collected in this study was examined through evaluation of time-dependent concentration trends at specific locations. Summary statistics were calculated for selected parameters after averaging across sampling events for each location (e.g., mean, median, standard deviation, minimum and maximum values). Parameters with non-detect values were set at half the method detection limit; summary statistics determined for parameters that showed mixed results, both above and below the quantitation limit (QL), were generally determined only when over 50% of the concentration data were above the QL (US EPA, 2000b). In rare cases, concentration values set at half the MDL were used for calculating summary statistics (e.g., for iron and manganese), and these cases are noted in the tabulated data. The three springs sampled as part of this study in the southern area were grouped together with ground water samples collected from the domestic wells. In all cases, springs were sampled at their discharge points and showed geochemical parameters consistent with ground water—e.g., dissolved oxygen concentrations were below the saturation level, indicating that the springs are representative of surficial aquifers. Surface water samples were treated as a separate group.

Concentration data for organic compounds were not averaged across the multiple sampling events because relatively few detections above the QL were found and because detections were generally not consistent through time at specific sampling locations. Stable isotope and strontium isotope data, used to identify fluid sources and biogeochemical processes, were not averaged so that the full range of data variability could be evaluated. Furthermore, historical sources of isotope data for the study were not available so that weighting was not a significant data analysis issue.

Historical water quality data from Washington County were collected from Newport (1973) and online from the USGS NWIS (USGS, 2013a) and the USGS National Uranium Resource Evaluation, or NURE (USGS, 2013b) databases. Secondary data from these sources were considered based upon various evaluation criteria, such as: (i) did the organization that collected the data have a quality system in place; (ii) were the secondary data collected under an approved QAPP or other similar planning document; (iii) were the analytical methods used comparable to those used for the primary data; (iv) did the analytical laboratories have demonstrated competency (such as through accreditation) for the analysis they performed; (v) were the data accuracy and precision control limits similar to those for the primary data; (vi) were the secondary data source MDLs (method detection limits) and QLs comparable to those associated with the primary data or at least adequate to allow for comparisons; and (vii) were sampling methods comparable to those used for the primary water quality data collected for this study. In general, the secondary water quality data sources are missing the accompanying metadata necessary to fully assess these evaluation criteria; thus, the secondary data are used with the understanding that they are of an indeterminable quality relative to the requirements specified for this study (see QAPP; Wilkin, 2013). The EPA STORET (Storage and Retrieval) data warehouse was not used because these data may be indicative of environmental impact monitoring that could skew background characterization.

The software package AqQA (version 1.1.1; Standard Methods, 2012) was used to evaluate internal consistency of water compositions by calculating cation/anion balances and by comparing measured and calculated electrical conductivity values (see Appendix A, Table A26). Major ion charge balance was calculated by comparing the summed milliequivalents of major cations (calcium, magnesium, sodium, and potassium) with major anions (chloride, sulfate, and bicarbonate) in filtered samples using the equation:

$$\text{Charge balance error (\%)} = |(\Sigma\text{cat}-\Sigma\text{an})/(\Sigma\text{cat}+\Sigma\text{an})*100| \qquad (1)$$

where Σcat and Σan are the summed milliequivalents of positively and negatively charged ions, respectively. The calculated charge balance error over the three sampling rounds ranged between 0.1 and 9.0%; 71% of the samples collected for this study had a charge balance error less than 5% (see Appendix A). For data collected in this study, the calcite saturation index was determined using the Geochemist's Workbench package (version 8; Bethke, 1996). Speciation and mineral equilibria calculations were made by using temperature and concentrations of base species: major cations (Na^+, K^+, Ca^{2+}, Mg^{2+}), anions (Cl^-, SO_4^{2-}, HCO_3^-), and pH. Activity corrections were made using the extended Debye-Hückel equation (Stumm and Morgan, 1996). The LLNL (EQ3/6) thermodynamic database was selected for use in the calculations (Delany and Lundeen, 1990). For these calculations, charge imbalance was handled by compensating with chloride for samples with an anion deficit or by compensating with sodium for samples with a cation deficit. Only samples with a charge balance error <5% were used for determining saturation indices.

For the historical datasets, samples with a charge balance error ≤15% were used for water-type analysis and for constructing geochemical plots such as Piper and Schoeller diagrams. In most cases, charge balance errors exceeding the 15% criterion were due to missing concentrations of major cations or anions in the historical datasets. Again, the historical data from locations with multiple sampling events were averaged and summary statistics were determined, in order to avoid undue weighting of locations sampled on multiple occasions. Charge balance criteria were not used to screen data for use in summary statistic calculations and for plotting box and whisker diagrams. Ground water and spring data were combined, and surface water was treated as a separate group. Summary statistics for historical data were determined on a countywide basis for comparison with the data collected in this study and also on a reduced-area basis (3-mile radius) in order to more directly evaluate data from samples collected in nearby locations. The reduced areas used for evaluating water quality data were chosen to approximately coincide with the areas considered in the background assessment of potential contaminant sources (see Appendix C). Various issues relating to data quality and applicability of historical water quality data have been discussed previously (Battelle, 2013; US EPA, 2013; Wilkin, 2013), such as comparability of analytical methods, comparability of analytes, unknown sample collection methods, and unavailable laboratory QC data and data quality-related qualifiers. While recognizing these limitations, historical data are used as the best points of reference available to compare with the water quality data collected in this study.

Statistical evaluations were carried out using the ProUCL (US EPA, 2010b) and Statistica (version 12) software packages. Hypothesis testing for the water quality data was performed using parametric

(ANOVA) and nonparametric (Kruskal-Wallis) methods. An assumption underlying parametric statistical procedures is that datasets are normally distributed or can be transformed to a normally distributed form; data transformations in some cases included logarithmic functions. For the analysis of the major-ion trends, average values were used in the statistical tests and were combined with single observations. As noted previously, this approach was used to avoid the undue weighting of locations sampled multiple times, either in the new data collected for this study or in the historical water quality data. *Post hoc* tests were performed to identify significant differences among water quality datasets for particular analytes, including the Scheffe and Kruskal-Wallis multiple comparison tests. A p-value of less than 0.05 was interpreted as a significant difference between compared datasets. Because a large number of comparisons were made between the data from this study and the historical water quality data, which encompass many sampling investigations, multiple locations, and extended periods of time, the problem of multiple comparisons is suggested: that is, the increased likelihood of rejecting the null hypothesis and flagging significant differences among datasets. Given the exploratory nature of this study, p-value adjustments (e.g., Bonferroni or Šidák correction factors) were not incorporated and the traditional significance threshold of 0.05 was applied for the data comparisons.

5. Historical Water Quality Data

Historical ground water quality data for Washington County were obtained from Newport (1973), and the USGS NWIS (USGS, 2013a) and USGS NURE databases (USGS, 2013b). These data sources represent sampling events conducted before 2005 that pre-date unconventional gas development in the county. Comparisons of data from historical sources and collected during this study were conducted at the county scale (approximate area 860 square miles). No attempt was made to expand the analysis to include adjacent counties in Pennsylvania, West Virginia, and Ohio; however, more refined analysis was conducted in areas proximal to the sampling locations of this study (reduced-area comparisons; approximately 150 square miles in the northern area and 30 square miles in the southern area). The regions included in the reduced-area comparisons were controlled by the spatial distribution of sampling locations from this study; for example, a smaller region was considered in the southern area because sampling locations there were relatively close to one another (e.g., within 1 mile; see Figure 8). The historical data are constrained temporally by the availability of information in the databases, as noted below. It is important to point out that the historical water quality data are not taken *a priori* as being representative of the background condition in the county, where background is taken to represent the water quality regime in the absence of all human activities, including unconventional oil and gas development. It is anticipated that the historical databases, in fact, contain examples in which the water quality information reflects anthropogenic impact. Thus, for the purposes of this report, the historical data are used as points of reference for screening-level comparisons in order to illustrate regional concentration ranges typical in ground water and for constraining major water composition types that have previously been encountered throughout the county. The applicability of these data is limited by the parameters for which data have been historically collected; organic compounds, radiogenic parameters, stable isotopes, and dissolved gases are not generally represented in the historical data, yet these data types are critical for this study (Bowen et al., 2015). Subsequent analysis of the historical water quality information, in relation to the new data collected for this study, provides appropriate context regarding the geologic settings and geochemical environments, the influence of anthropogenic impacts based on environmental record searches (see Appendix C), and the recognition of data quality issues (see US EPA, 2013). The following paragraphs briefly describe the historical datasets used for comparison purposes in this study.

The Newport (1973) report provides water quality data for 14 sampling locations noted to be representative of water from wells drilled in Washington County, although an unspecified number of samples were considered to represent extreme conditions atypical of background conditions. Concentration data for major cations (sodium, potassium, calcium, magnesium), major anions (bicarbonate, sulfate, chloride), and other constituents (silicon, nitrate, and total iron) were provided in tabular form (see Table 4 in Newport, 1973). Water samples were collected from wells ranging in depth from 28 to 200 feet below land surface (median = 90 feet) and represent a range of topographic locations, including stream channels, valleys, and hilltops. Sampling locations are approximated in Figure 8 (coordinates provided for the southeast corner of the 1-minute quadrangle containing the well). For the Newport (1973) dataset, the calculated charge balance error ranges from 0.2% to 13.1% (median = 1.4%); thus, all data were used for evaluation of water types and constructing Piper diagrams.

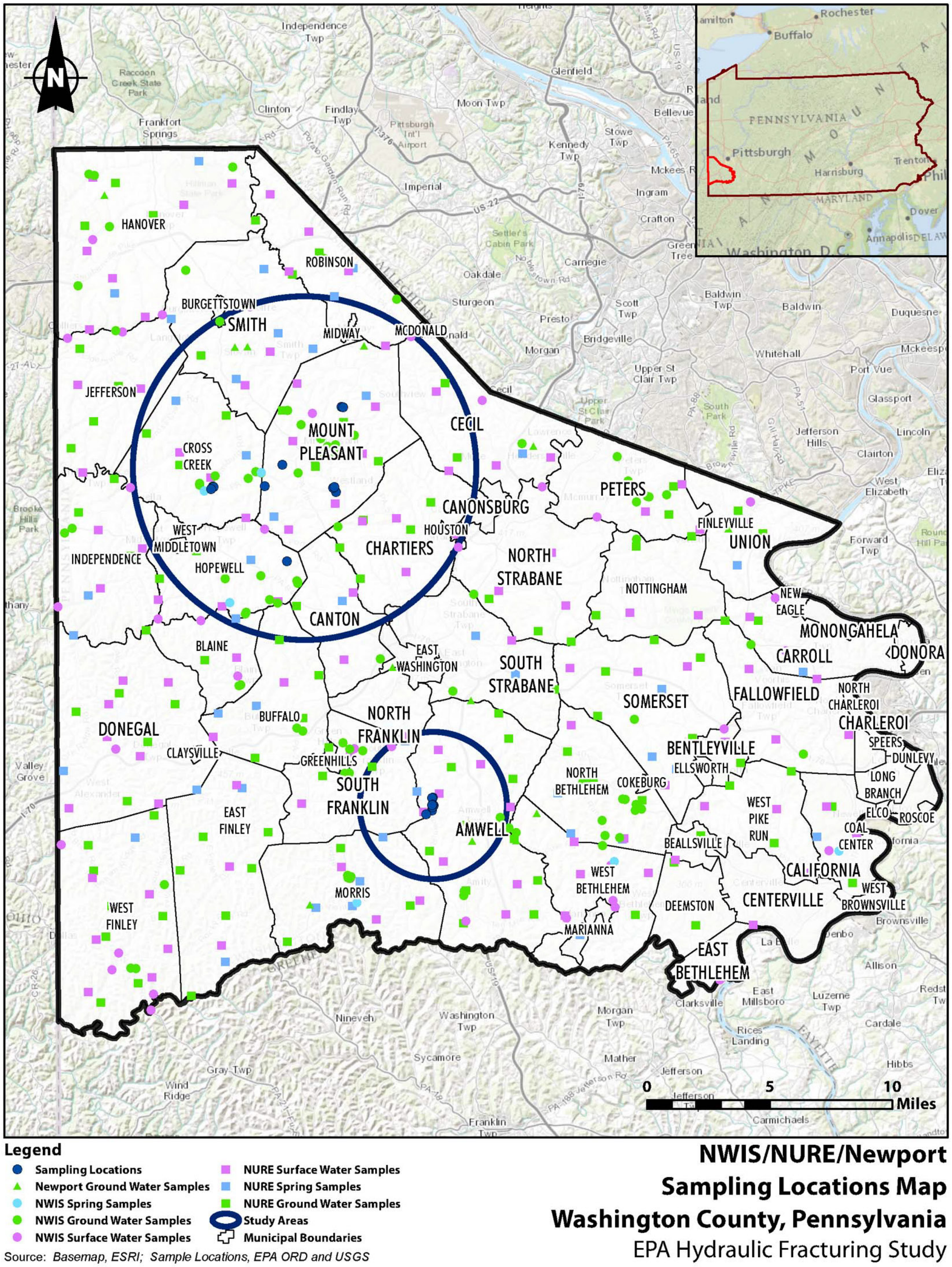


Figure 8. Northern and southern sampling areas and historical water quality locations. The blue circles show the reduced areas used for comparing the data collected in this study with historical water quality data.

The USGS NWIS database for Washington County contains entries for 95 ground water locations (1926–1997), six spring locations (1983–1985), and 46 surface water locations (1964–2012); sampling locations are identified in Figure 8. Ground water samples were collected from wells ranging in depth from 21 to 301 feet below land surface (median = 100 feet). Water quality data from the ground water and spring entries were combined. Analytical data mainly include major cations, anions, general parameters (e.g., pH, specific conductance, and alkalinity), some trace elements, and very limited entries for organic compounds and radiogenic constituents. Of the 101 combined ground water and spring samples, 50 samples have a charge balance error of 15% or lower and were used for evaluating water types and for constructing Piper diagrams. Of the 46 surface water locations, 40 samples have a charge balance error of 15% or lower.

The USGS NURE database for Washington County contains entries for 107 ground water locations, 46 spring locations, and 107 stream water locations; sampling locations are identified in Figure 8. Ground water samples were collected from wells ranging in depth from about 6 to 250 feet below land surface (median = 60 feet). All of the samples were collected during the summer of 1978. Water quality data from the ground water and spring entries were combined. These data include a more limited selection of parameters, including pH, specific conductance, sodium, magnesium, chloride, fluoride, bromine, manganese, uranium, vanadium, and aluminum. Consequently, no charge balance evaluation is possible with the NURE dataset.

Summary statistics for water quality parameters were computed separately for the Newport (1973), NWIS, and NURE datasets, including minimum and maximum values, median, mean, and standard deviation. Analysis is provided for the countywide distribution of data as well as for the reduced-area distributions (see Figures 9 and 10).

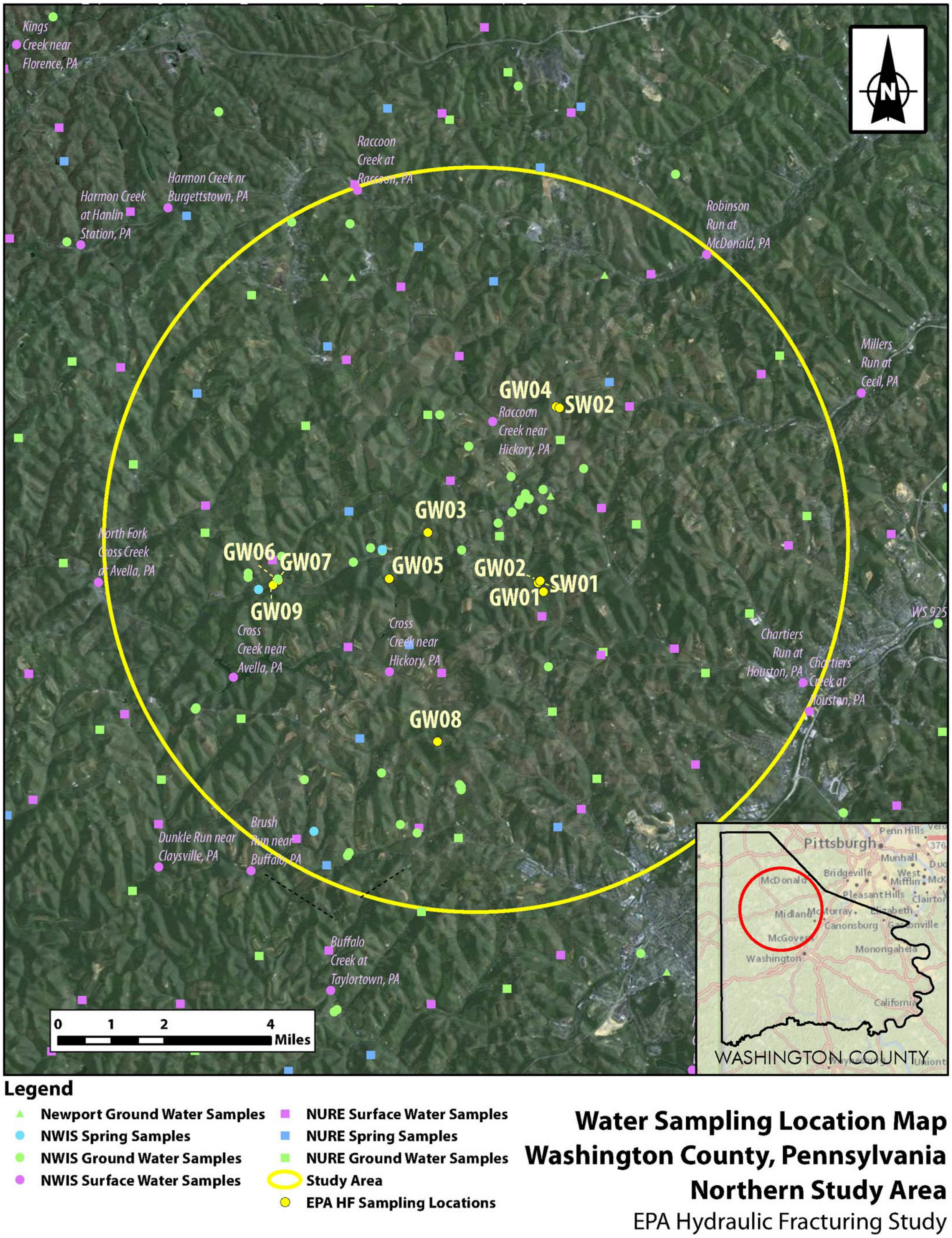
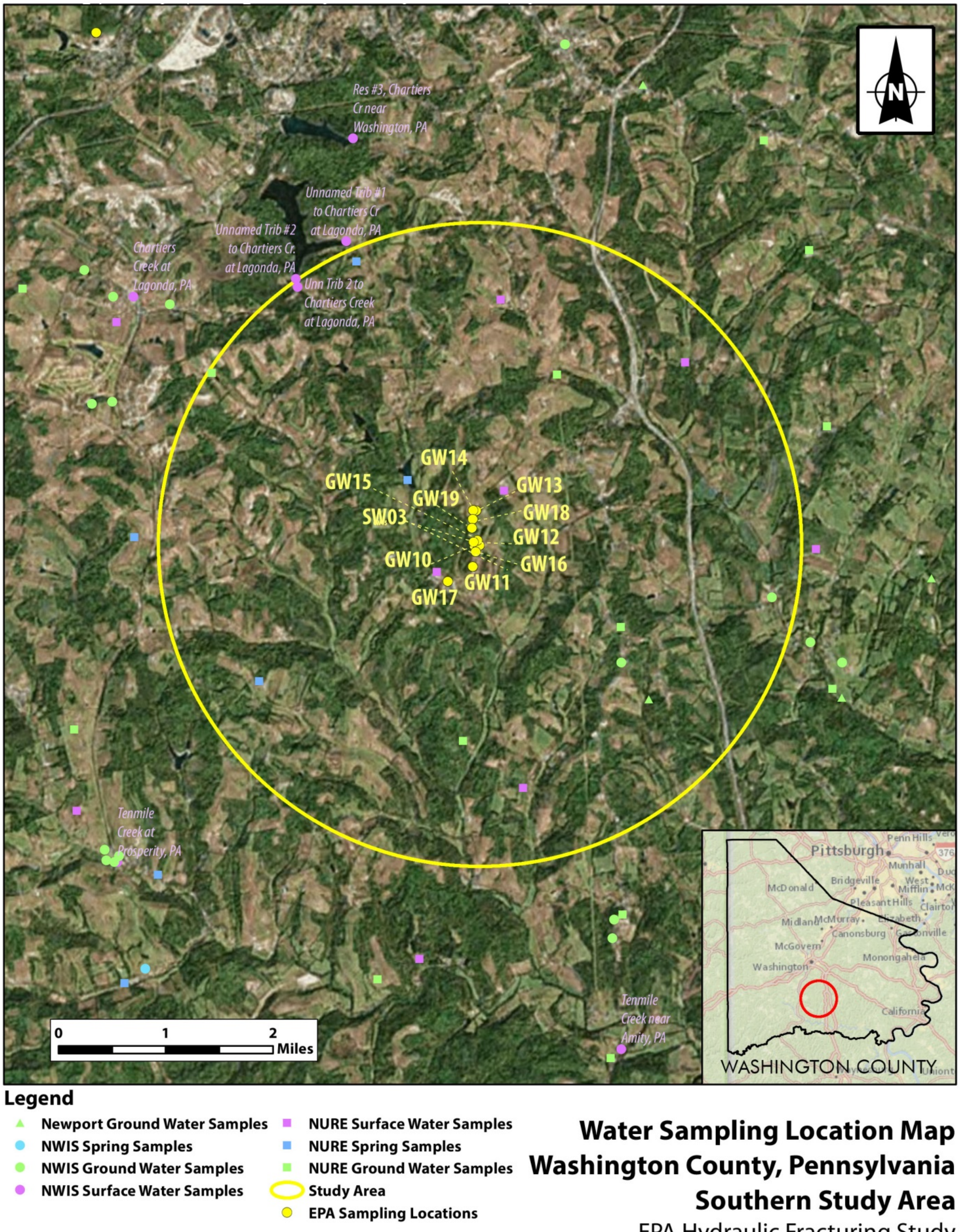


Figure 9. Northern sampling area with historical water quality locations.



Source: *Basemap, ESRI; Sample Locations, EPA ORD and USGS*

Figure 10. Southern sampling area with historical water quality locations.

6. Water Quality Data from This Study

The following sections describe the results and present interpretations of the water quality testing conducted in this case study, including geochemical parameters, major cations and anions, trace metals, organic compounds, dissolved gases, stable isotopes, and radiometric constituents. Also presented are comparisons of data from this study with historical data. Analytical data obtained during the three sampling events are provided in tabular form in Appendix B.

6.1. Geochemical Parameters

Water temperature, turbidity, dissolved oxygen, specific conductance, pH, ORP, and concentrations of dissolved sulfide were measured in the field during the collection of water samples. The mean temperature of well water and springs from the three sampling events ranged from 10.3 to 17.5 degrees Celsius (°C), with a median temperature of 13.3°C. Turbidity ranged from <1 to 18 nephelometric turbidity units (NTU), with a median of 5.4 NTU, representative of water with very little suspended particulate or colloidal material. Dissolved oxygen concentrations ranged from 0.05 to 7.7 mg/L, with a median of 4.6 mg/L. Although most of the well waters and springs were oxygenated, dissolved oxygen concentrations indicative of more reducing (anoxic) conditions—i.e., generally less than 1 mg/L—were measured at some of the locations. Concentrations of dissolved sulfide were below the level of detection (<0.01 mg/L) at all locations except SWPAGW06 during the second and third rounds of sampling (0.05 to 0.26 mg/L, J; see Appendix A for data qualifiers). Redox conditions and impacts on water quality characteristics are discussed in the "Iron and Manganese" section below.

Frequency distributions for values of specific conductance (a surrogate measure of TDS) from historical water quality data and this study are shown in Figure 11. Specific conductance values for ground water and springs measured in this study ranged from 440 to 1,801 µS/cm (median=659 µS/cm; $n = 19$) and fall within ranges of the NURE and NWIS datasets (see Figure 11 and Table 4). Statistical analysis of the specific conductance values from the different datasets on a countywide basis reveals a significant difference between data from this study and historical data using the nonparametric Kruskal-Wallis test (p-value <0.05); *post hoc* multiple comparison tests show that specific conductance values from this study and the NURE dataset are not significantly different (p-value = 0.14), indicating that the NWIS distribution of specific conductance values is distinct. NWIS data include samples with high specific conductance (>2,000 µS/cm), suggesting that the NWIS dataset may include impacted waters not representative of typical background conditions. This issue is further evaluated below in the discussion of water types.

The mean pH value of the NURE dataset (7.2; $n = 153$) is equivalent to the mean value from this study (7.2; $n = 19$). *Post hoc* statistical analysis reveals that pH data from this study and the NURE dataset are not significantly different (p-value = 0.82; Kruskal-Wallis). The distribution of pH values from the NWIS dataset differs from the distribution in this study and the NURE data (p-value <0.05; see Figure 12), with a positive shift of the mean pH value to 8.0 ($n = 88$; see Table 4).

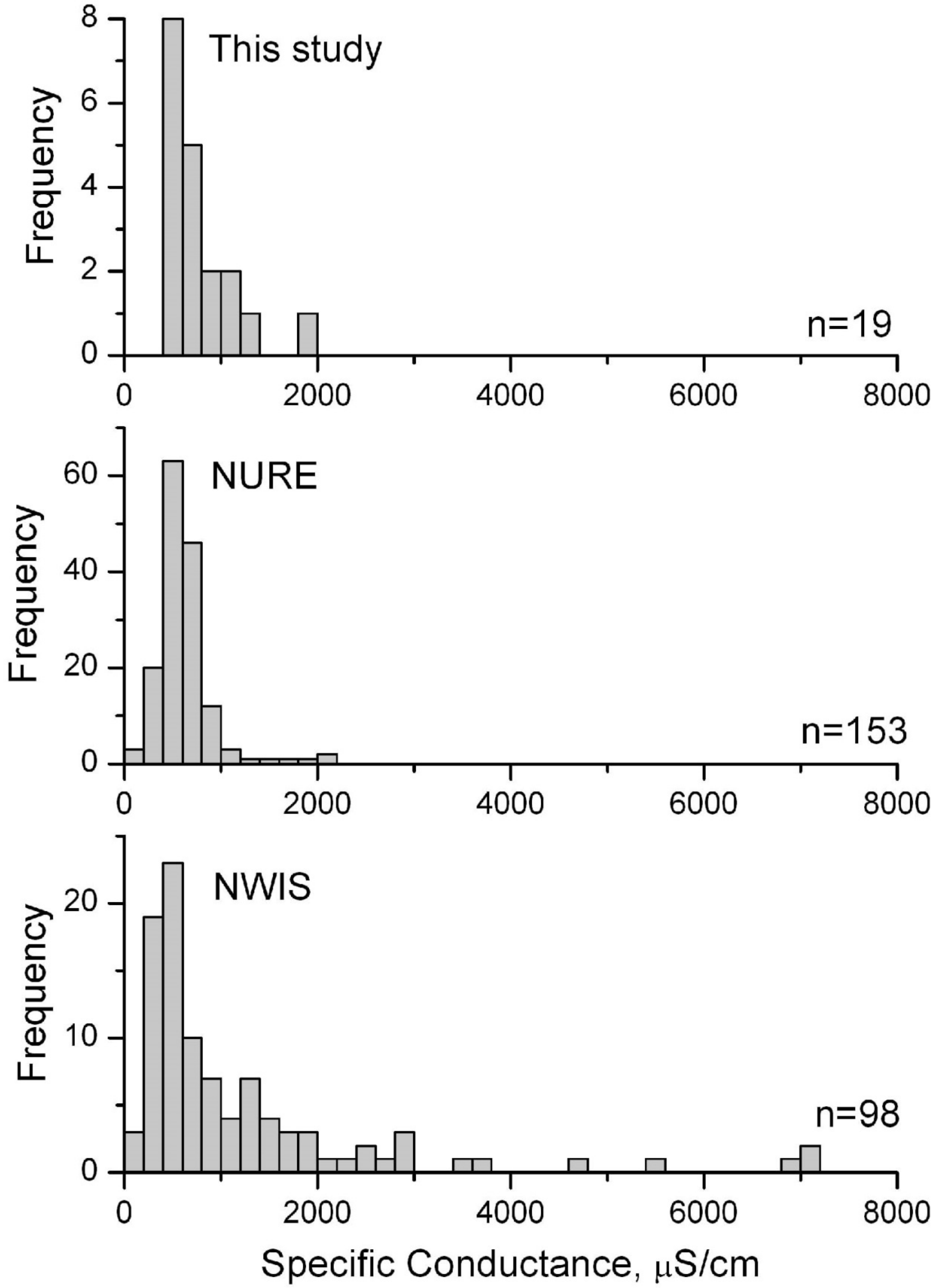


Figure 11. Frequency diagram showing distributions of specific conductance in ground water from this study and historical data.

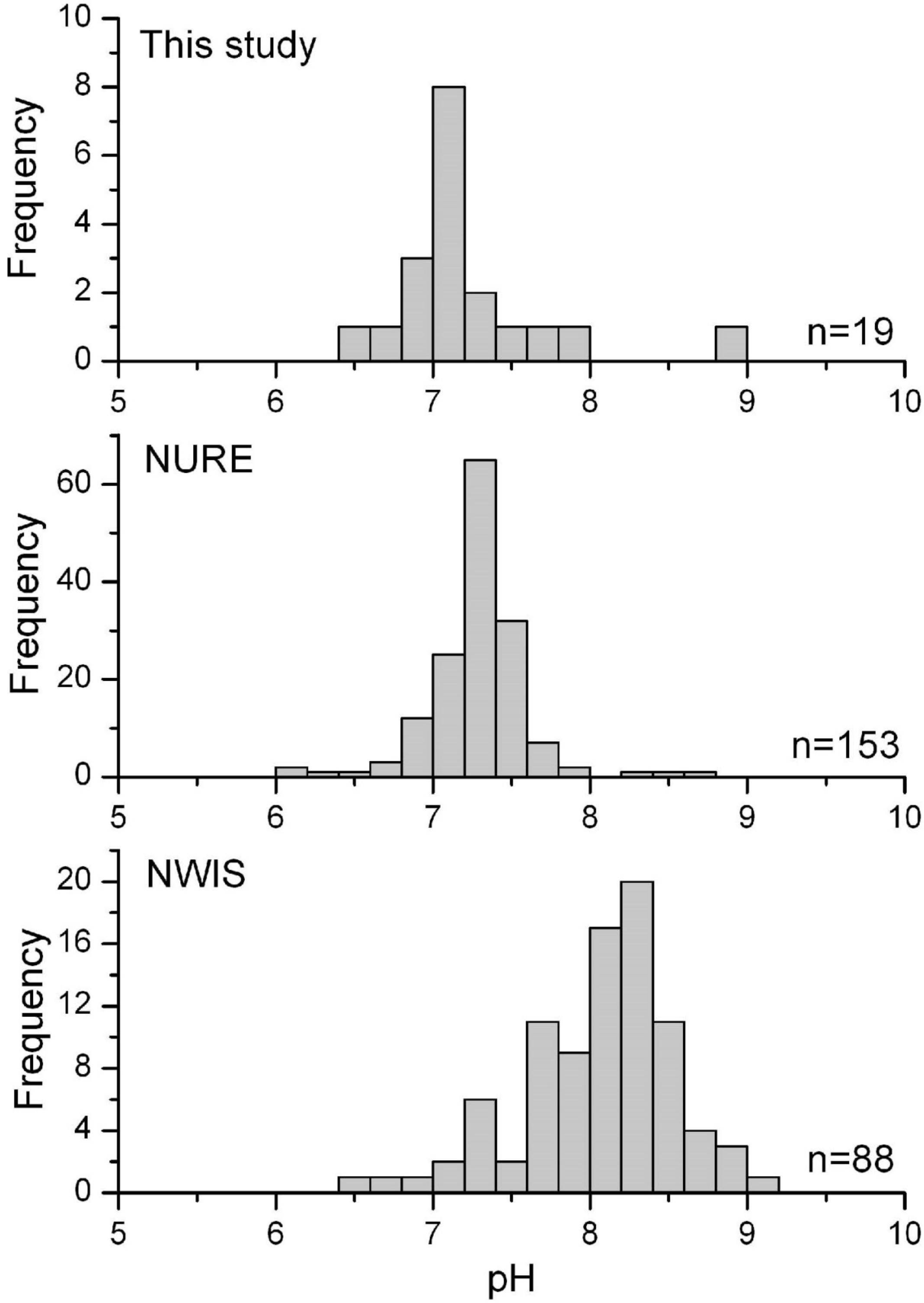


Figure 12. Frequency diagram showing distributions of ground water pH from this study and historical data.

Table 4. Summary statistics for countywide ground water and spring data.

Data Source	Parameter	Dissolved/ Total	Units	Mean	Median	SD	Min	Max	Locations	N	Z[1]
NURE	pH			7.2	7.3	0.32	6.1	8.7	153	153	--
NWIS	pH			8.0	8.1	0.50	6.5	9.1	101	88	--
This study	pH			7.2	7.1	0.53	6.5	8.9	19	19	--
NURE	SPC		µS/cm	604	550	298	80	2050	153	153	0
NWIS	SPC		µS/cm	1238	675	1412	71	7000	101	97	0
This study	SPC		µS/cm	742	659	341	440	1801	19	19	0
NWIS	Alkalinity		mg/L	164	156	71	9	460	101	91	0
This study	Alkalinity		mg/L	273	250	93	105	540	19	19	0
Newport (1973)	Sodium	dissolved	mg/L	87	33	122	8.2	440	14	14	0
NURE	Sodium	dissolved	mg/L	19	7	40	1.4	309	153	130	0
NWIS	Sodium	dissolved	mg/L	198	42	362	4.0	1700	101	48	0
This study	Sodium	dissolved	mg/L	51	20	70	3.3	265	19	19	0
Newport (1973)	Potassium	dissolved	mg/L	4.7	3.6	3.0	1.7	12	14	14	0
NWIS	Potassium	dissolved	mg/L	3.5	3.4	1.7	0.2	7.2	101	48	0
This study	Potassium	dissolved	mg/L	1.3	1.3	0.3	0.9	1.8	19	19	0
Newport (1973)	Calcium	dissolved	mg/L	94	69	124	2.8	506	14	14	0
NWIS	Calcium	dissolved	mg/L	74	66	30	19	160	101	69	0
This study	Calcium	dissolved	mg/L	98	93	68	6.2	311	19	19	0
Newport (1973)	Magnesium	dissolved	mg/L	26	18	35	2.1	141	14	14	0
NURE	Magnesium	dissolved	mg/L	10	7	10	1.0	73	153	123	0
NWIS	Magnesium	dissolved	mg/L	20	14	15	3.6	67	101	69	0
This study	Magnesium	dissolved	mg/L	14	12	7	4.4	29	19	19	0
Newport (1973)	Chloride	dissolved	mg/L	45	17	72	1.4	220	14	14	0
NURE	Chloride	dissolved	mg/L	23	9	51	1.9	404	153	128	0
NWIS	Chloride	dissolved	mg/L	90	29	159	3.0	910	101	73	0
This study	Chloride	dissolved	mg/L	74	35	116	2.2	494	19	19	0
Newport (1973)	Sulfate	dissolved	mg/L	176	54	416	3.7	1600	14	14	0
NWIS	Sulfate	dissolved	mg/L	349	175	521	10	2600	101	91	0
This study	Sulfate	dissolved	mg/L	40	38	20	4.5	95	19	19	0

Table 4. Summary statistics for countywide ground water and spring data.

Data Source	Parameter	Dissolved/ Total	Units	Mean	Median	SD	Min	Max	Locations	N	Z[1]
NURE	Fluoride	dissolved	mg/L	0.12	0.07	0.17	0.01	1.24	153	102	0
NWIS	Fluoride	dissolved	mg/L	0.27	0.20	0.16	<0.1	0.8	101	48	2
This study	Fluoride	dissolved	mg/L	0.29	0.10	0.50	<0.05	2.03	19	19	3
Newport (1973)	Bicarbonate	dissolved	mg/L	340	316	181	45	867	14	14	0
NWIS	Bicarbonate	dissolved	mg/L	209	190	89	13	560	101	54	0
This study	Bicarbonate	dissolved	mg/L	349	335	99	146	605	17	19	0
Newport (1973)	Nitrate	dissolved	mg/L	9.3	0.95	21.6	<0.1	75	14	14	1
NWIS	Nitrate[2]	dissolved	mg/L	0.5	0.5	0.4	<0.04	1.4	101	16	1
This study	Nitrate	dissolved	mg/L	2.0	0.6	4.6	<0.01	20.4	19	19	2
Newport (1973)	Silicon	dissolved	mg/L	15	16	5.4	7.3	26	14	14	0
NWIS	Silicon	dissolved	mg/L	6.6	5.7	3.3	2.9	21	101	48	0
This study	Silicon	dissolved	mg/L	6.1	5.8	1.4	4.3	10	19	19	0
NWIS	Barium	dissolved	µg/L	51	13	70	9	183	101	6	0
This study	Barium	dissolved	µg/L	143	125	105	34	437	19	19	0
NWIS	Strontium	dissolved	µg/L	1485	810	1800	445	6400	101	11	0
This study	Strontium	dissolved	µg/L	493	453	308	86	1267	19	19	0
Newport (1973)	Iron	total	µg/L	771	700	639	70	2300	14	14	0
NWIS	Iron	total	µg/L	693	330	1278	<50	9200	101	79	1
This study	Iron	total	µg/L	561	63	1366	<22	5175	19	19	10
NWIS	Iron	dissolved	µg/L	675	320	1383	130	9000	101	42	0
This study	Iron	dissolved	µg/L	158	29	326	<20	1280	19	19	12
NWIS	Manganese	total	µg/L	107	60	126	<10	710	101	67	2
This study	Manganese	total	µg/L	201	15	384	<4	1265	19	19	11
NURE	Manganese	dissolved	µg/L	131	62	176	7	903	153	71	0
NWIS	Manganese[2]	dissolved	µg/L	69	40	74	10	340	101	58	0
This study	Manganese	dissolved	µg/L	115	10	241	<4	913	19	19	12
NURE	Uranium	dissolved	µg/L	0.30	0.22	0.27	0.004	1.7	153	153	0
This study	Uranium	dissolved	µg/L	0.54	0.53	0.39	<0.05	1.6	19	19	2
NURE	Vanadium	dissolved	µg/L	1.2	0.6	1.1	0.2	3.1	153	7	0
This study	Vanadium	dissolved	µg/L	0.05	0.04	0.07	<0.02	0.28	13	13	4

Table 4. Summary statistics for countywide ground water and spring data.

Data Source	Parameter	Dissolved/ Total	Units	Mean	Median	SD	Min	Max	Locations	N	Z[1]
NURE	Br[3]	dissolved	mg/L	0.15	0.04	0.36	0.10	1.9	153	45	0
This study	Br	dissolved	mg/L	0.93	0.83	0.71	<0.17	2.5	19	19	8

1 Z is the number of locations with left-censored data; concentration values were set at ½ of the MDL or Reporting Level.
2 Data base entries of "0" were not included in the statistical analysis.
3 The NURE dataset provides results for bromine. It is likely that total bromine is present as bromide; however, because of uncertainty about the analytical procedures used for Br analysis, comparisons between the NURE bromine results and bromide data from this study should be made with caution. NURE Br results are not provided in subsequent data tables.

6.2. Major Ions

Water types, based on the predominant cation-anion pair (molar basis), were determined for the Newport (1973) and NWIS historical water quality datasets for Washington County and compared to the results of this study. Results of the dissolved metals (filtered) analyses were used for water-type evaluations, charge balance calculations, and for constructing Piper diagrams. As noted previously, turbidity was generally low for the ground water and surface water samples, and in most cases, the results of total and dissolved metals analyses were similar, typically with the exceptions of calcium, aluminum, iron, and manganese in some samples. The calcium-bicarbonate water type was the most frequently observed across all of the datasets in Washington County (see Figure 13), followed by the sodium-bicarbonate and calcium-sulfate water types. NWIS data include a high proportion of the sodium-sulfate water type (31%), which was not observed in this study or in the Newport (1973) data. This study included the calcium-chloride water type from several locations (SWPAGW05, SWPAGW13, and SWPAGW14); these sampling locations are discussed more fully in following sections.

The major cation and anion compositions of ground water and springs are shown on a trilinear diagram (Piper diagram; see Figure 14) for each water sample for which a charge balance error of 15% or lower was determined, encompassing all of the locations from this study, the Newport (1973) data, and 50 locations in Washington County from the NWIS database (ground water and springs). The Piper diagram includes two ternary plots, one for anions and one for cations, and a central quadrilateral plot, containing data projected from the ternary diagrams. In each of the datasets evaluated, major cations trend from compositions dominated by calcium and magnesium to compositions dominated by sodium plus potassium. The anion compositions of waters from this study are mainly bicarbonate-dominated, with a trend toward chloride-dominated compositions (represented mainly by locations SWPAGW13 and SWPAGW14); the chloride trend is not present in the historical water quality data (see Figure 14). The anionic composition of some waters from the NWIS data and the Newport (1973) data show a separate distinctive trend toward sulfate-dominated compositions. As discussed below, the sodium-sulfate type compositions present in the NWIS data, but not in this study, tend to be elevated in TDS and may be representative of more evolved water-rock interactions, perhaps involving weathering of sulfide minerals such as pyrite contained in coal and other sedimentary rocks.

The origin of major ions in ground water in part reflects long-term reactions of recharge water with the minerals contained in subsurface aquifers, including silicate-rich and carbonate-rich rocks and unconsolidated materials. The primary chemical reactions expected in ground water systems include abiotic dissolution-precipitation processes and several important biotic processes (e.g., Hem, 1985). Various trends are revealed by plotting specific water quality parameters against the measure of TDS (or its surrogate specific conductance) and retaining context to the primary water types (see Figure 15). For example, water samples with pH below 7 (acidic) tend to be unbuffered and low in specific conductance. The sodium-sulfate water type (NWIS data) tends to be elevated in pH and enriched in TDS resulting from water-rock interactions. The calcium-chloride water type from this study shows increasing calcium and chloride concentrations with increasing specific conductance, but no change in pH or the concentrations of bicarbonate, sulfate, and sodium, suggesting decoupled behavior and a specific source of calcium and chloride enrichment (see Figure 15).

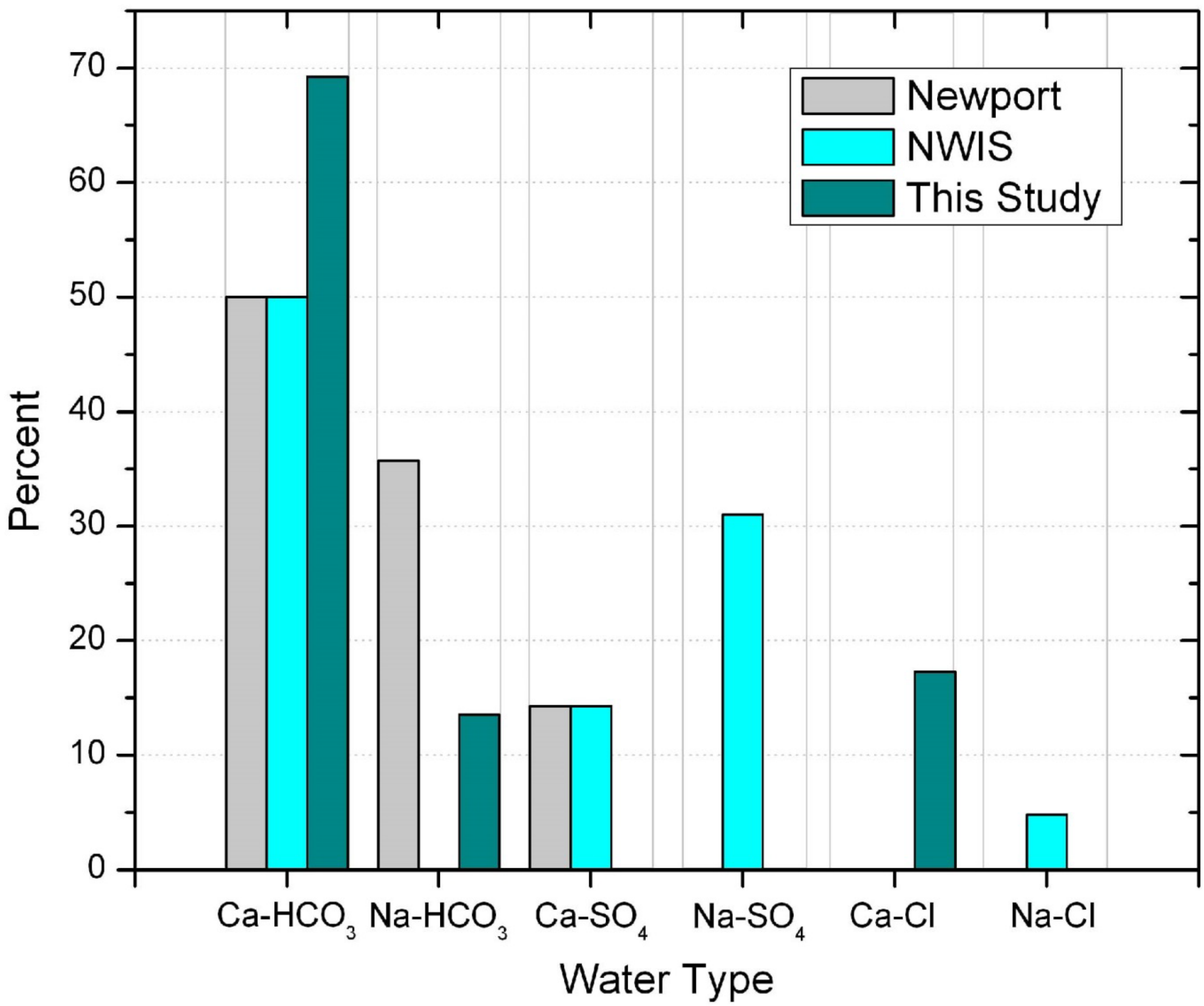


Figure 13. Frequency diagram of water types (ground water) identified in Washington County from this study and from historical water quality data.

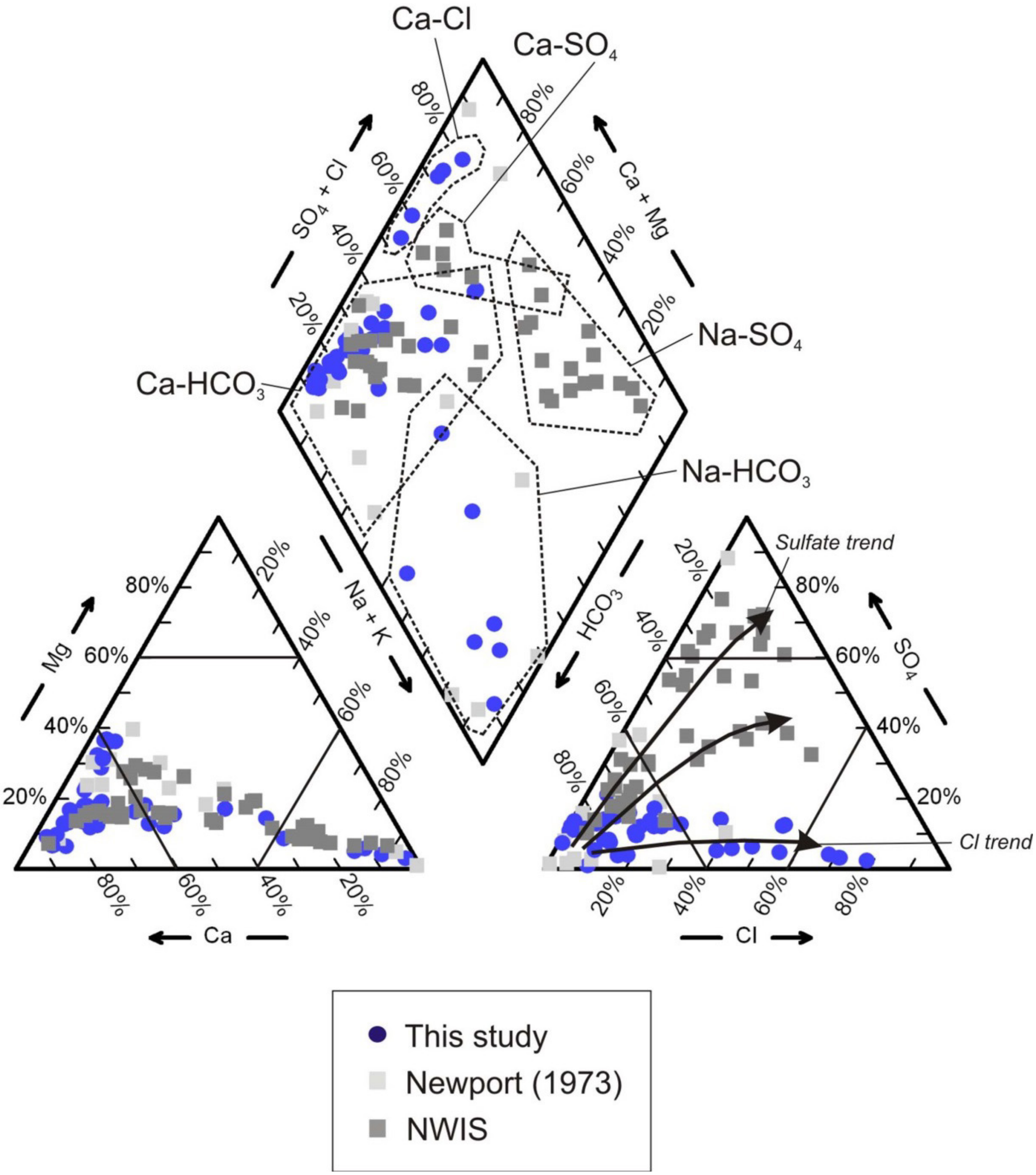


Figure 14. Major ion chemistry of ground water from this study and from historical data.

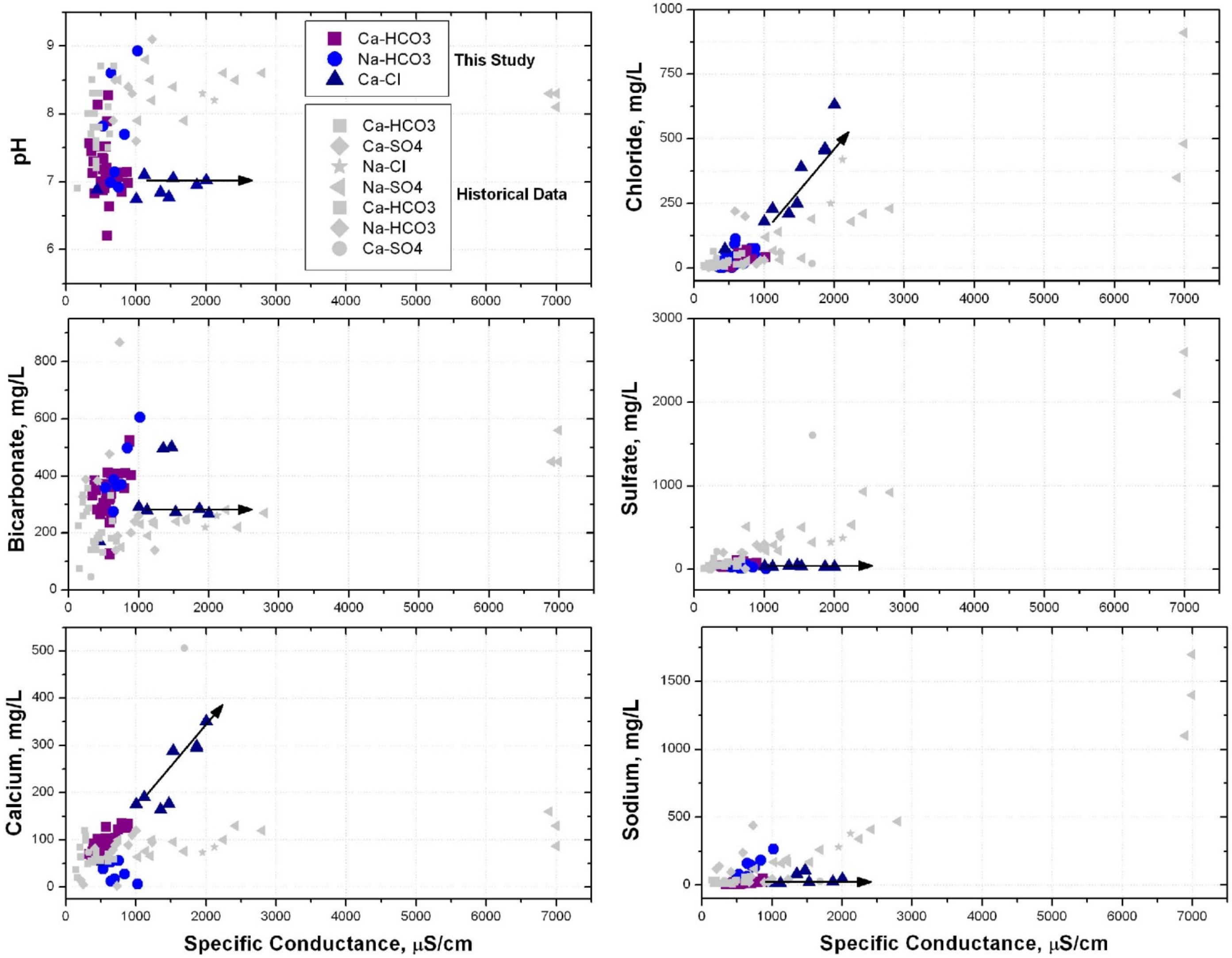


Figure 15. Relationship between specific conductance and pH and the concentrations of chloride, bicarbonate, sulfate, calcium, and sodium for ground water in Washington County; data are plotted with respect to water type. Arrows indicate trends in Ca-Cl type waters from this study.

Water quality data collected for this study are compared to historical data from Washington County in Tables 4 through 7. Descriptive statistics for selected water quality parameters were determined, and data from this study were compared to values determined from the historical data on a countywide basis (see Table 4) and on a reduced-area basis (see Tables 5 and 6). Data for surface water are presented in Table 7. Descriptive statistics include the mean, median, standard deviation, minimum and maximum values, number of total locations, and number of data entries for the particular parameter. The last two metrics indicate that the datasets are not always complete for all of the parameters of interest, for example, not all locations have concentration data for sodium, etc. Summary statistics are also provided in Table 8 for selected parameters measured in this study but not generally included in historical water quality datasets (i.e., ORP, dissolved oxygen, DOC, dissolved and total arsenic, and dissolved lithium).

The reduced search areas (see Figures 9 and 10) were drawn to represent a 3-mile radius of influence from the central point in the southern area (equivalent to the site-7H area; see Appendix C) and to consider the area encompassed by overlapping 3-mile radii around sampling locations in the northern area (resulting in a 7-mile radius; see Appendix C). Box and whisker plots were constructed from the historical datasets and from data collected for this study (see Figures 16, 17, and 18).

On a countywide basis, the concentrations of sodium and chloride from this study, the NURE dataset, and the Newport (1973) dataset are generally lower than those from the NWIS dataset. Statistical analysis of sodium concentrations using the *post hoc* Scheffe test revealed no significant differences between the Newport (1973) data, NURE data, and data from this study (p-value >0.62). Values for magnesium from this study are within the ranges of the Newport (1973), NURE, and NWIS data. Calcium and bicarbonate values from this study and from Newport (1973) are generally similar to the NWIS data but lower for sulfate (see Table 4 and Figure 16). With the exception of calcium, ANOVA (log-transformed) and Kruskal-Wallis tests showed significant differences among all of the datasets for the major ions: sodium, chloride, sulfate, magnesium, and bicarbonate (p-value <0.05). In particular, the presence of high sulfate concentrations in the NWIS dataset compared to the data collected for this study indicates that comparisons with lumped historical water quality data may not be appropriate; however, no attempt was made to filter the datasets in order to avoid unintended bias in the evaluation of historical data.

Northern area reduced-area analysis: The northern sampling area retains good coverage of water quality data from the Newport (1973), NURE, and NWIS datasets, with up to 4, 16, and 32 locations within the reduced area, respectively (see Figure 17). With the exception of calcium, the range of major ion concentrations observed in this study fell within historical data ranges. Concentrations of sodium, magnesium, chloride, sulfate, and bicarbonate were generally lower in the data from this study compared to NWIS data. Significant differences among the datasets were found for all parameters in Figure 17 using the Kruskal-Wallis nonparametric ANOVA by ranks test (p-value <0.05).

Table 5. Summary statistics for northern area ground water and spring data.

Data Source	Parameter	Dissolved/ Total	Units	Mean	Median	SD	Min	Max	Locations	N	Z[1]
NURE	pH			7.2	7.3	0.23	6.6	7.6	29	29	--
NWIS	pH			8.0	8.1	0.43	7.0	8.8	35	31	--
This study	pH			7.1	7.1	0.29	6.5	7.6	9	9	--
NURE	SPC		µS/cm	603	575	299	300	2000	29	29	0
NWIS	SPC		µS/cm	1110	505	1615	305	7000	35	33	0
This study	SPC		µS/cm	640	530	240	440	1230	9	9	0
NWIS	Alkalinity		mg/L	160	150	90	9	460	35	32	0
This study	Alkalinity		mg/L	251	250	70	105	342	9	9	0
Newport (1973)	Sodium	dissolved	mg/L	44	33	37	12	97	4	4	0
NURE	Sodium	dissolved	mg/L	18	11	29	4.2	124	29	16	0
NWIS	Sodium	dissolved	mg/L	229	46	448	7.4	1700	35	22	0
This study	Sodium	dissolved	mg/L	39	20	42	5.1	124	9	9	0
Newport (1973)	Potassium	dissolved	mg/L	4.4	4.9	1.8	1.8	5.9	4	4	0
NWIS	Potassium	dissolved	mg/L	3.5	3.2	1.4	0.7	6.9	35	22	0
This study	Potassium	dissolved	mg/L	1.3	1.2	0.3	0.9	1.8	9	9	0
Newport (1973)	Calcium	dissolved	mg/L	70	69	9	62	82	4	4	0
NWIS	Calcium	dissolved	mg/L	63	58	22	24	130	35	29	0
This study	Calcium	dissolved	mg/L	87	77	37	27	155	9	9	0
Newport (1973)	Magnesium	dissolved	mg/L	26	29	6	17	30	4	4	0
NURE	Magnesium	dissolved	mg/L	9	6	10	3	44	29	16	0
NWIS	Magnesium	dissolved	mg/L	17	12	15	7	67	35	29	0
This study	Magnesium	dissolved	mg/L	15	12	7	8	29	9	9	0
Newport (1973)	Chloride	dissolved	mg/L	19	18	14	4	38	4	4	0
NURE	Chloride	dissolved	mg/L	13	8	11	2	35	29	15	0
NWIS	Chloride	dissolved	mg/L	102	21	192	7	910	35	30	0
This study	Chloride	dissolved	mg/L	57	52	55	5	178	9	9	0
Newport (1973)	Sulfate	dissolved	mg/L	116	123	105	6	210	4	4	0
NWIS	Sulfate	dissolved	mg/L	299	92	618	26	2600	35	32	0
This study	Sulfate	dissolved	mg/L	39	39	9	25	50	9	9	0

Table 5. Summary statistics for northern area ground water and spring data.

Data Source	Parameter	Dissolved/ Total	Units	Mean	Median	SD	Min	Max	Locations	N	Z[1]
NURE	Fluoride	dissolved	mg/L	0.21	0.11	0.26	0.01	0.98	29	16	0
NWIS	Fluoride	dissolved	mg/L	0.30	0.20	0.20	<0.1	0.70	35	22	2
This study	Fluoride	dissolved	mg/L	0.20	0.11	0.26	0.06	0.87	9	9	0
Newport (1973)	Bicarbonate	dissolved	mg/L	248	282	145	45	383	4	4	0
NWIS	Bicarbonate	dissolved	mg/L	233	200	104	140	560	35	18	0
This study	Bicarbonate	dissolved	mg/L	333	342	94	146	506	9	9	0
Newport (1973)	Nitrate	dissolved	mg/L	20	1.4	37	0.2	75	4	4	0
NWIS	Nitrate	dissolved	mg/L	0.49	0.51	0.25	0.2	0.87	35	5	0
This study	Nitrate	dissolved	mg/L	0.81	0.56	0.73	<0.01	1.88	9	9	1
Newport (1973)	Silicon	dissolved	mg/L	14	14	3	10	17	4	4	0
NWIS	Silicon	dissolved	mg/L	6.0	5.9	1.9	3.1	10	35	22	0
This study	Silicon	dissolved	mg/L	6.0	5.7	1.7	4.3	10	9	9	0
Newport (1973)	Iron	total	µg/L	520	610	250	170	700	4	4	0
NWIS	Iron	total	µg/L	676	360	918	70	4800	35	32	0
This study	Iron	total	µg/L	1058	54	1910	15	5175	9	9	5
NWIS	Iron	dissolved	µg/L	624	510	530	150	1900	35	9	0
This study	Iron	dissolved	µg/L	310	90	440	10	1280	9	9	6
NWIS	Manganese	total	µg/L	125	60	136	<10	590	35	27	1
This study	Manganese	total	µg/L	182	17	333	<4	1002	9	9	6
NURE	Manganese	dissolved	µg/L	118	99	92	30	321	29	11	0
NWIS	Manganese	dissolved	µg/L	76	50	79	10	340	35	23	0
This study	Manganese	dissolved	µg/L	170	30	300	<4	910	9	9	6
NURE	Uranium	dissolved	µg/L	0.21	0.16	0.2	0.004	0.77	29	29	0
This study	Uranium	dissolved	µg/L	0.33	0.32	0.21	0.07	0.63	9	9	0

[1] Z is the number of locations with left-censored data; concentration values were set at ½ of the MDL or Reporting Level.

Table 6. Summary statistics for southern area ground water and spring data.

Data Source	Parameter	Dissolved/ Total	Units	Mean	Median	SD	Min	Max	Locations	N	Z[1]
NURE	pH			7.4	7.4	0.18	7.2	7.7	8	8	--
NWIS	pH			--	--	--	--	--	2	2	--
This study	pH			7.3	7.0	0.68	6.6	8.9	10	10	--
NURE	SPC		µS/cm	500	520	122	360	675	8	8	0
NWIS	SPC		µS/cm	--	--	--	--	--	2	2	--
This study	SPC		µS/cm	838	750	397	491	1801	10	10	0
NWIS	Alkalinity		mg/L	--	--	--	--	--	2	2	--
This study	Alkalinity		mg/L	293	259	110	200	540	10	10	0
Newport (1973)	Sodium	dissolved	mg/L	--	--	--	--	--	1	1	--
NURE	Sodium	dissolved	mg/L	21	9	26	2	75	8	7	0
NWIS	Sodium	dissolved	mg/L	--	--	--	--	--	2	1	--
This study	Sodium	dissolved	mg/L	62	18	90	3.3	265	10	10	0
Newport (1973)	Potassium	dissolved	mg/L	--	--	--	--	--	1	1	--
NWIS	Potassium	dissolved	mg/L	--	--	--	--	--	2	1	--
This study	Potassium	dissolved	mg/L	1.3	1.3	0.3	0.9	1.7	10	10	0
Newport (1973)	Calcium	dissolved	mg/L	--	--	--	--	--	1	1	--
NWIS	Calcium	dissolved	mg/L	--	--	--	--	--	2	1	--
This study	Calcium	dissolved	mg/L	108	96	88	6.2	311	10	10	0
Newport (1973)	Magnesium	dissolved	mg/L	--	--	--	--	--	1	1	--
NURE	Magnesium	dissolved	mg/L	6	7	4	1.6	11	8	7	0
NWIS	Magnesium	dissolved	mg/L	--	--	--	--	--	2	1	--
This study	Magnesium	dissolved	mg/L	13	12	7	4.4	28	10	10	0
Newport (1973)	Chloride	dissolved	mg/L	--	--	--	--	--	1	1	--
NURE	Chloride	dissolved	mg/L	8	7	5	2.8	17	8	7	0
NWIS	Chloride	dissolved	mg/L	--	--	--	--	--	2	1	--
This study	Chloride	dissolved	mg/L	89	34	154	2.2	494	10	10	0
Newport (1973)	Sulfate	dissolved	mg/L	--	--	--	--	--	1	1	--
NWIS	Sulfate	dissolved	mg/L	--	--	--	--	--	2	2	--
This study	Sulfate	dissolved	mg/L	40	30	27	4.5	95	10	10	0

Table 6. Summary statistics for southern area ground water and spring data.

Data Source	Parameter	Dissolved/ Total	Units	Mean	Median	SD	Min	Max	Locations	N	Z[1]
NURE	Fluoride	dissolved	mg/L	0.11	0.1	0.09	0.02	0.23	8	6	0
NWIS	Fluoride	dissolved	mg/L	--	--	--	--	--	2	1	--
This study	Fluoride	dissolved	mg/L	0.38	0.08	0.65	0.03	2.03	10	10	0
Newport (1973)	Bicarbonate	dissolved	mg/L	--	--	--	--	--	1	1	--
NWIS	Bicarbonate	dissolved	mg/L	--	--	--	--	--	2	1	--
This study	Bicarbonate	dissolved	mg/L	367	327	108	274	605	10	8	0
Newport (1973)	Nitrate	dissolved	mg/L	--	--	--	--	--	1	1	--
NWIS	Nitrate	dissolved	mg/L	--	--	--	--	--	2	0	--
This study	Nitrate	dissolved	mg/L	3.1	0.59	6.2	<0.10	20	10	10	1
Newport (1973)	Silicon	dissolved	mg/L	--	--	--	--	--	1	1	--
NWIS	Silicon	dissolved	mg/L	--	--	--	--	--	2	1	--
This study	Silicon	dissolved	mg/L	6.3	6.3	1.1	4.6	8.1	10	10	0
Newport (1973)	Iron	total	µg/L	--	--	--	--	--	1	1	--
NWIS	Iron	total	µg/L	--	--	--	--	--	2	2	--
This study	Iron	total	µg/L	113	67	128	<22	423	10	10	5
NWIS	Iron	dissolved	µg/L	--	--	--	--	--	2	2	--
This study	Iron	dissolved	µg/L	23	13	18	<20	60	10	10	6
NWIS	Manganese	total	µg/L	--	--	--	--	--	2	2	--
This study	Manganese	total	µg/L	217	12	442	<4	1265	10	10	5
NURE	Manganese	dissolved	µg/L	34	22	33	10	82	8	4	0
NWIS	Manganese	dissolved	µg/L	--	--	--	--	--	2	2	--
This study	Manganese	dissolved	µg/L	66	10	174	<4	560	10	10	6
NURE	Uranium	dissolved	µg/L	0.32	0.25	0.3	0.03	0.95	8	8	0
This study	Uranium	dissolved	µg/L	0.73	0.78	0.43	0.09	1.6	10	10	0

[1] Z is the number of locations with left-censored data; concentration values were set at ½ of the MDL or Reporting Level.

Table 7. Summary statistics for countywide surface water data.

Data Source	Parameter	Dissolved/ Total	Units	Mean	Median	SD	Min	Max	Locations	N	Z[1]
NURE	pH			8.0	8.1	0.23	7.1	8.5	107	107	--
NWIS	pH			7.5	7.5	0.45	5.8	8.1	46	46	--
This study	pH			7.5	7.4	0.55	7.0	8.1	3	3	--
NURE	SPC		µS/cm	716	550	542	330	4300	107	107	0
NWIS	SPC		µS/cm	847	788	474	365	3600	46	46	0
This study	SPC		µS/cm	522	553	59	454	559	3	3	0
NWIS	Alkalinity		mg/L	181	166	60	96	450	46	45	0
This study	Alkalinity		mg/L	259	235	44	232	310	3	3	0
NURE	Sodium	dissolved	mg/L	16	9	27	1.4	241	107	107	0
NWIS	Sodium[2]	dissolved	mg/L	69	36	109	9.2	720	46	45	0
This study	Sodium	dissolved	mg/L	12	8	7	7.5	19	3	3	0
NWIS	Potassium[2]	dissolved	mg/L	2.8	2.4	1.7	1.2	12	46	45	0
This study	Potassium	dissolved	mg/L	1.2	1.2	0.2	1.1	1.4	3	3	0
NWIS	Calcium[2]	dissolved	mg/L	78	77	22	30	151	46	45	0
This study	Calcium	dissolved	mg/L	86	92	14	71	96	3	3	0
NURE	Magnesium	dissolved	mg/L	13	8	14	2	81	107	106	0
NWIS	Magnesium[2]	dissolved	mg/L	19	20	8	7	48	46	45	0
This study	Magnesium	dissolved	mg/L	18	18	9	10	27	3	3	0
NURE	Chloride	dissolved	mg/L	11	8	10	2.3	83	107	106	0
NWIS	Chloride[2]	dissolved	mg/L	63	26	145	2.2	950	46	45	0
This study	Chloride	dissolved	mg/L	20	11	24	1.9	47	3	3	0
NWIS	Sulfate	dissolved	mg/L	157	123	132	26	490	46	46	0
This study	Sulfate	dissolved	mg/L	43	44	4	39	47	3	3	0
NURE	Fluoride	dissolved	mg/L	0.10	0.09	0.06	0.01	0.39	107	102	0
NWIS	Fluoride[2]	dissolved	mg/L	0.44	0.33	0.28	0.15	1.3	46	44	0
This study	Fluoride	dissolved	mg/L	0.13	0.14	0.05	0.06	0.17	3	3	0
NWIS	Bicarbonate[2]	dissolved	mg/L	240	241	70	144	540	46	44	0
This study	Bicarbonate	dissolved	mg/L	317	331	64	250	375	3	3	0
NWIS	Nitrate[2]	dissolved	mg/L	1.3	0.42	2.4	0.01	9	46	18	0
This study	Nitrate	dissolved	mg/L	0.91	0.68	0.58	0.48	1.57	3	3	0
NWIS	Silicon[2]	dissolved	mg/L	11	11	3	6.3	22	46	44	0
This study	Silicon	dissolved	mg/L	5	5	0.4	4.5	5.3	3	3	0

Table 7. Summary statistics for countywide surface water data.

Data Source	Parameter	Dissolved/ Total	Units	Mean	Median	SD	Min	Max	Locations	N	Z[1]
NWIS	Iron	total	µg/L	2355	1135	4932	110	33095	46	46	0
This study	Iron	total	µg/L	327	349	305	<22	620	3	3	1
NWIS	Iron	dissolved	µg/L	1455	665	2437	95	14620	46	42	0
This study	Iron	dissolved	µg/L	29	19	25	<20	58	3	3	1
NWIS	Manganese	total	ug/L	259	140	285	10	1074	46	45	0
This study	Manganese	total	ug/L	30	9	43	<4	79	3	3	1
NURE	Manganese	dissolved	µg/L	378	181	642	9	3752	107	104	0
NWIS	Manganese	dissolved	µg/L	553	192	836	10	4600	46	44	0
This study	Manganese	dissolved	µg/L	19	2	29	<4	52	3	3	1
NURE	Uranium	dissolved	µg/L	0.40	0.33	0.50	<0.002	5	107	107	12
This study	Uranium	dissolved	µg/L	0.78	0.65	0.38	0.48	1.2	3	3	0
NWIS	Aluminum	total	µg/L	1965	686	2780	0	7600	46	8	0
This study	Aluminum	total	µg/L	120	19	190	<3.7	339	3	3	1
NURE	Vanadium	dissolved	µg/L	0.77	0.60	0.52	0.20	2.1	107	107	0
This study	Vanadium	dissolved	µg/L	0.34	--	--	0.18	0.50	2	2	0

[1] Z is the number of locations with left-censored data; concentration values were set at ½ of the MDL or Reporting Level. [2] Data base entries of "0" were not included in the statistical analysis.

Table 8. Summary statistics for countywide ground water and spring data, additional parameters.

Data Source	Parameter	Dissolved/ Total	Units	Mean	Median	SD	Min	Max	Locations	N	Z[1]
This study	ORP		mV	86	113	87	-128	224	19	19	--
This study	Dissolved Oxygen		mg/L	3.7	4.6	2.8	0.05	7.7	19	19	--
This study	Organic Carbon	Dissolved	mg/L	0.76	0.64	0.42	0.25	1.99	17	17	0
This study	Arsenic	Dissolved	µg/L	0.49	0.54	0.24	<0.04	0.84	19	19	2
This study	Arsenic	Total	µg/L	1.02	0.56	1.36	0.23	5.9	19	19	0
This study	Lithium	Dissolved	µg/L	9.0	8.4	4.9	3.7	18.8	13	13	0

[1] Z is the number of locations with left-censored data; concentration values were set at ½ of the MDL.

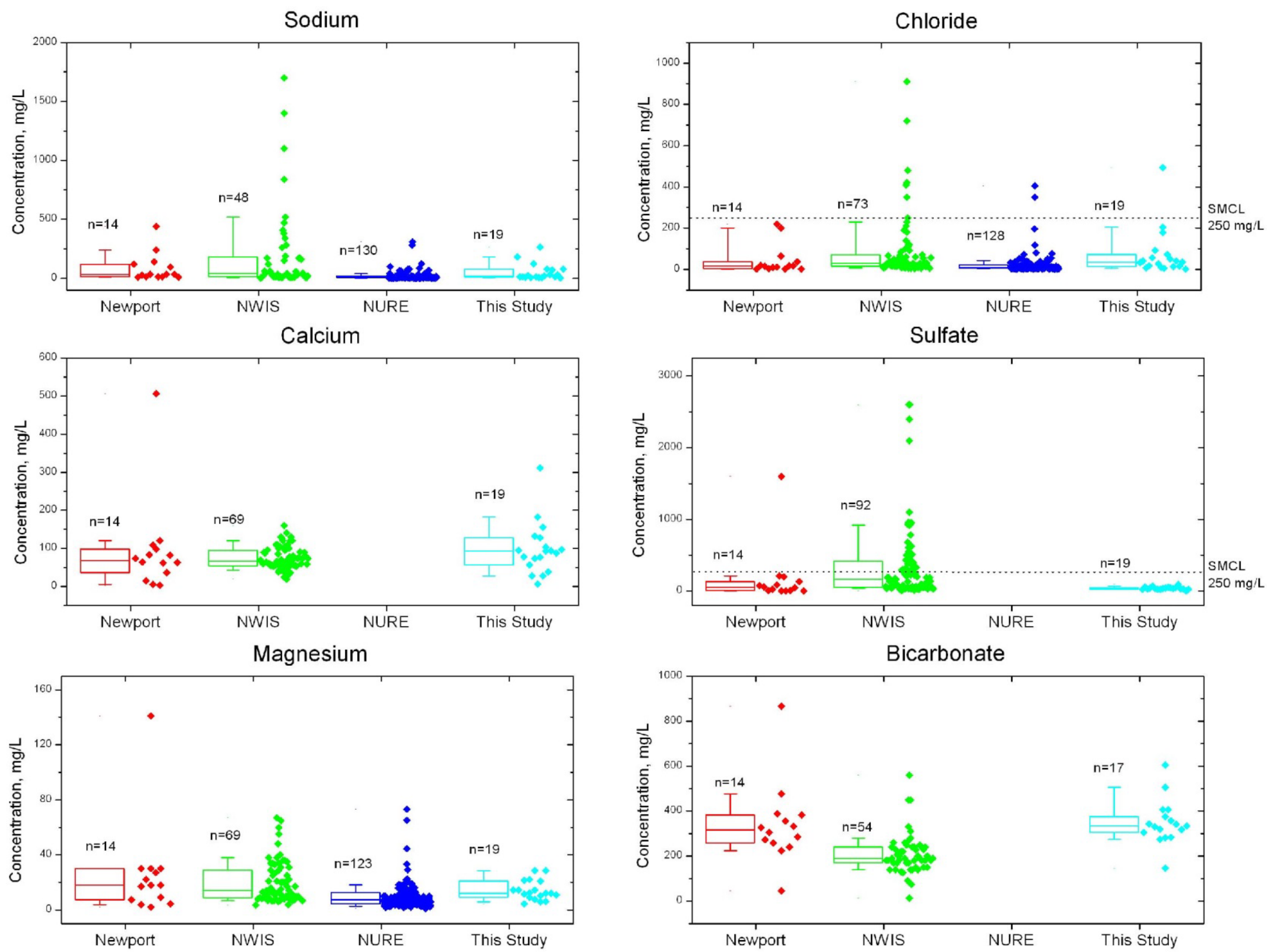


Figure 16. Countywide box-and-whisker plots, showing the 5th, 25th, 50th, 75th, and 95th percentiles. The Newport, NWIS, and NURE water quality data are representative of samples collected before Marcellus Shale gas development in Washington County.

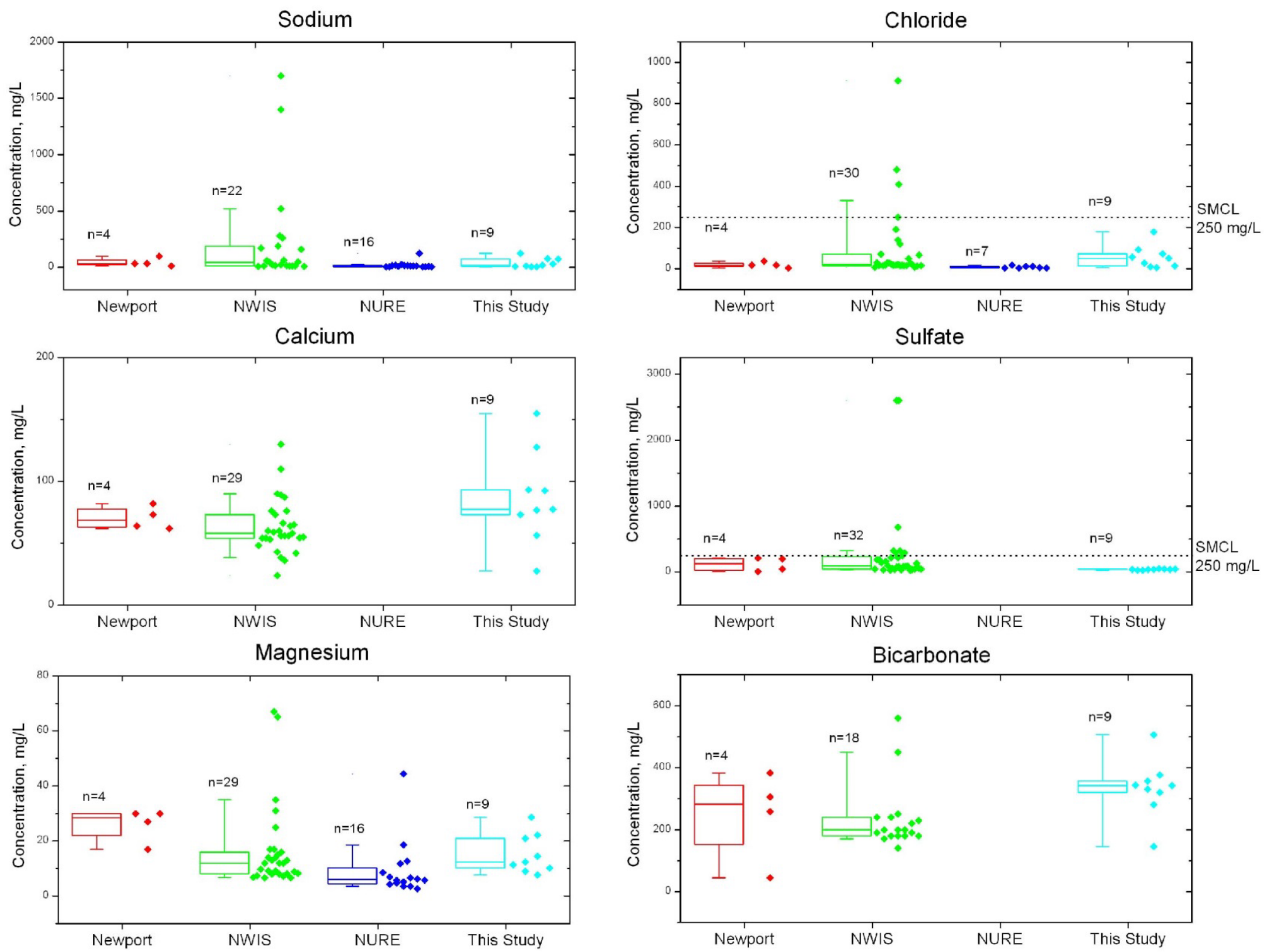


Figure 17. Northern area box-and-whisker plots, showing the 5th, 25th, 50th, 75th, and 95th percentiles. The Newport, NWIS, and NURE water quality data are representative of samples collected before Marcellus Shale gas development in Washington County.

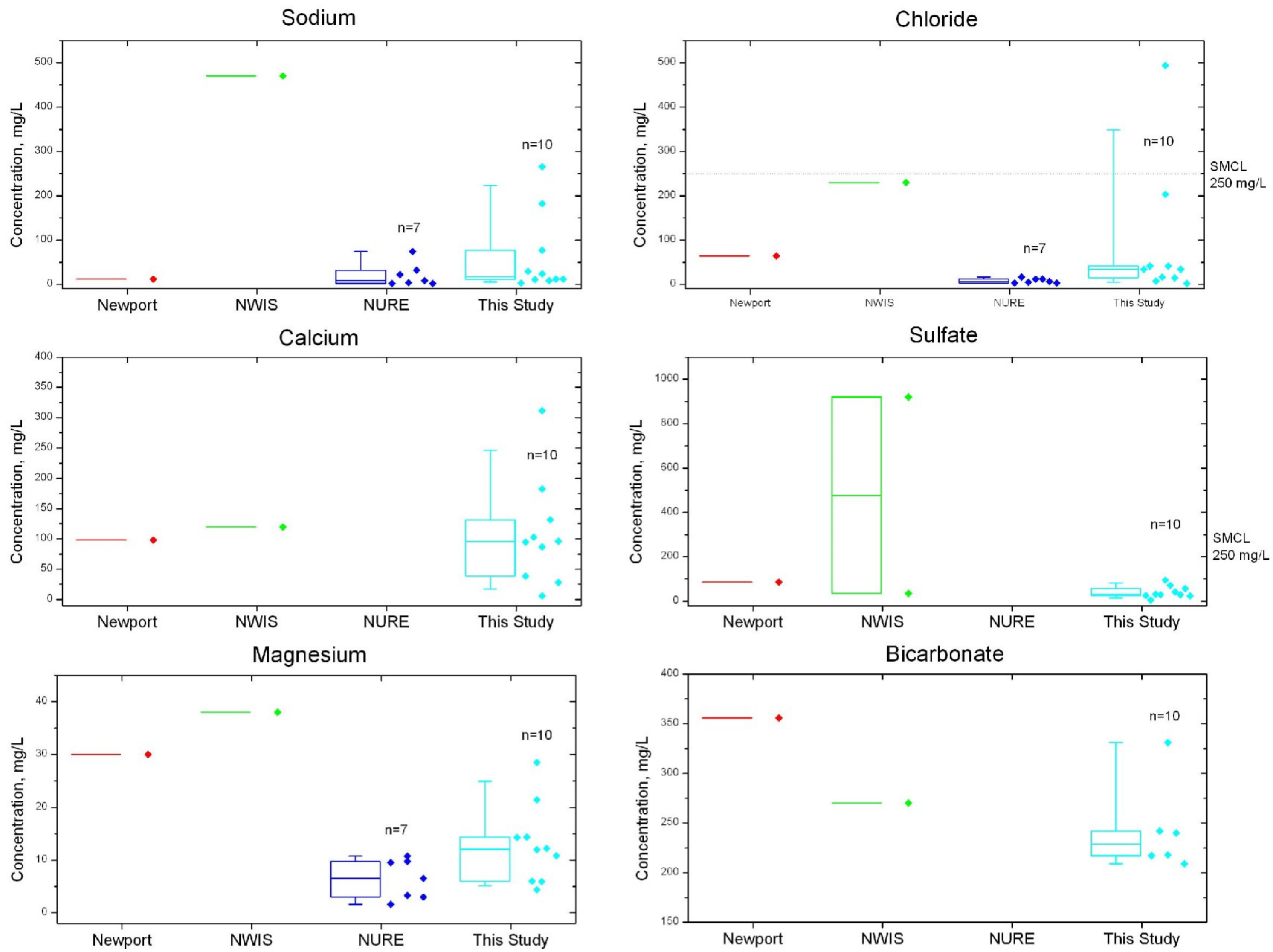


Figure 18. Southern area box-and-whisker plots, showing the 5th, 25th, 50th, 75th, and 95th percentiles. The Newport, NWIS, and NURE water quality data are representative of samples collected before Marcellus Shale gas development in Washington County.

Southern area reduced-area analysis: In the southern area, only the NURE dataset allowed for any comparison with the data from this study (see Figure 18). Overall, values for sodium, chloride, and magnesium were higher from this study than in the NURE data. With the exceptions of sodium, calcium, magnesium, and chloride from several specific sampling locations (SWPAGW13 and SWPAGW14), the data collected for this study in relation to major cations and anions generally fell within the ranges observed in historical water quality data. Although historical water quality data in the southern area are sparse, it is clear that chloride concentrations at one location (SWPAGW13) were anomalous, e.g., chloride concentrations exceeded secondary drinking water standards as described below and they were within the upper 90th percentile of chloride concentrations available for Washington County (see Figure 16). This sampling location is described in more detail in a following section ("Southern Area").

The concentration data in historical datasets indicate that secondary drinking-water standards (SMCLs) of 250 mg/L for both chloride and sulfate have been exceeded in Washington County in some cases (see Figure 16). For data collected in this study, exceedances of the chloride SMCL were noted at location SWPAGW13 during each sampling event; no exceedances of the sulfate SMCL at any sampling location were noted in the data collected for this study. Concentrations of aluminum, iron, and manganese, in some cases, exceeded SMCLs (50 to 200 µg/L, 300 µg/L, and 50 µg/L, respectively). These secondary standards are limits based on aesthetic qualities of water, such as taste, odor, and staining properties. Similar observations relating to ground water quality in Washington County, and throughout Pennsylvania generally, were described in previous studies (PA DEP, 1998; Williams et al., 1993; Newport, 1973). Iron and manganese concentrations are influenced by oxidation-reduction (redox) processes as discussed in a following section ("Iron and Manganese"). Total aluminum concentrations in this study ranged from <3.7 to 2,380 µg/L and aluminum was detected above the QL in 9 of the 19 ground water and spring sampling locations. Aluminum was above the minimum value of the SMCL range in seven ground water and spring samples across the three sampling events, but the SMCL exceedances for aluminum were never repeated at specific sampling locations. Particulate aluminum in ground water is generally considered to be fine-grained aluminum hydroxide or an aluminosilicate (Hem, 1985).

In this study, primary MCL exceedances were observed for nitrate at location SWPAGW10 and total lead at locations SWPAGW09 and SWPAGW12. Sources of nitrate to ground water include septic systems, animal manure, and fertilizers applied to lawns and crops; nitrate is not typically considered to be associated with hydraulic fracturing operations. A precise evaluation of the source of nitrate from the well at location SWPAGW10 was beyond the scope of this project; however, isotopic tracer techniques could be applied for this purpose. Other sample locations in proximity to SWPAGW10 did not show elevated levels of nitrate, including surface water (SWPASW03) located about 250 feet to the northwest (see Figure 3). In round 1 sampling (July 2011), a total lead concentration of 17 µg/L (J) was detected at location SWPAGW12; a field duplicate showed a concentration of 14 µg/L (J), as compared to the lead action level of 15 µg/L. Concentrations of lead in the dissolved (filtered) samples were <17 µg/L. In round 2 sampling (March 2012), concentrations of total and dissolved lead were <1 µg/L at location SWPAGW12, and revealed no consistent pattern of detection. During the third round of sampling (May 2013), a total lead concentration of 25.6 µg/L was detected at location SWPAGW09; the concentration in the corresponding dissolved sample was 1.4 µg/L, suggesting that the lead was partitioned to particulate matter. The mobility of lead in ground water is limited due to the low solubility of lead carbonates and hydroxy carbonates, and because of the tendency for lead to sorb to mineral surfaces

(Hem, 1985). Precise evaluation of the source of lead in these samples was outside the scope of the study. Lead is not typically considered to be associated with hydraulic fracturing operations but can be derived from weathering of natural lead-containing minerals (e.g., galena) and drinking water can potentially be contaminated by lead pipes or copper pipes with lead solder.

Ground water quality characteristics are expected to be influenced by aquifer formation properties, such as mineral content and bulk chemical composition. Studies have indicated that ground water derived from the Monongahela Group may contain higher chloride levels than ground water from other formations, but data are generally not available to make more detailed assessments of links between geologic formations and water quality in Washington County (Battelle, 2013). The depth of wells sampled in this study ranged from about 50 to 160 feet below land surface, with a median value of 95 feet below land surface. The distribution of well depths in the northern study area are compared to the distribution of well depths from the NURE and NWIS datasets on a countywide and reduced-area basis in Figure 19. Within the northern study area, well depths are highly comparable (p-value = 0.43) to well depths represented in the historical water quality datasets, suggesting that similar formation characteristics are captured in the analysis of ground water chemical data. The same depth relationships are apparent in the southern study area, although data are not plotted in Figure 19.

Time-dependent trends in water quality parameters are critical for evaluating potential impacts because natural variability as well as potential source-response trends can result in changing geochemical signatures with time. Figure 20 shows time-trends for selected parameters in wells that were sampled during each of the three events. Specific conductance values and other major ions showed consistent patterns through time in samples from well locations SWPAGW03, SWPAGW04, SWPAGW06, and SWPAGW08. In contrast, SWPAGW05 data showed increasing specific conductance values with time, and data from location SWPAGW13 showed decreasing values. These time-dependent trends were generally followed by other major cation and anion concentration data in these wells. For comparison, the Cl/specific conductance ratio increased at location SWPAGW05 (0.09 to 0.17) over the three rounds of sampling and the molar [Sr/Ca] ratio decreased from 0.006 to 0.003 ($^{87}Sr/^{86}Sr$ ratios were invariant). The molar [Sr/Ca] ratio in flowback and produced water from Marcellus Shale gas wells is >0.05 (Chapman et al., 2012). These characteristics suggest that the changing concentrations in this well may not be associated with impacts from Marcellus Shale water or other identifiable sources of contamination and are possibly related to natural variability, but mixing processes cannot be ruled out at this location. For example, model results from Kolesar Kohl et al. (2014) indicate that very small shifts in molar [Sr/Ca] ratios could result from the mixing of upward-migrating brines with shallow ground water. Additional complicating factors include high dilution of deeper formation waters and possible modification of ground water chemistry due to mineral-water processes like carbonate dissolution-precipitation and cation exchange with clay minerals. State record searches indicated several violation notices issued in June 2011 related to discharge of pollutants within 0.4 to 1 mile of location SWPAGW05 although the nature and composition of the discharged material is not known (see Appendix C). Time-dependent behavior of dissolved ions at location SWPAGW13 is discussed in a following section ("Southern Area").

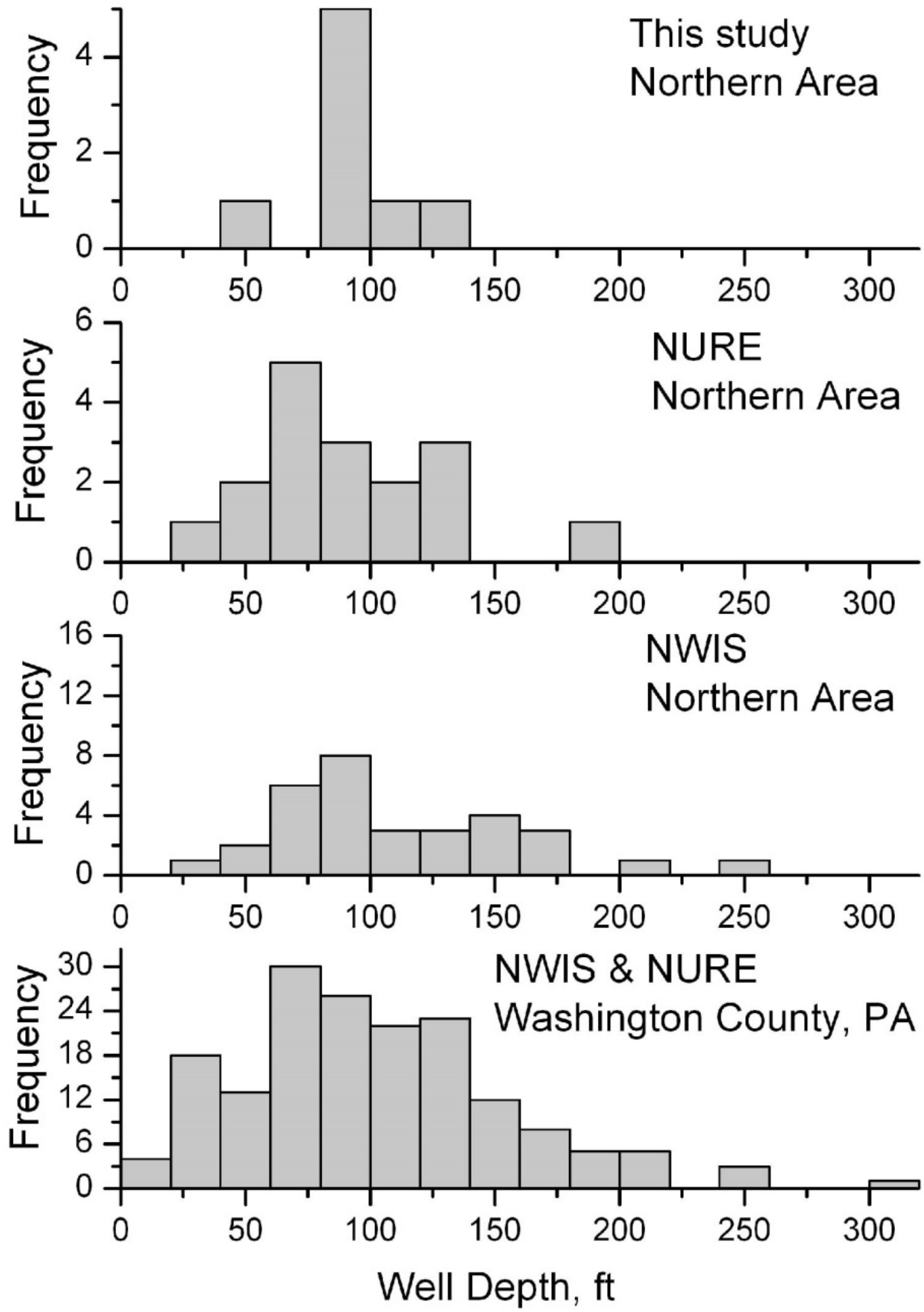


Figure 19. Frequency diagram showing well depths for samples collected in this study and samples included in historical water quality databases (countywide and northern area).

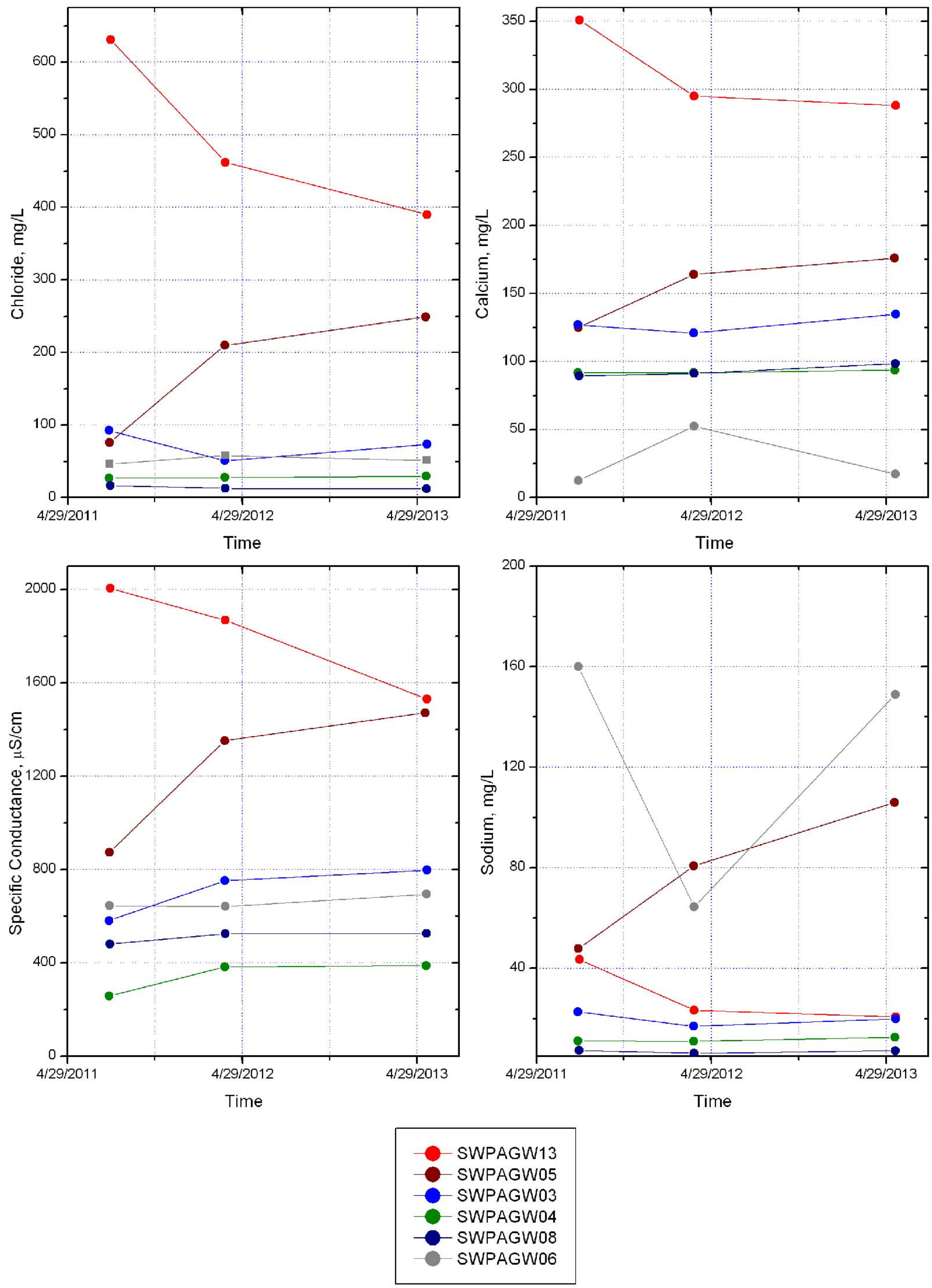


Figure 20. Time trends for chloride, calcium, sodium, and specific conductance in ground water samples from this study. Only locations that were sampled in each of the three sampling rounds are plotted.

Time-dependent trends have some implication regarding the use of data averaged across multiple sampling events for calculating summary statistics of water quality parameters (Tables 4 through 8). At most well locations, variability in major-ion (Na, K, Ca, Mg, Cl, SO_4) concentration data was minimal. The coefficient of variation (standard deviation/mean) was <0.30 in 81% of the major-ion comparisons across all sampling locations of this study. However, locations SWPAGW05 and SWPAGW13 showed more significant concentration trends with time. Using time-averaged values from these locations reduces the maximum concentration values, but the overall shift in other statistical parameters (e.g., mean, median) is minor, indicating that the summary data in Tables 4 through 8 are representative of the water quality data collected in this study.

Brantley et al. (2014) concluded that the most Marcellus-specific “fingerprint” elements are Ba, Sr, and Br. The available information for these parameters is limited in the historical water quality datasets. For example, concentrations of Ba and Sr are not reported in the NURE dataset or Newport (1973). The NWIS database includes Ba concentrations from six locations in Washington County (samples collected 1985 to 1997; Table 4) and Sr concentrations from 11 locations (samples collected 1983 to 1999; Table 4). In general, Sr concentrations from this study are lower than those in the NWIS database and Ba concentrations are higher (Table 4). Too few data are available in the historical datasets to draw any inferences about water quality trends for these elements as a function of time. Historical concentrations of bromide in ground water are not available in the NWIS dataset for Washington County.

Surface waters were sampled primarily to establish potential links, if any, between observed ground water quality and nearby surface water quality. Summary statistics for the historical data and the data from this study for surface water are provided in Table 7. In all cases, median concentration data determined in this study from surface water locations were comparable to or below median concentrations determined from historical water quality data. Maximum concentration values determined in this study were in all cases below maximum values from historical data. Surface water location SWPASW02 is situated about 0.3 miles down gradient from the Carter impoundment, formerly used for storage of flowback and produced water from hydraulic fracturing. Chloride concentrations at this location ranged from about 40 to 60 mg/L, and [Cl/Br] weight ratio values ranged from about 60 to 125; these were the highest values determined for any surface water in this study. Ground water from nearby location SWPAGW04 showed lower chloride concentrations (27–30 mg/L) and lower [Cl/Br] ratios (15–24; see “Halogen Ions” section below). Thus, it is possible that the surface water in this area shows some input from fluids stored in the impoundment or runoff of road salt used for deicing (see Appendix C).

6.3. Organic Compounds

Water samples were analyzed for VOCs, SVOCs, glycol ethers, low-molecular-weight acids, DRO, and GRO. Measurements evaluated up to 133 organic compounds. The purpose of these analyses was to examine the potential occurrence in ground water and surface water of chemicals generally documented to be components of hydraulic fracturing fluids (e.g., Ely, 1989; Veatch et al., 1989; Vidic et al., 2013; U.S. House of Representatives, 2011) and, more specifically, chemicals in fracturing fluids that have been used in Pennsylvania (PA DEP, 2010). For example, organic chemicals frequently used in hydraulic fracturing formulations are alcohols, glycol ethers, BTEX compounds (i.e., benzene, toluene, ethyl benzenes, and xylenes), and organic acids, such as acetic acid. These chemicals are covered, in large part, by the analytical methods used in this study. For example, glycols (diethylene glycol, triethylene glycol, and tetraethylene glycol) and the chemically related compound 2-butoxyethanol, are frequently used in hydraulic fracturing fluids, but are not found naturally in ground water. Thus, these chemicals serve as potentially reliable indicators of water resource contamination from hydraulic fracturing activities. The analytical method for glycols used in this study is an improved liquid chromatography–tandem mass spectrometry method (LC-MS-MS) developed to increase the sensitivity and resolution of glycol analysis over existing methods (e.g., EPA Method 8015; see US EPA, 2012).

A summary of all organic compounds detected in this study is provided in Table 9. In terms of general analytical groups, organic compounds detected included VOCs, SVOCs, and DRO (see Table 9). There were no analytically significant detections of glycol ethers, GRO, or acetate in ground water or surface water samples. None of the concentrations in Table 9 represent exceedances of EPA's drinking water standards (MCLs), where available. Historical water quality data do not provide information on the comprehensive set of analytes evaluated in this study; thus, meaningful comparisons between organic compound data collected for this study and historical data collected before unconventional gas development in Washington County are not possible. The nature of organic compound detections is discussed below by analytical grouping.

Table 9. Detections of organic compounds in ground water and surface water.

Chemical/Location	Concentration (µg/L)	Qualifier[1]	Notes
July 2011			
Volatile Organic Compounds			
Toluene	(MCL = 1,000 µg/L)		
SWPAGW04-0711	0.80	B	Trip blank = 0.75 µg/L, SWPAGW04 data are used with caution.
SWPASW01-0711	2.18	B	Trip blank = 0.75 µg/L, SWPASW01 data are used with caution.
Semivolatile Organic Compounds			
2-butoxyethanol			Present in the field duplicate of SWPAGW05 at 0.56 µg/L (J-). Present in the field duplicate of SWPAGW12 at 0.87 µg/L (J-), but not in the primary sample. Equipment blank detection at 3.61 µg/L (J-). See Table A26 and discussion in report; data are used with caution.
SWPAGW05-0711	1.00	J-	
SWPAGW08-0711	0.74	J-, B	
SWPAGW10-0711	0.69	J-, B	
SWPAGW11-0711	1.99	J-	
SWPAGW13-0711	2.92	J-	
SWPASW01-0711	0.54	J-	
SWPASW03-0711	1.65	J-, B	
Phenol			
SWPAGW06-0711	1.39		
SWPAGW11-0711	1.31	J-	Potential low bias.

Table 9. Detections of organic compounds in ground water and surface water.

Chemical/Location	Concentration (µg/L)	Qualifier[1]	Notes
Bis-(2-ethylhexyl) phthalate	(MCL = 6 µg/L)		
SWPAGW01-0711	2.17		
SWPAGW02-0711	1.51		
SWPAGW07-0711	1.38		
SWPAGW08-0711	1.06	J-	Potential low bias.
Butyl benzyl phthalate			
SWPAGW06-0711	1.40		
SWPAGW11-0711	2.16	J-	Potential low bias.
Diesel-Range Organics			
SWPAGW04-0711	34.6	J-	Detected in a field duplicate of SWPAGW05 at 32.3 µg/L (J-), but not in primary field sample. Potential low bias.
SWPAGW06-0711	31.5	J-	
SWPAGW08-0711	71.2	J-	
SWPAGW10-0711	26.9	J-	
SWPAGW11-0711	73.8	J-	
SWPAGW12-0711	27.1	J-	
SWPASW01-0711	34.9	J-	
SWPASW02-0711	28.7	J-	
March 2012			
Semivolatile Organic Compounds			
di-n-octyl phthalate			
SWPAGW05-0312	1.13		
Diesel-Range Organics			
SWPAGW08-0312	74.7		Detected in field duplicate at 71.1 µg/L.
SWPAGW10-0312	27.1		
SWPAGW11-0312	84.4		
SWPAGW16-0312	24.8		
SWPAGW17-0312	87.9		
SWPASW02-0312	29.0	B	Sample concentration was similar to but greater than blank values; data are used with caution.
May 2013			
Volatile Organic Compounds			
Acetone			
SWPAGW03-0513	0.87	J	Below QL.

Table 9. Detections of organic compounds in ground water and surface water.

Chemical/Location	Concentration (µg/L)	Qualifier[1]	Notes
SWPAGW09-0513	0.48	J	Below QL.
SWPAGW19-0513	1.3		
Chloroform	(MCL = 80 µg/L)		
SWPAGW14-0513	0.15	J	Below QL.
SWPASW02-0513	0.28	J	Below QL.
Benzene	(MCL = 5 µg/L)		
SWPAGW19-0513	0.07	J	Below QL.
Toluene	(MCL = 1,000 µg/L)		
SWPAGW04-0513	0.37	J	Below QL.
SWPAGW18-0513	0.11	J	Below QL.
SWPAGW19-0513	2.20		
Semivolatile Organic Compounds			
Bis-(2-ethylhexyl) phthalate	(MCL = 6 µg/L)		
SWPAGW09-0513	4.34		
Diesel-Range Organics			
SWPAGW04-0513	32.4		
SWPASW02-0513	51.2		

[1] J = value is an estimate; J- = value is an estimate and may be biased low; B = analyte was found in a blank sample above the QL. See Appendix A for additional details regarding these qualifiers.

6.3.1. Volatile Organic Compounds

VOCs are a subset of organic compounds with inherent physical and chemical properties (i.e., high vapor pressure, low to medium water solubility, and low molecular weight) that allow these compounds to move preferentially from water into air. Some VOCs occur naturally, while others result from anthropogenic activities, and some VOCs have both origins (Zogorski et al., 2006). Toluene was detected at a low concentration in one domestic well (location SWPAGW04) and one surface water sample (location SWPASW01) during the first sampling event in July 2011. No VOCs were detected in any of the ground water or surface samples collected during the second sampling event in March 2012. In the third sampling round (May 2013), low concentrations of acetone, toluene, and benzene were detected in one newly constructed domestic well (SWPAGW19). Most of these detections were below the QL, but were above the MDL. The concentrations of VOCs in Table 9 are 1.9 to 4.0 orders of magnitude below EPA's drinking water standards (maximum contaminant levels [MCLs] where available, for benzene, toluene, and chloroform). The sources of acetone and benzene at location SWPAGW19 and toluene at locations SWPAGW18 and SWPAGW19 possibly included newly installed well components (pumps) and construction materials used for the wells. Toluene was also detected in the third round of sampling at location SWPAGW04 at a concentration less than the QL. Toluene can be a constituent of the petroleum distillate light fraction that is added to some hydraulic fracturing fluids and has been detected in Marcellus Shale flowback and produced water (Abualfaraj et al., 2014; Maguire-Boyle and

Barron, 2014). Toluene can also be present as a laboratory or field contaminant as indicated by infrequent detections of toluene in blank samples (US EPA, 1992; Douglas, 2012; Miller, 2015; Table 9). Lack of consistent correlation with other potential chemical indicators in ground water samples with low-level VOC detections, such as elevated chloride and other organic compounds such as glycols, suggest that the toluene detected did not likely originate from hydraulic fracturing activities. In anaerobic ground water environments, natural breakdown products of organic compounds such benzene, toluene, and glycols include acetate (e.g., Corseuil et al., 2011; Dwyer and Tiedje, 1983). The absence of acetate in the ground water samples further suggests that significant degradation of organic compounds, which could have resulted in the accumulation of daughter products, has not occurred at the sampling locations.

6.3.2. Semivolatile Organic Compounds

SVOCs are typically hydrophobic organic compounds that have a moderate tendency to volatilize; consequently, SVOCs are released slowly from their source and have a propensity to preferentially distribute into organic phases, such as tissue (i.e., bioaccumulation) and/or sediments containing organic carbon (Lopes and Dionne, 1998; Smith et al., 1988). Several phthalates were detected in the three rounds of sampling, including bis-(2-ethylhexyl) phthalate, butylbenzyl phthalate, and di-n-octyl phthalate; however, these compounds were not detected consistently at any sampling location (see Table 9). Phthalates are common lab contaminants and are most commonly associated with plastics (Griffiths et al., 1985; US EPA, 1992; Miller, 2015); thus, phthalates sometimes appear in equipment blank samples and field samples that are passed through tubing, plastic fittings, and capsule filters made of plastic. Phthalates can also leach from plastic components in well construction materials. Phenol was detected in the first sampling round in two domestic wells (SWPAGW06 and SWPAGW11), but was not detected in either well in the second round, or during the third round at location SWPAGW06. 2-butoxyethanol was detected in several domestic wells, a spring, and two surface water samples during the first round of sampling. Concentrations of 2-butoxyethanol ranged from 0.54 to 2.92 µg/L. An equipment blank collected in the field during the first round of sampling returned the highest 2-butoxyethanol concentration (3.61 µg/L). This chemical was not detected in subsequent rounds of sampling; however, the method QL for 2-butoxyethanol increased in the second and third rounds due to method updates at the Region 8 Laboratory resulting from annual MDL studies. The detections of 2-butoxyethanol are of interest because of the common use of this chemical in hydraulic fracturing fluids and occurrence of 2-butoxyethanol in Marcellus Shale wastewater (e.g., Ferrar et al., 2013). The detections of 2-butoxyethanol are viewed with caution because: (i) they were not repeated past the first round of sampling, (ii) there was detection in an equipment blank exceeding sample concentrations, and (iii) there were no supportive qualified detections of 2-butoxyethanol using the LC-MS-MS method for glycols and 2-butoxyethanol in any sampling round (see Table B-5; Appendix B). Because there were no detections of 2-butoxyethanol in subsequent sampling rounds, detections in the July 2011 sampling round were likely due to contamination in the laboratory, sampling equipment, and/or sample containers because 2-butoxyethanol is commonly used in soaps and detergents (Harris et al., 1998; Wess et al., 1998). Repeated low-level detections of these compounds would necessarily be viewed as a potential water quality impact, by implying a continuous source. However, note that 2-butoxyethanol and glycol ethers may be degraded rapidly in the environment by microorganisms under suitable conditions (e.g., Howard et al., 1991; Dwyer and Tiedje, 1983; Mrklas et al., 2004; Carnegie and Ramsay, 2009).

6.3.3. Diesel- and Gasoline-Range Organics

DRO was detected in ground water and surface water samples during each of the three sampling rounds. DRO are solvent-extracted compounds that include hydrocarbons from C_{10} to C_{28}, found in particular diesel fuels, fuel oils, and kerosene. However, non-targeted organic compounds, such as pesticides, phenols, phthalates, and other hydrocarbons can be captured in the chromatographic integration window and reported as DRO. Note that some of these compounds were detected in the semivolatile scans previously described. Therefore, it is often helpful to view the DRO chromatograms directly, as shown in Figure 21 for samples collected at locations SWPAGW08, SWPAGW10, SWPAGW11, and SWPAGW17. The chromatograms indicate that most of the samples contain weathered or degraded organic compounds at low levels. Phthalates are suggested in samples SWPAGW08-0711 and SWPAGW10-0711 by the dual peaks that appear at a retention time of about 20 minutes. The chromatogram available for the sample collected at location SWPAGW17 shows a broad feature with a peak at about 27 minutes; this pattern implies longer, alkane-series carbon chains and the presence of heavier oils. The environmental records search indicated two leaking underground storage tanks (USTs), one gasoline and one diesel, about 1.2 miles from the sampling points in the southern area (see Appendix C), which includes location SWPAGW17. These underground tanks are not likely sources of DRO to ground water in the area due to their distance from the nearest sampling locations. There were no analytically significant detections of GRO in this study (see Table 9).

6.4. Water Isotopes

Stable isotopes can be useful in water quality studies for understanding water sources and gaining insight about the physical and biogeochemical processes affecting the composition of ground water and surface water (e.g., Toran, 1982). Water samples were analyzed for the isotope ratios of hydrogen (δ^2H) and oxygen (δ^{18}O) expressed as δ values, in parts per thousand (permil), as the ratio of the heavy to the light isotope relative to a standard:

$$\delta_{sample} = 1000[(R_{sample}/R_{standard})-1] \tag{2}$$

where R_{sample} and $R_{standard}$ are the ratio of the heavy to light isotope in the sample and the standard, respectively. The standard for water used in this study is VSMOW such that SLAP (Standard Light Antarctic Precipitation) reference water is -428 permil and -55.5 permil for δ^2H and δ^{18}O, respectively. A larger δ value shows enrichment of the heavier isotope, whereas a smaller value indicates depletion of the heavier isotope. Results and interpretation of the stable isotope data for water are discussed below.

The δ^{18}O and δ^2H values of water samples collected in this study in rounds 2 and 3 using CRDS revealed a narrow range, from -9.1 to -8.2 and -59.0 to -51.8 permil, respectively (see Figure 22). These data fall within a similar range of water isotope data reported by Sharma et al. (2014) for shallow ground water collected from the nearby Monongahela River Basin of north-central West Virginia, a basin where limited Marcellus Shale gas development has occurred (see Figure 22A). The isotopic composition of shallow ground water in this region (southwestern Pennsylvania and north-central West Virginia) is different from water produced from the Marcellus Shale, Upper Devonian sands (Sharma et al., 2014), and oil and gas brines from southwestern Pennsylvania (Dresel and Rose, 2010). The latter fluids are

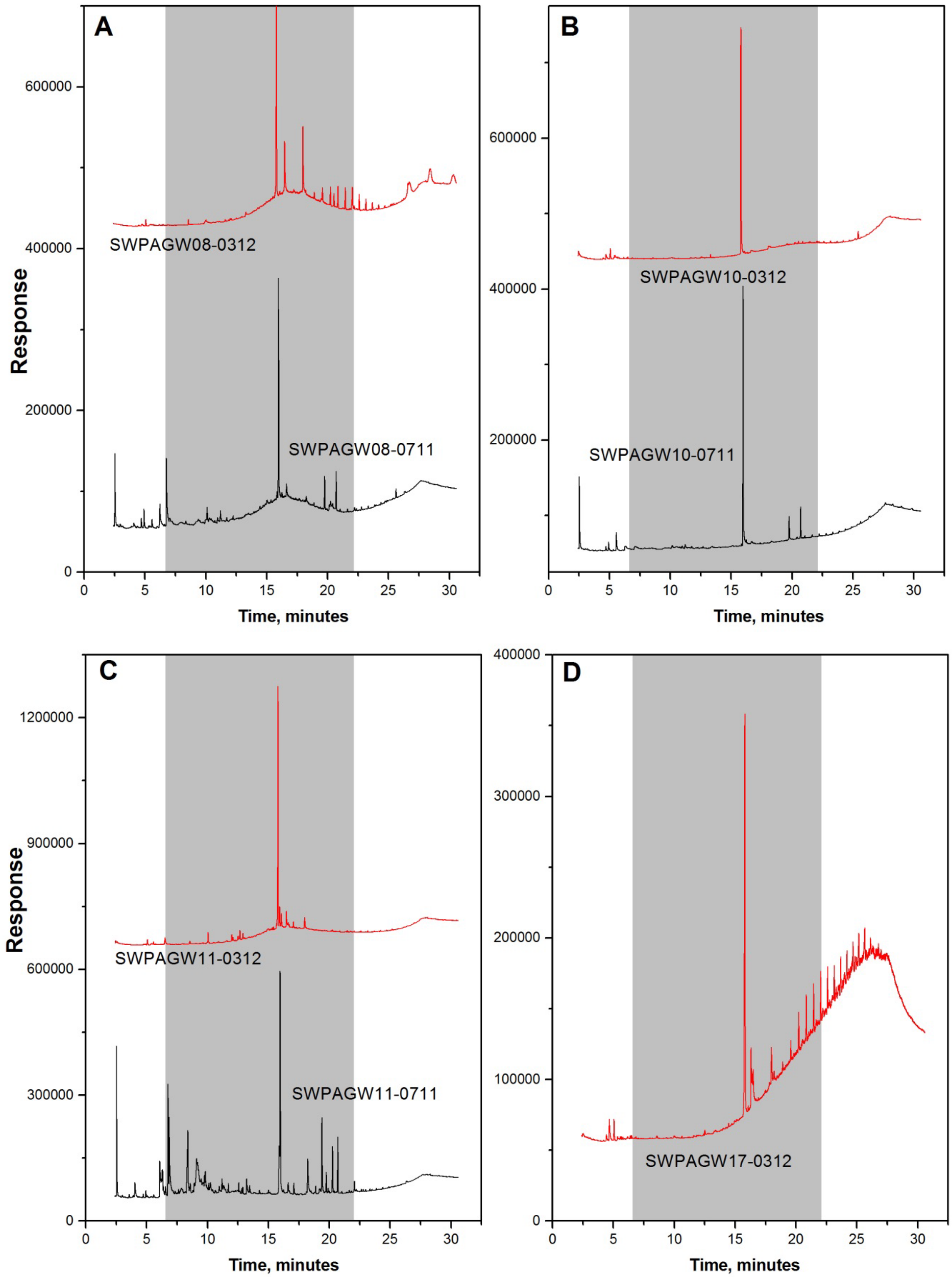


Figure 21. DRO chromatograms (GC-FID) for selected samples: A) SWPAGW08, B) SWPAGW10, C) SWPAGW11 (rounds 1 and 2), and D) SWPAGW17 (round 2). The window of integration for DRO is shaded; the large peak at about 16 minutes is the surrogate *o*-terphenyl.

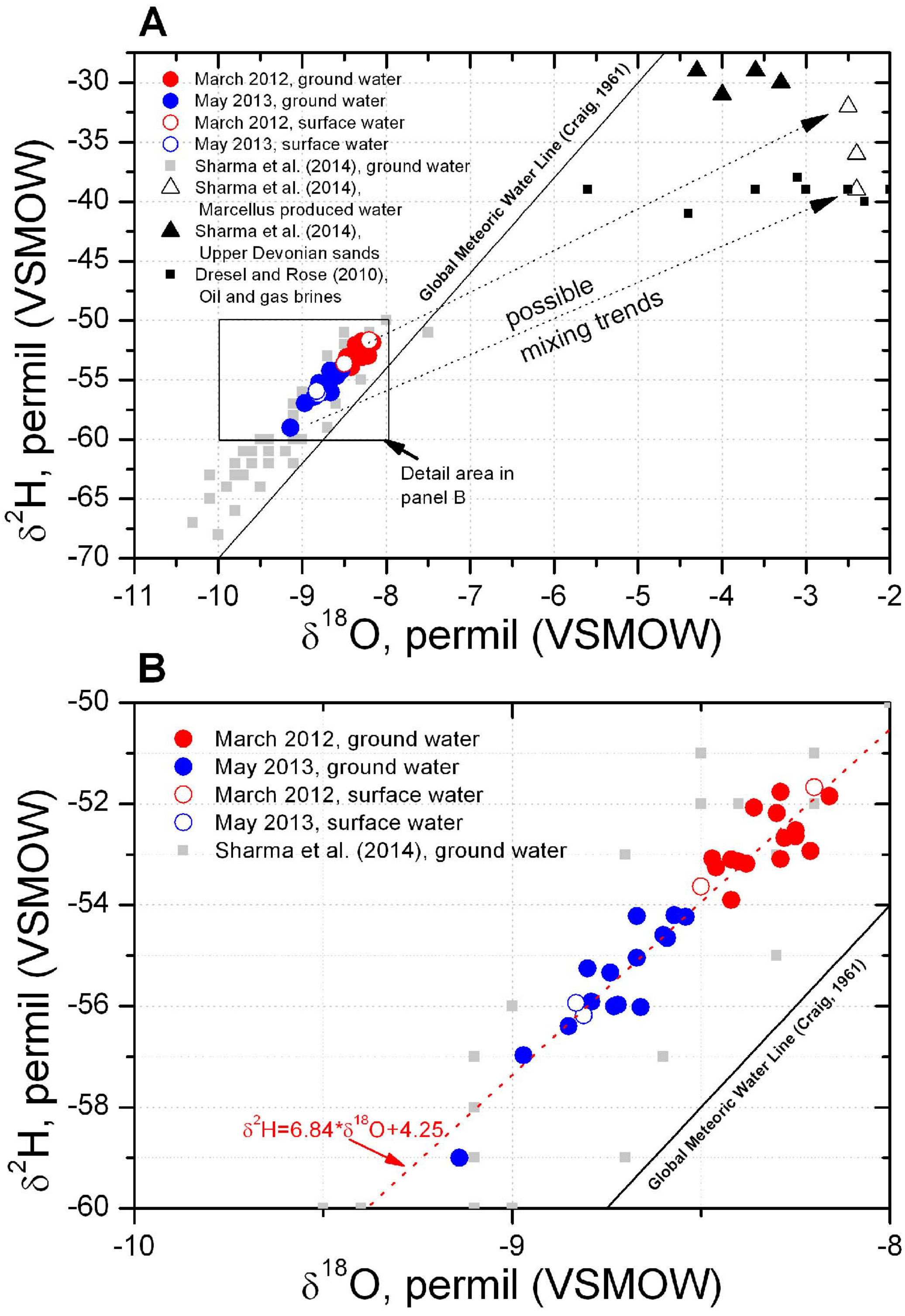


Figure 22. A) Oxygen and hydrogen isotope compositions of ground water, Marcellus Shale flowback water, and oil and gas brines in Pennsylvania, with potential mixing trends indicated. B) Detail area showing fitted equation (dashed line) for the local meteoric water line. Note only data collected from rounds 2 and 3 using cavity ring-down spectrometry are plotted.

highly enriched in ^{18}O and deuterium (^2H) compared to shallow ground water, and they plot to the right of the Global Meteoric Water Line (see Figure 22A). Enrichment of ^{18}O compared to ^2H in the produced waters and brine is the result of extensive oxygen exchange between meteoric water and reservoir rocks (Clayton et al., 1966). Mixing small quantities of brine or Marcellus Shale–produced water with local ground water will cause increases in the $\delta^{18}O$ and δ^2H values of ground water and would be expected to correlate with increasing brine signatures, e.g., concentrations of TDS and chloride. Because the isotope signatures of the gas-producing fluids and shallow ground water are so different, $\delta^{18}O$ and δ^2H of water can be informative probes of potential mixing of these water types. However, due to the very large differences in solute concentrations between brines and shallow ground water, dilute mixtures of brine and ground water will have a large effect on the concentrations of major and minor ions, but the effect of mixing is expected to be less significant for $\delta^{18}O$ and δ^2H of water (e.g., Warner et al., 2012). Figure 22A shows that the water isotope data collected in this study falls within a similar range determined for a nearby region in West Virginia without extensive Marcellus Shale gas development. There is no discernible indication that the stable isotope signature of shallow ground water in Washington County, based on the samples collected for this study, is impacted by deep brines, including flowback and produced water from hydraulically fractured Marcellus Shale gas wells. The paired results for δ^2H and $\delta^{18}O$ define a trend for the local meteoric water line (LMWL) of:

$$\delta^2H=6.84*\delta^{18}O + 4.25\ (R^2=0.94) \qquad (3)$$

as shown in Figure 22B (linear regression of data collected in March 2012 and May 2013 using CRDS). Note that the water isotope values from this study and from Sharma et al. (2014) fall above the Global Meteoric Water Line of Craig (1961): $\delta^2H=8\ \delta^{18}O + 10$. This deviation from the global mean trend reflects local patterns in the isotopic composition of precipitation and recharge water. Temporal changes in the water isotope data collected in this study show variability along the LMWL and not along inferred mixing lines with deep brine or flowback and produced water from the Marcellus Shale. The isotopic composition of surface water also falls along the LMWL, suggesting limited isotopic enrichment due to evaporation.

6.5. Dissolved Gases

In Pennsylvania, the PA DEP has set an action level of 7 mg/L for dissolved methane in ground water (Pennsylvania Code, 2011). In cases where sustained concentrations in homeowner wells are equal to or greater than 7 mg/L and operators are deemed responsible for the methane presence, operators—in conjunction with the PA DEP—are required to “take measures necessary to ensure public health and safety.” The action level of 7 mg/L represents 25% of the approximate 28 mg/L solubility limit for methane in water at atmospheric pressure (atmosphere 100% methane). Dissolved methane concentrations at depth can be much greater than 28 mg/L (due to the effects of hydrostatic pressure); as a result, dissolved methane in water pumped from depth may undergo significant outgassing to yield free methane once at the surface. The Department of the Interior (DOI; Eltschlager et al., 2001) has proposed an action level for dissolved methane in water of 10 mg/L, with the recommendations that at concentrations between 10 mg/L and 28 mg/L, “remediation may be prudent to reduce the methane concentration to less than 10 mg/L” and “ignition sources be removed from the immediate area.” Other federal action levels for dissolved methane in water were not available during the time of this study.

Dissolved methane was detected above the analytical level of quantitation in nine ground water samples (domestic wells and springs) collected during the three sampling rounds of this study, representing 24% of the total ground water samples. Methane was not detected in any of the surface water samples. When detected, methane concentrations in ground water ranged from about 0.002 to 15.5 mg/L, with a median concentration of 0.045 mg/L (mean = 3.0 mg/L; n = 9). Concentrations above 0.5 mg/L were detected in domestic well SWPAGW06 in each of the sampling events, and in domestic well SWPAGW17, which was sampled in March 2012. A methane concentration exceeding PA DEP's 7 mg/L action level was measured in domestic well SWPAGW17 during the second sampling event (15.5 mg/L). Dissolved ethane was detected twice at location SWPAGW06 at concentrations of about 0.004 mg/L, and at location SWPAGW17 at a concentration of 0.29 mg/L. The distribution of methane concentrations observed in this study is shown in Figure 23 and compared to methane concentrations reported in Sharma et al. (2014) for shallow ground water in north-central West Virginia. A similar positively skewed concentration pattern is indicated in both datasets. Historical methane data are unavailable to document pre-gas development concentrations in domestic wells in southwestern Pennsylvania, analogous to the survey recently conducted in Sullivan County in north-central Pennsylvania (Sloto, 2013). Methane occurs naturally in the strata underlying southwestern Pennsylvania at depths above the Devonian black shales, often at significant concentrations. For example, methane is present in coal seams present in the Monongahela and Conemaugh Group aquifers and thus coal seams could provide a natural source of methane gas to shallow ground water (e.g., Markowski, 1998).

Methane occurrence in natural systems is recognized to be the result of two main pathways: thermogenic and microbial. Thermogenic methane is formed by the thermal breakdown, or cracking, of organic material that occurs during deep burial of sediments (Schoell, 1980; 1988). In contrast, microbial methane is produced via anaerobic decomposition of buried organic material, such as glacial drift and other sedimentary deposits that contain organic carbon (e.g., Schoell, 1980; Whiticar et al., 1986; Coleman et al., 1995; Martini et al., 1998). Microbial methane that forms in shallow subsurface environments via acetate fermentation is called marsh gas, swamp gas, and landfill gas (Coleman et al., 1995). In glacial-drift deposits, methane formed by microbial reduction of carbon dioxide (CO_2) is referred to as drift gas. Techniques that evaluate and analyze stable isotope signatures of methane and related molecules can be used to help determine the importance of these different sources of methane in the environment. Multiple post-genetic processes, such as oxidation, migration, and mixing of sources, may alter isotope ratios and dissolved gas concentrations. Each of these processes (oxidation, migration, and mixing) can change the isotopic composition of methane gas, making unambiguous discrimination between thermogenic and microbial methane challenging.

6.5.1. Methane Isotopes

Schoell (1980) suggested that $\delta^{13}C_{CH4}$ values less than -64 permil and ethane concentrations less than 0.5 mol% may represent a signature of microbially generated methane gas, whereas increasingly more positive $\delta^{13}C_{CH4}$ values grade into admixtures of thermogenic and microbial gas and finally pure thermogenic gas. Discrimination criteria for evaluating methane sources have expanded to use multiple isotopes and gas ratios (e.g., Whiticar et al., 1986; Whiticar, 1999).

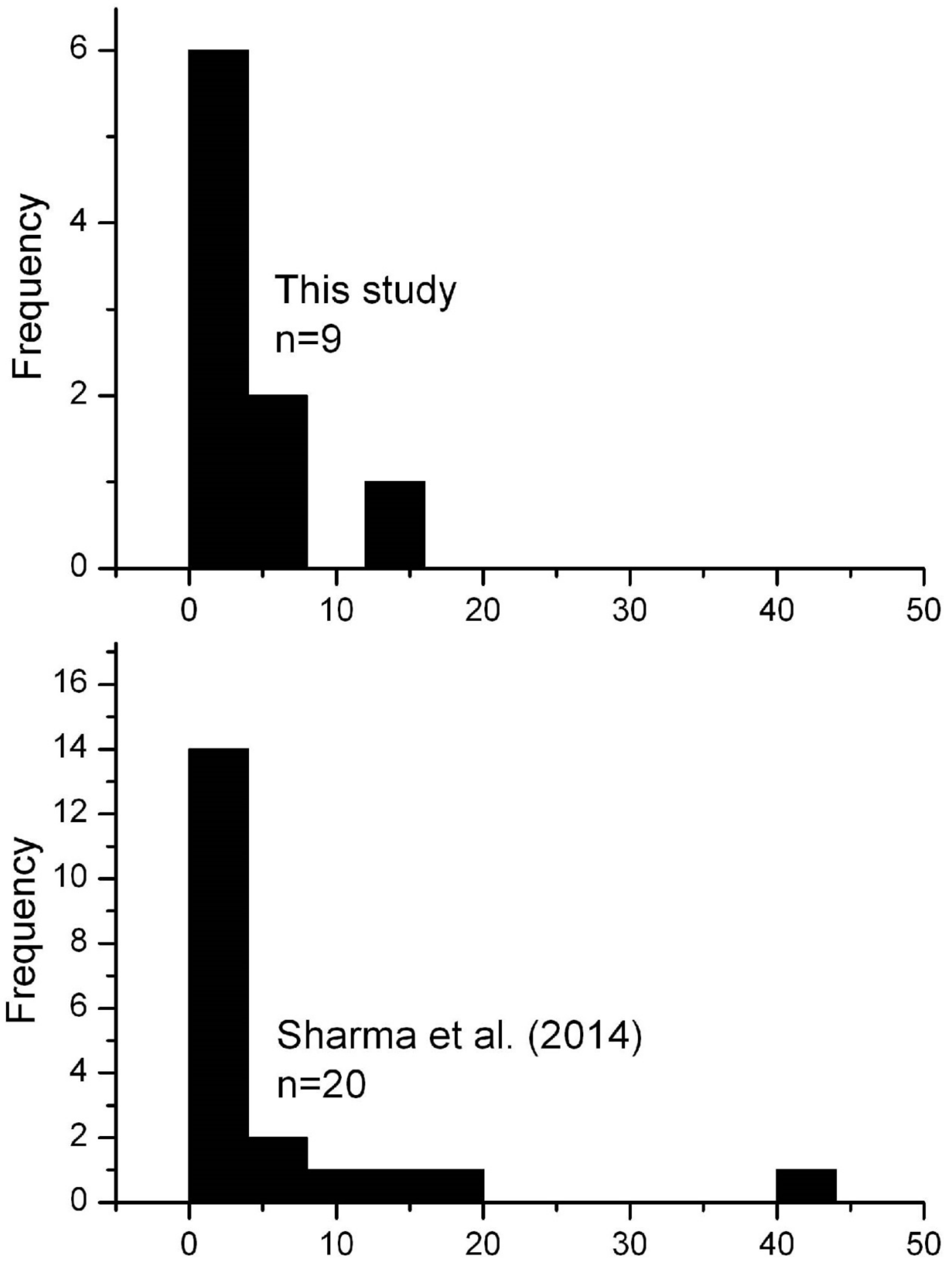


Figure 23. Dissolved methane concentrations in shallow ground water; data from this study and from Sharma et al. (2014).

Various isotopic fingerprint diagrams that utilize $\delta^{13}C_{CH4}$ and $\delta^{2}H_{CH4}$ have been applied to better understand gas occurrences in ground water systems (e.g., Osborn et al., 2011; Jackson et al., 2013; Révész et al., 2010; Giustini et al., 2013; Baldassare and Laughrey, 1997; Taylor et al., 2000; Sharma et al., 2014; Molofsky et al., 2013). Concentrations of methane were sufficient at two locations (SWPAGW06 and SWPAGW17) for measurement of C and H isotope signatures. Figure 24 shows a methane C and H isotope diagram, with genetic zonation from Giustini et al. (2013). Data plotted on this diagram include methane isotope data for samples collected in this study at locations SWPAGW06 and SWPAGW17; shallow ground water samples from north-central West Virginia (Sharma et al., 2014); production gas from the Marcellus Shale and Upper Devonian sands in southwestern Pennsylvania (Sharma et al., 2014); and production gas from the Marcellus Shale in Susquehanna County in northeastern Pennsylvania (Molofsky et al., 2013).

In Figure 24, data from location SWPAGW17 plot within the "Microbial CO_2 Reduction" field. The overall methanogenic reaction implied by this process is:

$$CO_2 + 4H_2 \Rightarrow CH_4 + 2H_2O \qquad (4)$$

Methanogenesis occurs in highly reducing systems that are low in sulfate and elevated in hydrogen (Chapelle et al., 1995). Ground water from location SWPAGW17 had low dissolved oxygen (<0.1 mg/L), low sulfate (4.5 mg/L; lower 25th percentile), and a methane to ethane ratio of 100. Furthermore, the $\delta^{13}C$ value of DIC in this water was the most enriched (-7.8 permil) encountered in this study, suggesting microbial fractionation as CO_2 is reduced to CH_4 (Simpkins and Parkin, 1993; Martini et al., 1998). All of these features are consistent with the high levels of methane in this well (15.5 mg/L) resulting from bacterial reduction of CO_2 (i.e., drift gas). Note that the observed fractionation between DIC and CH_4 ($\alpha = R_{DIC}/R_{CH4} = 1.0738$) in ground water from location SWPAGW17 is in reasonable agreement with the predicted temperature-dependent equilibrium fractionation factor between CO_2 and CH_4 ($\alpha = 1.0753$ at 13°C; see Botz et al., 1996). In addition, the $\delta^{2}H_{CH4}$ (-238.8 permil) is heavier than the model presented in Waldron et al. (1999) for predicting $\delta^{2}H_{CH4}$ from $\delta^{2}H_{H2O}$ in marine environments, which matches the pattern for drift gas from wells in Illinois. This trend could also be due to gas migration and associated fractionation of the lighter isotope (e.g., Prinzhofer and Pernaton, 1997). Note also that the highest ethane concentration detected in this study was from location SWPAGW17.

The isotopic composition of Marcellus Shale methane, as reported by Sharma et al. (2014) and Molofsky et al. (2013), is enriched in ^{13}C and ^{2}H and plots within the thermogenic field in Figure 24. These data suggest that there may be subtle differences in the isotopic composition of methane from the Marcellus Shale, depending on geographic location, which may reflect the thermal history of the Appalachian Basin and the composition of organic carbon in the Marcellus Shale. An extensive dataset on the gas composition and stable isotope compositions of methane and ethane from Neogene to Middle Devonian-age strata was recently published by Baldasarre et al. (2014) for a five-county study area in northeastern Pennsylvania. The results of this study indicate that similar datasets in other areas of active Marcellus Shale gas development would be essential for stray gas investigations.

Methane concentrations in well SWPAGW06 ranged from 0.78 to 5.56 mg/L, and isotopic data reveal a consistent pattern within the "Mixed" field in Figure 24. Note that the isotopic composition of methane from well SWPAGW06 was similar to methane data reported by Sharma et al. (2014) for a nearby region that has yet to experience extensive gas development of the Marcellus Shale. Samples from well

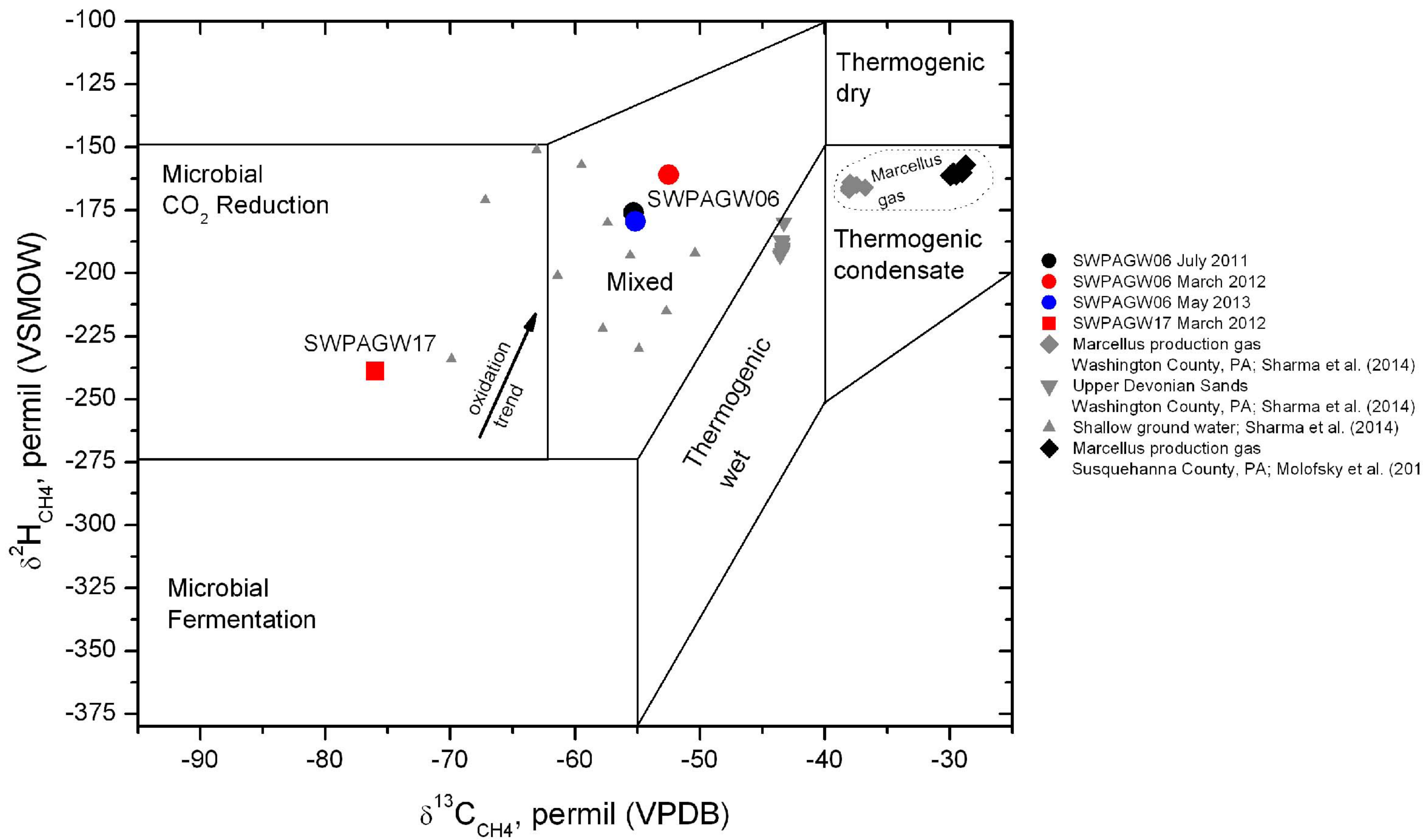


Figure 24. Methane C and H isotope diagram with genetic zonation from Giustini et al. (2013). Data plotted are from this study, Sharma et al. (2014; ground water and Marcellus production gas), and Molofsky et al. (2013; Marcellus production gas).

SWPAGW06 had detections of dissolved sulfide, up to 0.26 mg/L (J), generally low sulfate concentrations, and slightly elevated $\delta^{13}C$ values of inorganic carbon compared to the mean of all ground water samples. The presence of dissolved sulfide suggests that anaerobic methane oxidation may play a role in controlling the C and H isotope ratios, as the $\delta^{13}C$ and $\delta^{2}H$ values of methane potentially lie along an oxidation trend originating from a microbial end member. Sharma et al. (2014) suggested that methane occurrence in the aquifers of north-central West Virginia is not the result of recent microbiological activity, but rather is a consequence of migration from deeper formations over millions of years through natural structural pathways and/or abandoned oil and gas wells, as there was no shale drilling program in the region at the time their samples were collected. While this long-term migration model may be somewhat speculative, it is clear from the results of this study and the Sharma et al. (2014) study that the available isotopic and hydrocarbon signatures of methane in shallow ground water aquifers of this region (north-central West Virginia and southwestern Pennsylvania), Upper Devonian sands, and the Marcellus Shale are distinct from one another. As noted previously, these differences in isotopic composition can be related to different sources as well as secondary effects, such as oxidation, fractionation during transport, and/or mixing of different sources.

6.5.2. Inorganic Carbon Isotopes

The processes that control the stable isotope composition of inorganic carbon ($\delta^{13}C_{DIC}$) in ground water include breakdown of organic matter, carbonate mineral dissolution and precipitation, microbially mediated processes that oxidize reduced carbon and generate CO_2, microbially mediated processes that reduce CO_2 and generate CH_4, and mixing of waters with different $\delta^{13}C_{DIC}$ values (e.g., Deines et al. 1974; Botz et al., 1996; Alperin et al., 1988). All $\delta^{13}C_{DIC}$ values reported here are in permil relative to the VPDB.

$\delta^{13}C_{DIC}$ values in ground water ranged from -18.1 to -7.8 permil, with a mean value of -14.6 ± 1.9 permil (n = 37), and $\delta^{13}C_{DIC}$ values in surface water ranged from -16.2 to -11.9 permil, with a mean value of -13.8 ± 1.7 permil (n = 7). In general, an apparent positive correlation was observed between DIC concentrations and $\delta^{13}C$ (R^2 = 0.20; see Figure 25A).

Ground water undersaturated with respect to calcite tended to be depleted in ^{13}C (see Figure 25B) and low in TDS and may represent more recent recharge with a comparatively short residence time in the aquifer. The most enriched ^{13}C samples tended to be oversaturated with respect to calcite (see Figure 25B). As discussed in the previous section on dissolved gases, one sample from location SWPAGW17 had a $\delta^{13}C_{DIC}$ of -7.8 permil and showed other chemical characteristics consistent with CO_2 reduction. During CO_2 reduction, methanogenic bacteria preferentially oxidize isotopically light CO_2 to CH_4, resulting in enriched inorganic carbon in the ground water. An elevated calcite saturation index for this sample (SWPAGW17) was mainly the result of elevated pH (8.93), which may be a secondary effect caused by methane off-gassing during water well purging (Taulis and Milke, 2013).

The carbon isotope ratios of DIC from this study are compared to the results presented in Sharma et al. (2014) for samples collected from shallow ground water aquifers and streams overlying the Marcellus Shale in north-central West Virginia and southwestern Pennsylvania, and wells producing gas from the Middle Devonian Marcellus Shale and Upper Devonian sands in southwestern Pennsylvania (see Figure 26). The $\delta^{13}C_{DIC}$ values in shallow ground water are similar between the datasets collected from similar geographic and geologic regions. Surface water $\delta^{13}C_{DIC}$ values from Sharma et al. (2014) tend to be more enriched than those reported here. The $\delta^{13}C_{DIC}$ values of DIC of produced waters from Devonian-age

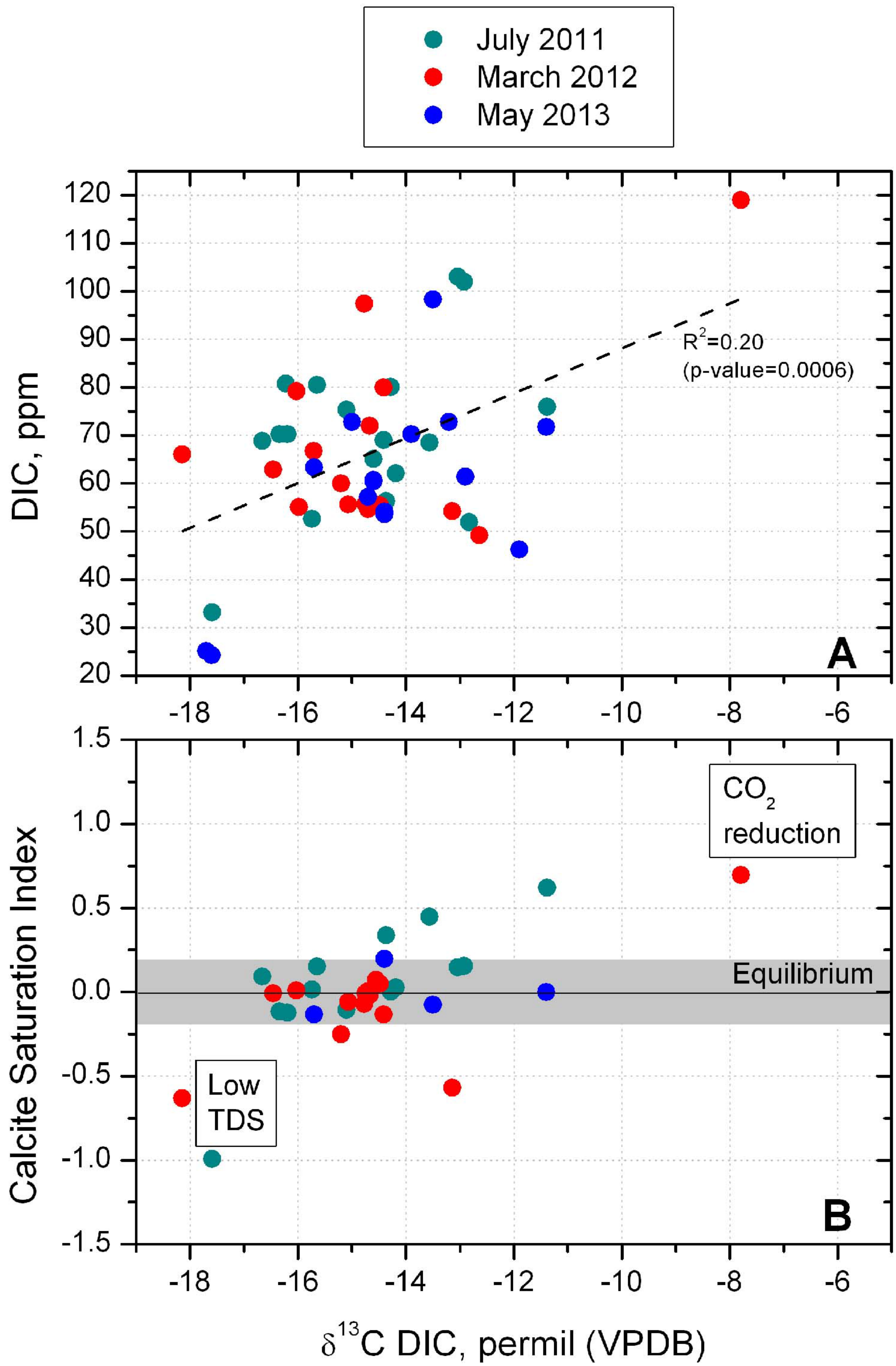


Figure 25. $\delta^{13}C$ of dissolved inorganic carbon in shallow ground water and correlation with dissolved inorganic carbon concentration and the calcite saturation index.

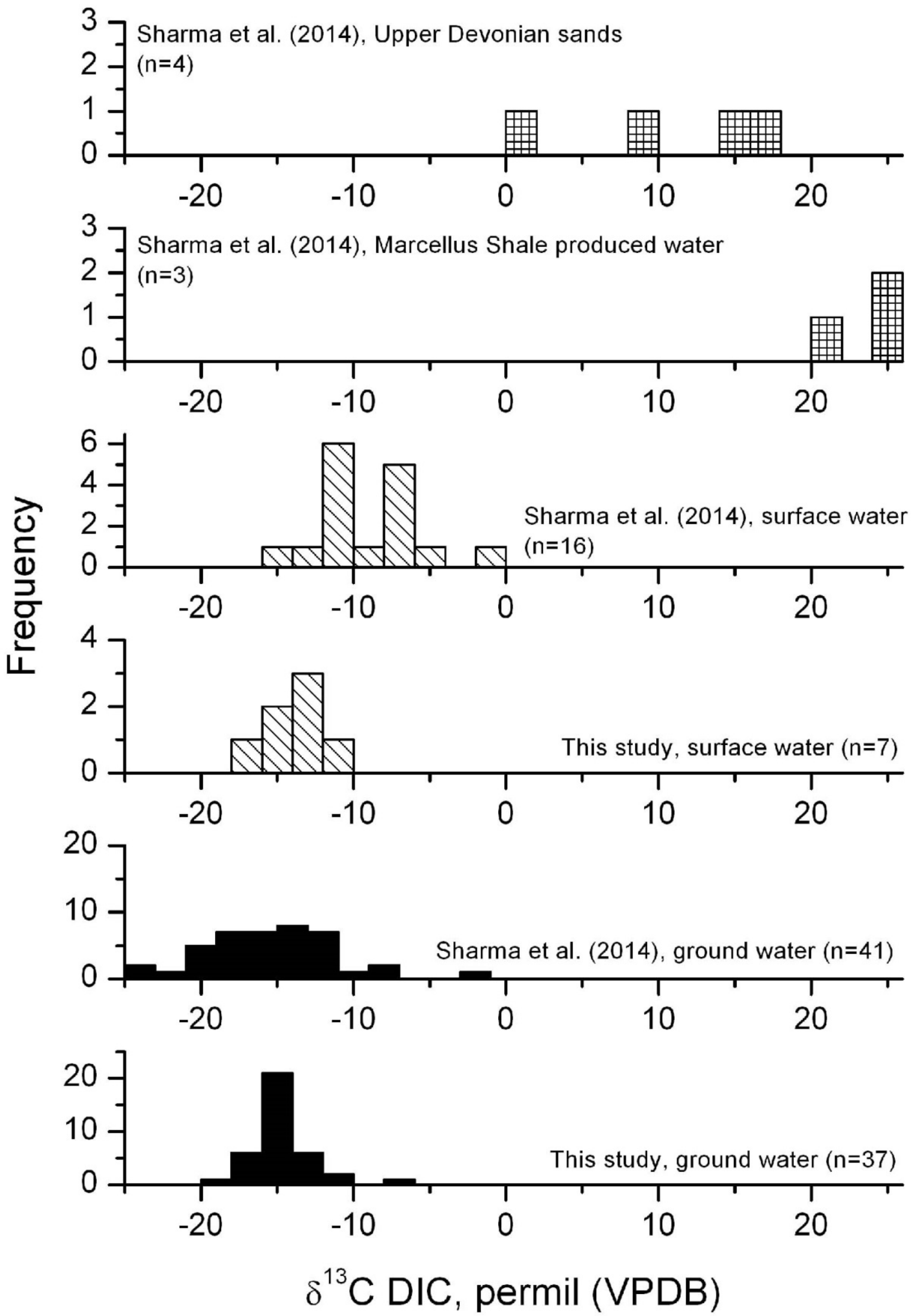


Figure 26. Frequency diagrams of δ^{13}C of dissolved inorganic carbon.

shales and sands are high, generally greater than +8 permil. The heavy $\delta^{13}C_{DIC}$ signatures suggest an origin through biogenic methanogenesis (e.g., Botz et al., 1996; Sharma and Baggett, 2011). Shallow ground water from the study area in southwestern Pennsylvania does not show similarity in carbon isotope ratios of DIC with water from Devonian-age gas-producing formations.

6.6. Strontium Isotopes

Samples were collected in each of the three field events for strontium isotope analysis by thermal ionization mass spectrometry. Studies have shown that fluid mixing behavior can be understood by the combined evaluation of strontium concentrations and strontium isotope signatures ($^{87}Sr/^{86}Sr$). This technique is highly sensitive, especially in cases where two end member fluids differ significantly in both concentration and isotope ratio (e.g., Capo et al., 1998; Frost and Toner, 2004; Shand et al., 2009; Peterman et al., 2012). In this case study, the practical problem is applying strontium isotopes and concentrations to evaluate whether or not shallow ground water has been impacted by deeper brine and/or flowback and produced water from Marcellus Shale gas wells. For example, Myers (2012) concluded that preferential flow through fractures could allow transport of contaminants from deep hydraulically fractured zones to shallow aquifers over timescales of less than 10 years (see also Saiers and Barth, 2012; Cohen et al., 2013; Flewelling and Sharma, 2014; and Rozell, 2014). Long-term (~10^4 years) migration of brine from depth to near-surface environments has also been suggested to explain major ion and strontium isotope trends in northeastern Pennsylvania (e.g., Warner et al., 2012; Llewellyn, 2014). Abandoned wells could also potentially connect deep and shallow aquifers that would otherwise be separated by continuous aquitards (e.g., Newport, 1973; US EPA, 1977; Myers, 2012). Figure 27A shows a semilog plot of strontium concentrations versus $^{87}Sr/^{86}Sr$ values for samples collected in this study compared to Marcellus Shale flowback and produced waters from southwestern Pennsylvania reported by Chapman et al. (2012). Although the Marcellus Shale is ostensibly dry (see Engelder, 2012), Marcellus Shale flowback and produced waters have high strontium concentrations compared to shallow ground water in Washington County (Chapman et al., 2012; Haluszczak et al., 2013), and significant contrast is evident in the $^{87}Sr/^{86}Sr$ values. Figure 27A shows hypothetical mixing curves between flowback and produced Marcellus water and selected points within the field of shallow ground water data (SWPAGW16-0312 and SWPASW02-0513). The mixing curves were calculated using the equation from Faure (1998):

$$(^{87}Sr/^{86}Sr)_{mix} = a/[Sr]_{mix} + b \qquad (5)$$

where $(^{87}Sr/^{86}Sr)_{mix}$ is the isotope ratio in the fluid mixture, $[Sr]_{mix}$ is the strontium concentration in the mixture, and *a* and *b* are constants that are calculated based on end member $^{87}Sr/^{86}Sr$ ratios and strontium concentrations (Faure, 1998). The array of strontium isotope ratios in the shallow ground water field and the modeled mixing relationships suggest that mixing very small amounts of Marcellus-produced water (<0.1%) could explain some of the observed variability in the strontium data (e.g., Warner et al., 2012). The highest strontium concentration (up to 1,530 µg/L) observed in ground water in this study was from location SWPAGW05. Ground water from this location is similar to the Type D water described by Warner et al. (2012), i.e., sodium-calcium-chloride composition and elevated salt content. However, the $^{87}Sr/^{86}Sr$ value for location SWPAGW05 was distinctly greater than the value in flowback and produced water from the Marcellus Shale, but could fall along a potential mixing curve (see Figure 27A).

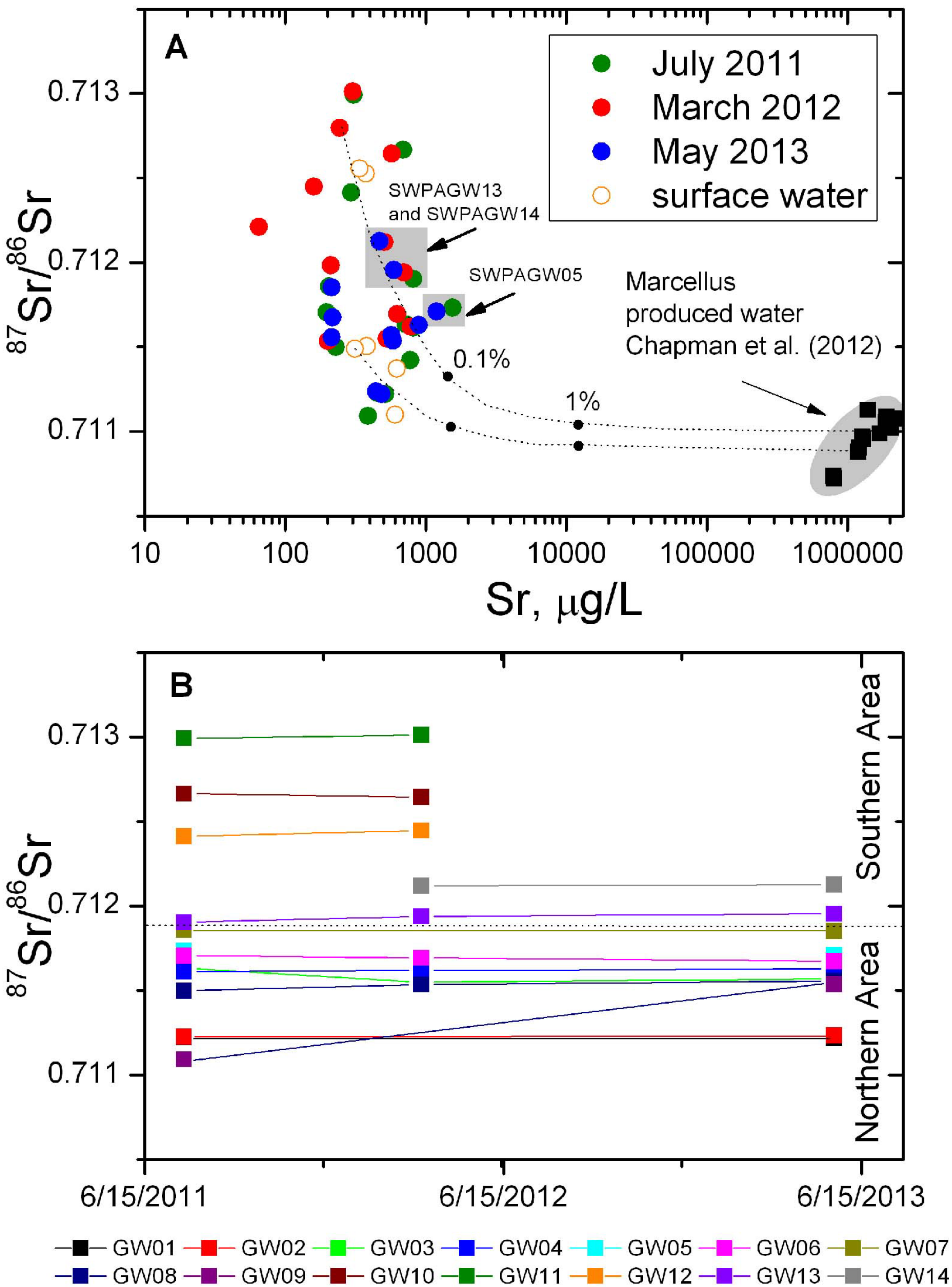


Figure 27. A) Strontium isotope values versus strontium concentrations and mixing model trends with % contributions of Marcellus Shale produced water (see text). B) $^{87}Sr/^{86}Sr$ values in ground water as a function of time and by well location.

In ideal situations, fixed end member fluid compositions are known or reasonably constrained. In this case, the Marcellus data represent a fairly robust end member composition. Selection of the receiving end member is more arbitrary, although adding produced water to shallow ground water should result in increased strontium concentrations and decreased $^{87}Sr/^{86}Sr$ values. Fluid mixing is expected to be a dynamic process and strontium concentrations and isotope ratios should vary in time as mixing occurs, or after fluid mixing occurs and background conditions are reestablished. Figure 27B shows that, in fact, $^{87}Sr/^{86}Sr$ values were remarkably consistent at each of the sampling points through time. The estimated uncertainty in the $^{87}Sr/^{86}Sr$ values is about 15×10^{-6} based on eight duplicate field samples collected over the course of this study. Variability in $^{87}Sr/^{86}Sr$ values observed at the sampling locations ranged from 1×10^{-6} to 446×10^{-6}, with a median value 22×10^{-6}. For comparison, Kolesar Kohl et al. (2014) recently showed that variability in the strontium isotopic composition of spring water, representing shallow ground water in Greene County, Pennsylvania (located just to the south of Washington County, see Figure 1), was ~100×10^{-6} over a 15-month period. Except locations SWPAGW03, SWPAGW08, SWPAGW09, and SWPAGW13, all the other sampling locations showed $^{87}Sr/^{86}Sr$ values that were independent of time within expected analytical and sampling uncertainties (see Figure 27B). Locations SWPAGW08, SWPAGW09, and SWPAGW13 all showed $^{87}Sr/^{86}Sr$ trends that increased with time, i.e., strontium isotope ratios at these locations became less like flowback and produced water from the Marcellus Shale; the $^{87}Sr/^{86}Sr$ ratio decreased with time at location SWPAGW03, becoming more similar to fluids recovered from the Marcellus Shale, yet the concentration of strontium did not increase at this location. The most significant change in $^{87}Sr/^{86}Sr$ was observed at location SWPAGW09 between the first and third sampling event (Figure 27B). The reason for the positive shift in $^{87}Sr/^{86}Sr$ is not certain, but other anomalous results were obtained at this well during the third sampling event, such as elevated turbidity and increased concentrations of iron, manganese, strontium, and sodium. Thus, it is challenging to draw conclusions from the data collected from this well. Note that the $^{87}Sr/^{86}Sr$ ratio was slightly higher in the southern area (0.71190 to 0.71301) compared to the northern area (0.71109 to 0.71185; see Figure 27B). Regional trends and the general invariant strontium isotope ratios suggest that the fluids are near equilibrium with surrounding aquifer materials. Lack of variability with time suggests that deep brine or fluids derived from Marcellus Shale gas wells did not impact shallow ground water at the selected sampling locations over the time scale of this study. The strontium isotope method can be highly sensitive for evaluating potential brine migration into shallow aquifers and this geochemical tool is most useful in cases where time-resolved data are available (e.g., Kolesar Kohl et al., 2014).

6.7. Halogen Ions

Another sensitive method for evaluating fluid-mixing processes and potential impacts to shallow ground water involves the use of dissolved halogen anions such as chloride and bromide (Davis et al., 1998; Panno et al., 2006; Kight and Siegel, 2011; Wilson et al., 2014). Both of these anions are expected to behave conservatively in ground water and surface water, and both anions are enriched in Pennsylvania oilfield brines and Marcellus Shale flowback and produced water (Dresel and Rose, 2010; Haluszczak et al., 2013; Barbot et al., 2013). Collectively, data from this study indicate that the [Cl/Br] ratio of ground water and surface water increases with increasing chloride concentration (see Figure 28). Similar trends in [Cl/Br] ratios were presented by Alawattegama et al. (2015) for ground water samples collected in southwestern Pennsylvania. Samples with low chloride concentrations and low [Cl/Br] ratios are characteristic of precipitation (e.g., Panno et al., 2006). Samples with high chloride concentrations

(>5,000 mg/L) and [Cl/Br] ratios ~100 are characteristic of oil and gas–produced waters in Pennsylvania (Figure 28).

The results of several conservative mixing models are also shown in Figure 28. In each model, the lowest chloride concentration/lowest [Cl/Br] ratio sample (SWPASW01-0711) was selected as the dilute end member composition. The sources of chloride and bromide were modeled as: (i) Marcellus Shale flowback water (site 32 from Haluszczak et al., 2013); (ii) NaCl brine with 0.1 wt% Br; and (iii) NaCl brine with 0.01 wt% Br. The latter two end members are representative of either Br-depleted road salt or septic discharge of Br-depleted salts associated with water softeners, respectively. The model results provide indistinguishable trends at low mixing concentrations (e.g., <0.1% salt source). Samples from locations SWPAGW13 and SWPAGW14 with the highest observed chloride concentrations (>100 mg/L) showed [Cl/Br] ratios that were higher than the [Cl/Br] ratio typical in Marcellus Shale flowback waters and oilfield brines of southwestern Pennsylvania, presumably excluding flowback water and brine as sources of chloride in these samples. It is important to note that the model results shown in Figure 28 are highly dependent on the choice of end member compositions and also on the assumption that a similar mechanism (i.e., fluid mixing) is responsible for the apparent trend of increasing [Cl/Br] ratio with increasing chloride concentration. It is possible that different samples in the group are influenced by different or multiple sources.

Concentrations of sodium, bromide, calcium, and lithium are compared to chloride concentrations in Figure 29 for samples collected in this study, Marcellus Shale flowback water, and oil and gas brines from western Pennsylvania. Analysis of geochemical data for water injected during hydraulic fracturing and for water produced from Marcellus Shale gas wells indicated that: (i) water returned to the surface after subsurface injection is modified by mixing of injected water with formation brines of evaporated paleoseawater, and (ii) injection of sulfate-rich water during hydraulic fracturing may stimulate microbial sulfate reduction at some sites (Engle and Rowan, 2014). Marcellus Shale–produced water exhibits [Na/Cl] and [Br/Cl] ratios similar to those of other oil and gas brines from Pennsylvania (Barbot et al., 2013; Haluszczak et al., 2013). However, Marcellus Shale flowback water has less calcium than other brines in Pennsylvania. The origin of salinity in the brines is considered to be related to seawater evaporation, precipitation of halite, and subsequent dilution by freshwater, seawater, or other brines (Haluszczak et al., 2013). Similarly, major ion trends in Marcellus Shale flowback water can be explained by mixtures of highly evaporated brine with more dilute water. With the exception of sodium, most other major and minor ions in shallow ground water and surface water are not explained by simple dilution of deep brine or Marcellus Shale flowback water (see Figure 29). Concentrations of chloride and sodium in shallow ground water appear to coincide with extensive brine dilution (see Figure 29); however, with some exceptions (notably locations SWPAGW13 and SWPAGW14), most shallow ground water data cluster around the molar [Na/Cl] ratio of 1, suggesting that NaCl dissolution could in part explain the concentrations of sodium and chloride in the aquifers used for drinking water. Lithium and bromide data from this study show chloride-independent changes in concentration that are inconsistent with brine dilution. Similarly, calcium shows several apparent trends with chloride: (i) surface water and sodium-bicarbonate type ground water shows low and variable calcium concentrations, and (ii) all other ground water samples show a slight regular increase in chloride with increasing calcium. Both trends appear to be discontinuous with extensive brine dilution (see Figure 29). Note that similar non-linear trends between brine and shallow ground water data were shown by Warner et al. (2012) for

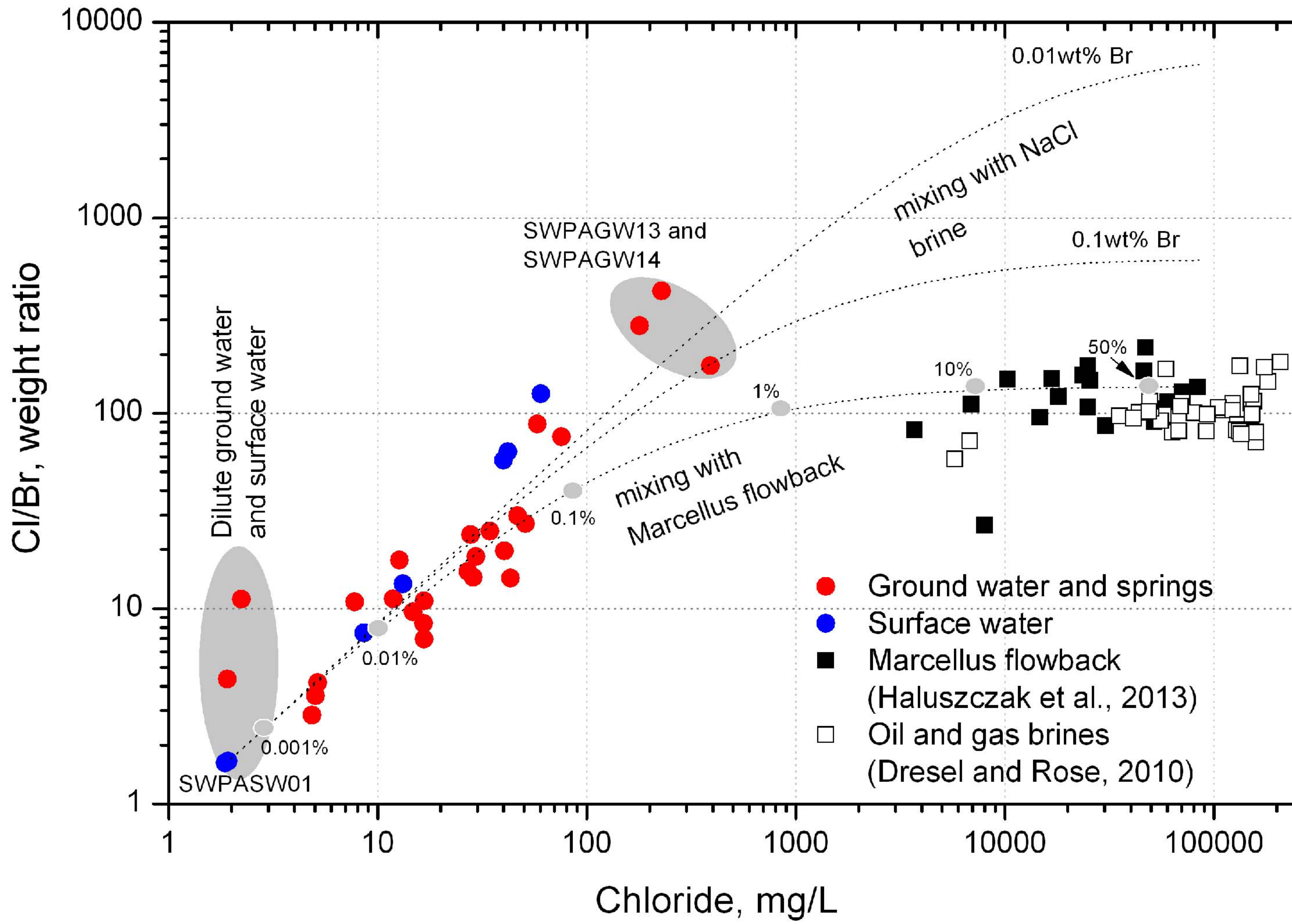


Figure 28. [Cl/Br] weight ratio versus chloride concentration for shallow ground water and surface water, as well as Marcellus Shale flowback water and oil and gas brines from Pennsylvania. Mixing model trends are shown with % contributions of Marcellus Shale produced water (see text).

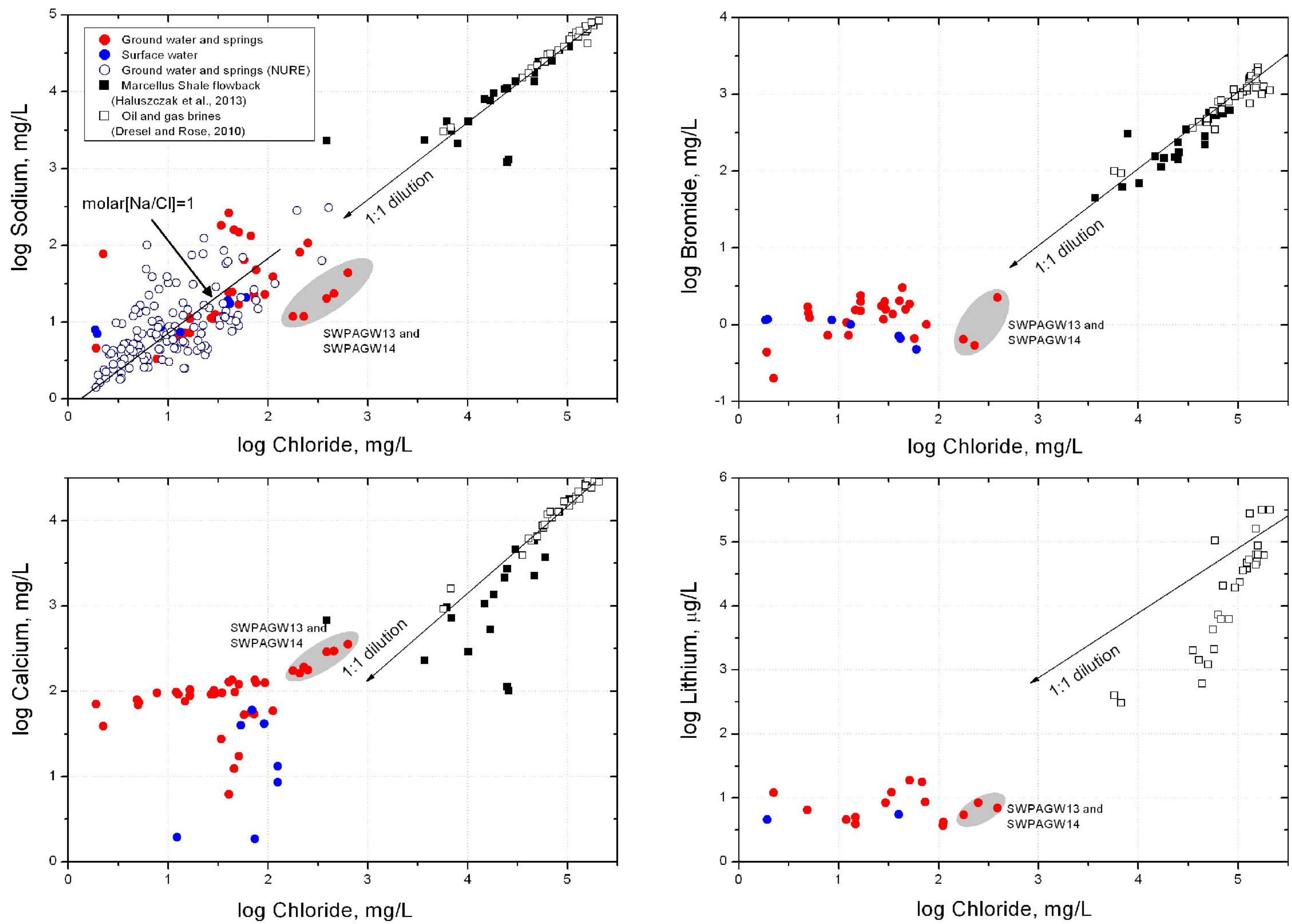


Figure 29. Chloride versus sodium, bromide, calcium, and lithium. Data are shown for shallow ground water (this study, NURE), surface water (this study), Marcellus Shale flowback water (Haluszczak et al., 2013), and oil and gas brines from Pennsylvania (Dresel and Rose, 2010).

northeastern Pennsylvania. These authors suggested that non-linear solute relationships were potentially related to mixing processes with sources from sewers and/or deicing salt.

Wilson et al. (2014) developed an approach to distinguish oil and gas–produced water from various coal-related wastewaters and brine treatment plant discharges in southwestern Pennsylvania using [SO_4/Cl] weight ratios and bromide concentrations. These geochemical parameters are useful because they may vary over many orders of magnitude, they are commonly measured anions, and because they may be qualitatively diagnostic of distinct sources of water. For example, the [SO_4/Cl] weight ratio is much higher in coal-related wastewaters than in oil and gas–produced waters, whereas bromide concentrations are much lower in mine discharge compared to oil and gas–produced waters. Figure 30 shows a [SO_4/Cl] weight ratio versus bromide concentration plot for shallow ground water and surface water of this study compared to Marcellus Shale flowback water, oil and gas brines from Pennsylvania, and highlighted data regions from Wilson et al. (2014), representing abandoned mine drainage, surface water, discharges from brine treatment plants, coal-fired power plant effluent, and Marcellus Shale–produced water. The data collected in this study for shallow ground water and surface water cluster near the data regions for surface water and mine drainage in Pennsylvania (Figure 30). The [SO_4/Cl] ratios of ground water and surface water from this study are generally several orders of magnitude higher than the ratios observed in Marcellus Shale–produced water. In contrast, bromide concentrations in ground water and surface water collected in this study were generally orders of magnitude lower than the bromide concentrations in Marcellus Shale–produced water (see Figure 30).

6.8. Radionuclides

Recent studies have indicated that saline Marcellus Shale brines can impact the quality of shallow drinking-water aquifers, perhaps due to brine migration along natural pathways (e.g., Warner et al., 2012; Myers, 2012; Vengosh et al., 2014). Data on the chemical composition of flowback and produced waters from Marcellus Shale wells in central and western Pennsylvania were recently reported by Haluszczak et al. (2013; see also Rowan et al., 2011). Their results show high concentrations of ^{226}Ra and ^{228}Ra in some of the flowback brines, with total ^{226}Ra+^{228}Ra concentrations ranging from 73 to 6,540 pC_i/L; these concentrations exceed EPA's MCL (5 pC_i/L) by 13 to 1,300 times.

In this study, analysis of gross radioactivity and specific radionuclides included gross α radioactivity, gross β radioactivity, and the radium isotopes ^{226}Ra and ^{228}Ra. Analyses were conducted in the second and third rounds of sampling in March 2012 and May 2013, respectively. Gross α and β measurements are generally used as screening-level measurements and are often used to indicate whether more detailed follow-up analyses are appropriate. The main α emitting radionuclides in natural decay series are ^{238}U, ^{234}U, ^{230}Th, ^{226}Ra, ^{210}Po, ^{232}Th and ^{228}Th. The major β emitting radionuclides are ^{210}Pb, ^{228}Ra, and ^{40}K (Bonotto et al., 2009). Naturally occurring radioactivity in ground water is produced mainly by the radioactive decay of ^{238}U and ^{232}Th. The ^{238}U atom has a half-life of 4.5×10^9 years, and its decay series products include ^{226}Ra and ^{222}Rn.

A total of 24 ground water and four surface water samples were collected for radionuclide measurements in the second and third sampling events. The isotopes of radium were not detected in any of the samples above the method reporting limit (1 pC_i/L). Gross α and β were detected above the method reporting limit at activities of 6.3 and 10.3 pC_i/L, respectively, in one sample from location SWPAGW09 collected in May 2013. The gross α and β activities in this well were below EPA's MCLs of 15 pC_i/L and 50 pC_i/L, respectively. (Note that the MCL for gross β activity is not an official regulatory level, but is used as a trigger for additional testing). During the purging of this well, significant drawdown of the water table was observed, which led to somewhat elevated turbidity at the time of sampling (>15 NTU). Interestingly, total barium was also elevated in this well (675 µg/L), which supports the observed correlation of gross α (and ^{226}Ra) and alkaline earths, such as barium (e.g., Haluszczak et al., 2013). In this well, dissolved and total thorium concentrations were 0.16 (J) and 1.2 µg/L, respectively, indicating the presence of some form of particulate thorium. Note that location SWPAGW09 also showed the presence of particulate lead above the primary action level for drinking water treatment. The radionuclide results are consistent with the isotope data for water, DIC, and strontium and suggest that shallow ground water and surface water from the selected sampling locations of this study were not impacted by flowback or produced water from Marcellus Shale gas wells, Upper Devonian sands, and/or other deep brines.

Dissolved uranium concentrations in ground water samples collected in March 2012 and May 2013 ranged from <0.05 to 1.6 µg/L, with a median concentration of 0.53 µg/L (n = 19). The distribution of uranium concentrations determined in this study was in very good agreement with the NURE dataset (see Table 4). These concentrations are below EPA's MCL for uranium of 30 µg/L.

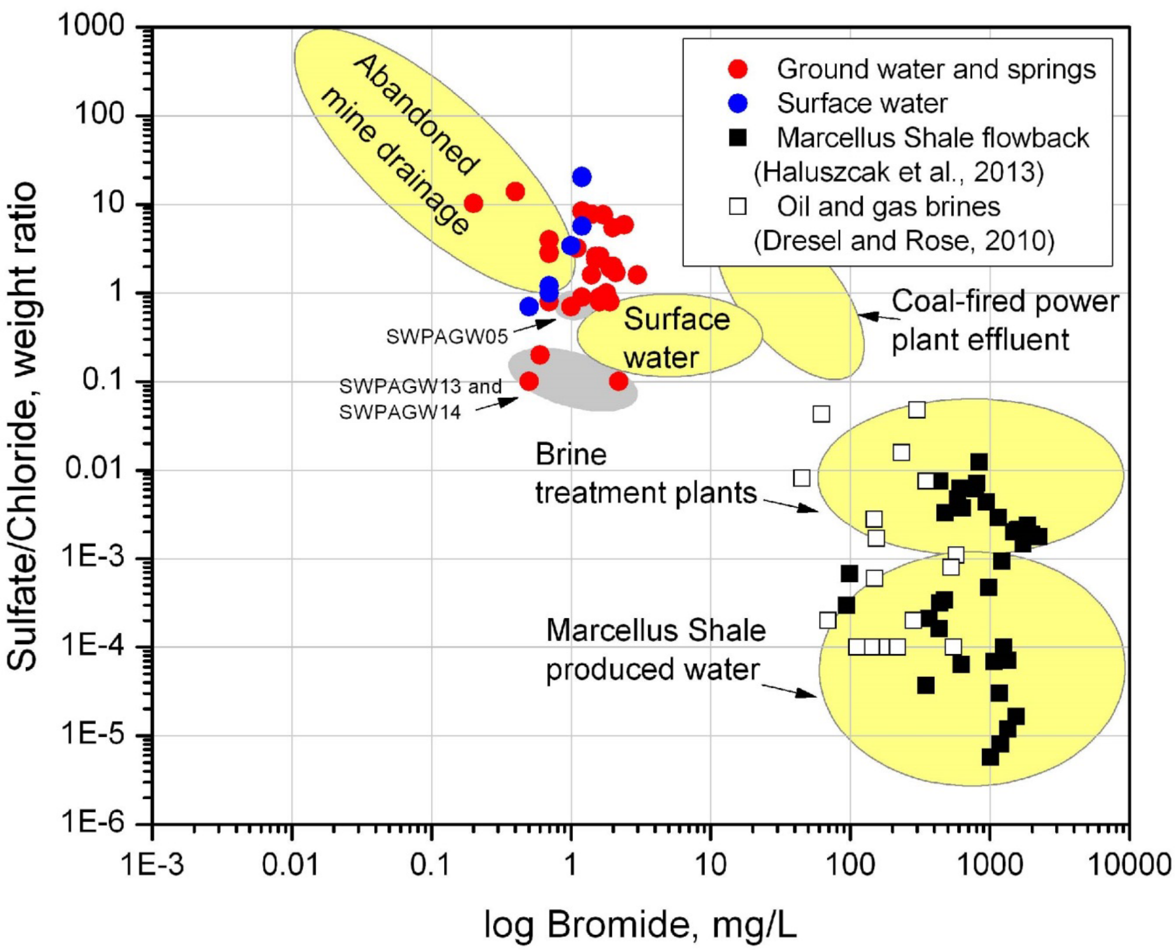


Figure 30. [SO_4/Cl] weight ratio versus bromide concentration for shallow ground water and surface water, as well as Marcellus Shale flowback water (Haluszczak et al., 2013), oil and gas brines from Pennsylvania (Dresel and Rose, 2010), and other water types identified in Wilson et al. (2014; yellow shaded regions).

7. Southern Area

The preceding analysis of historical water quality data and comparison to data collected for this study indicates several locations in the southern area with anomalous major ion signatures, i.e., examples where concentration data from this study fell near or above the 90th percentile in either the countywide or the reduced-area comparisons of historical water quality. In particular, locations SWPAGW13 and SWPAGW14 (springs) showed elevated ground water concentrations of chloride and calcium. The average chloride concentration at location SWPAGW13 over the three sampling rounds represents the third highest value (99th percentile) when compared to all of the historical water quality data from Washington County considered in this study. When compared to chloride concentrations in samples collected from springs only, locations SWPAGW13 and SWPAGW14 exceeded all historical data in the NWIS and NURE datasets by up to 8.7 times. When comparing to historical data in this way, it is necessary to establish a threshold for what is considered significantly different from the historical background data.

Matschullat et al. (2000) presented several methods for estimating the upper limits of background thresholds in geochemical data (see also Reimann et al., 2008). In each method, a critical mean±2σ value is determined as the normal range for background. The methods include: (i) inflection points on cumulative frequency curves, (ii) 4σ-outlier test, (iii) iterative 2σ-technique, (iv) original data mean±2σ value (96th percentile), and (v) the calculated distribution function based on values in the lower 50th percentile. Matschullat et al. (2000) concluded that the iterative 2σ-technique and the calculated distribution function provide realistic approximations of the background condition; however, they further pointed out that no single method can provide absolute results due to the inherent complexity of geochemical datasets. For example, environmental data may be collected using different sampling approaches and analytical methods. Chloride data from ground water and springs in Washington County are shown in Figure 31 using a histogram and a cumulative distribution curve. The results of the different background approximation methods are also provided in Figure 31. For the Washington County dataset, critical mean±2σ values for chloride range from 33 mg/L using the calculated distribution function to 405 mg/L using the inflection method. The average chloride concentration at location SWPAGW13 exceeded the critical values determined using each of the background estimation techniques and was, therefore, reasonably outside of background thresholds (see Figure 31). Average chloride concentrations from location SWPAGW14 fell within the critical values determined using the iterative 2σ-technique and the 4σ-outlier test; assessments about whether this location was within background conditions are less certain. When compared to chloride concentrations from springs, however, both SWPAGW13 and SWPAGW14 were consistently anomalous.

Chloride concentrations at location SWPAGW13 showed significant changes through time; chloride concentrations decreased by 27% and 16% between the first and second and the second and third rounds of sampling, respectively. Parallel concentration trends were also indicated for calcium, strontium, barium, and sodium (see Figure 20). Decaying concentration trends are well-established features of advective-dispersive transport of conservative tracers and contaminants that result from instantaneous pulses or transient sources such as spills and leachate migration from buried waste (e.g., Freeze and Cherry, 1979; Guerrero et al., 2010, 2013; Olayiwola et al., 2013). Elevated concentrations of chloride above background thresholds, time-dependent concentration behavior, and data collected at

SWPAGW13 and SWPAGW14 before this study in 2009 (described below) indicate that an impact has occurred at these sampling locations.

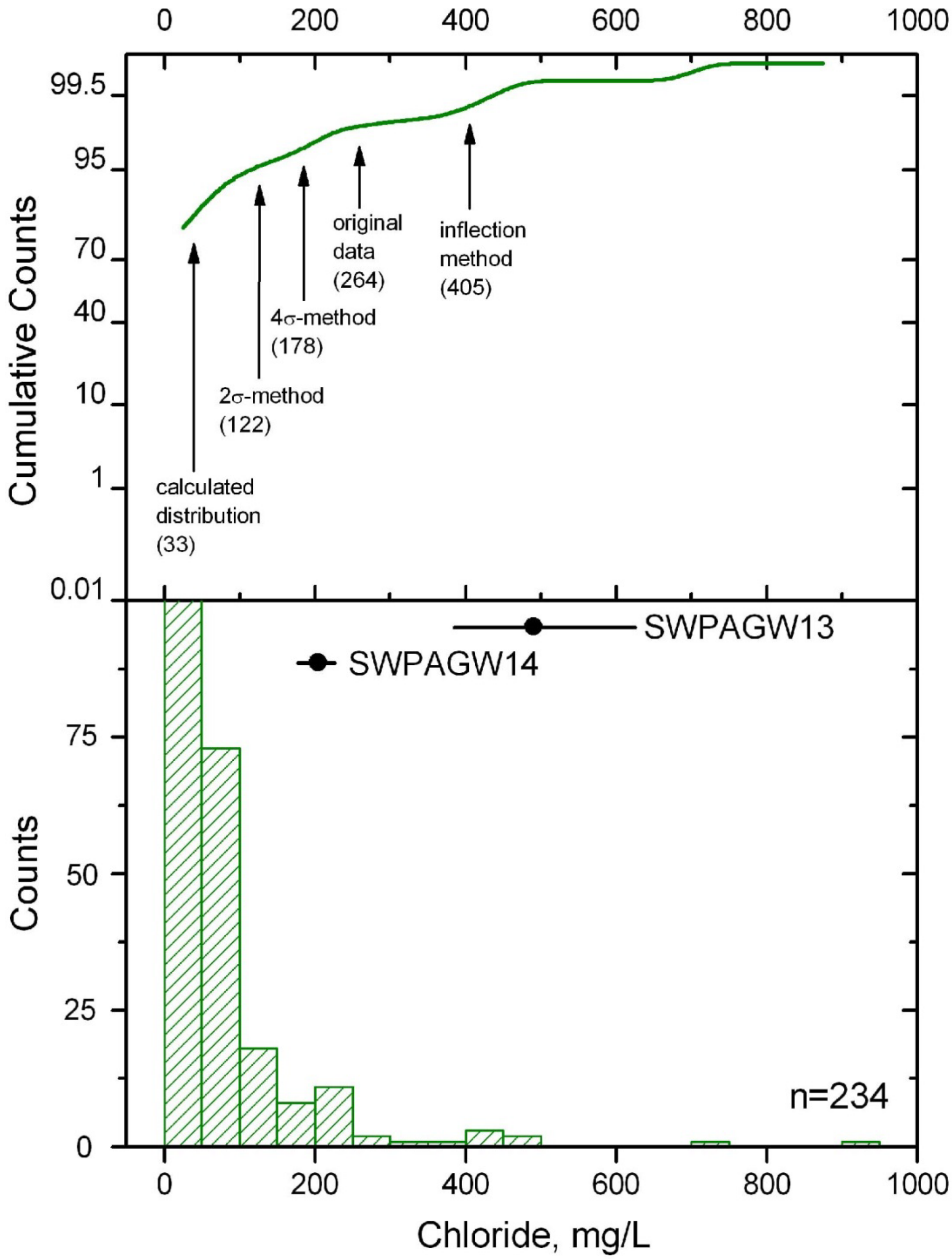


Figure 31. Histogram and cumulative distribution curve of chloride concentrations from ground water and springs in Washington County, including data from this study and historical data. Critical background values were determined using the methods presented by Matschullat et al. (2000; see text). The average and range of chloride concentrations is shown for locations SWPAGW13 and SWPAGW14.

The map locations of SWPAGW13 and SWPAGW14 and proximal sampling locations are shown in Figure 3. Locations SWPAGW13 and SWPAGW14 are both springs near the northern margin of the map area in Figure 3. Both springs are located to the east (~250 feet and ~75 feet, respectively) of a paved county road. SWPAGW13 is located east of SWPAGW14 and is about 35 feet higher in elevation; thus, location SWPAGW14 represents discharge of somewhat deeper ground water. The water discharging from these springs is protected within covered vaults. Both springs are located to the northwest and hydraulically down gradient from an impoundment, a former reserve pit used for the disposal of drilling wastes, and a gas well (well 7H, PA DEP permit no. 125-23824). Drilling of well 7H started in September 2009 and was completed in November 2009 to a depth of 7,190 feet below land surface; the well was hydraulically fractured in December 2009.

A common approach for evaluating background conditions in ground water investigations at hazardous waste sites includes analysis of nearby wells that are not expected to be influenced by sources of contamination (e.g., US EPA, 1995). The major ion composition of all water samples collected in the southern area of the study were compared using a Schoeller diagram (see Figure 32). As noted previously, samples collected in this study from locations SWPAGW13 and SWPAGW14 were calcium-chloride type waters; all other waters in the area were calcium-bicarbonate type, with the exceptions of SWPAGW18 and SWPAGW19, which were sodium-bicarbonate type. Samples from locations SWPAGW13 and SWPAGW14 showed higher concentrations of calcium and chloride than all other nearby samples, which collectively represent an approximation of background conditions in the area. In addition, samples collected from locations SWPAGW13 and SWPAGW14 in August 2009, prior to drilling activities at well 7H, showed calcium-bicarbonate type water typical of other water wells in the area (see Appendix D and Figure 32). Note in particular that chloride concentrations in both SWPAGW13 and SWPAGW14 were <5 mg/L in August 2009 before the impoundment was built. The chloride concentration in SWPAGW13 during the first round of sampling, for example, was 631 mg/L, indicating that a concentration change of over 155× occurred between August 2009 and July 2011. At location SWPAGW14, the increase in chloride concentration from August 2009 to March 2012 was over 90×. Similar abrupt increases in concentrations were indicated for calcium, strontium, barium, and sodium. Secondary data from SWPAGW13 and SWPAGW14 were weighted similarly to other historical data and were obtained using appropriate analytical methods (see Appendix D). Charge balance was within 2% for the samples collected in 2009 (Appendix D). In all cases, major ion data collected in 2009 from locations SWPAGW13 and SWPAGW14 fell within the range observed in nearby wells that are reasonably representative of local background conditions (see Figure 32).

The molar increase in chloride (17.7 mmol/L) between the August 2009 and July 2011 sampling of SWPAGW13 was not entirely balanced by molar increases in calcium (6.05 mmol/L) or sodium (1.71 mmol/L). This discrepancy suggests that water-rock interactions such as sodium for calcium cation exchange (Howard and Beck, 1993) may have an important influence on water chemistry and, consequently, the observed cation/anion distribution in ground water may not reflect the composition of the source.

With the exception of location SWPAGW12, available data did not show significant time-dependent changes in chloride or calcium concentrations in the other domestic wells and springs shown in Figure 32. The chloride concentration in well water from location SWPAGW12 decreased from 28.7 mg/L to 1.9 mg/L between the July 2011 and March 2012 sampling events. The chloride concentrations in this well were within the range of other wells in the area (2.2 to 41.8 mg/L), excluding SWPAGW13 and

SWPAGW14. Thus, the changes in chloride concentrations at location SWPAGW12 cannot be viewed as anomalous when compared to the chloride concentration distribution in nearby wells, although low-level impacts in this well, and other wells in the area, may be indistinguishable from the range of background concentrations.

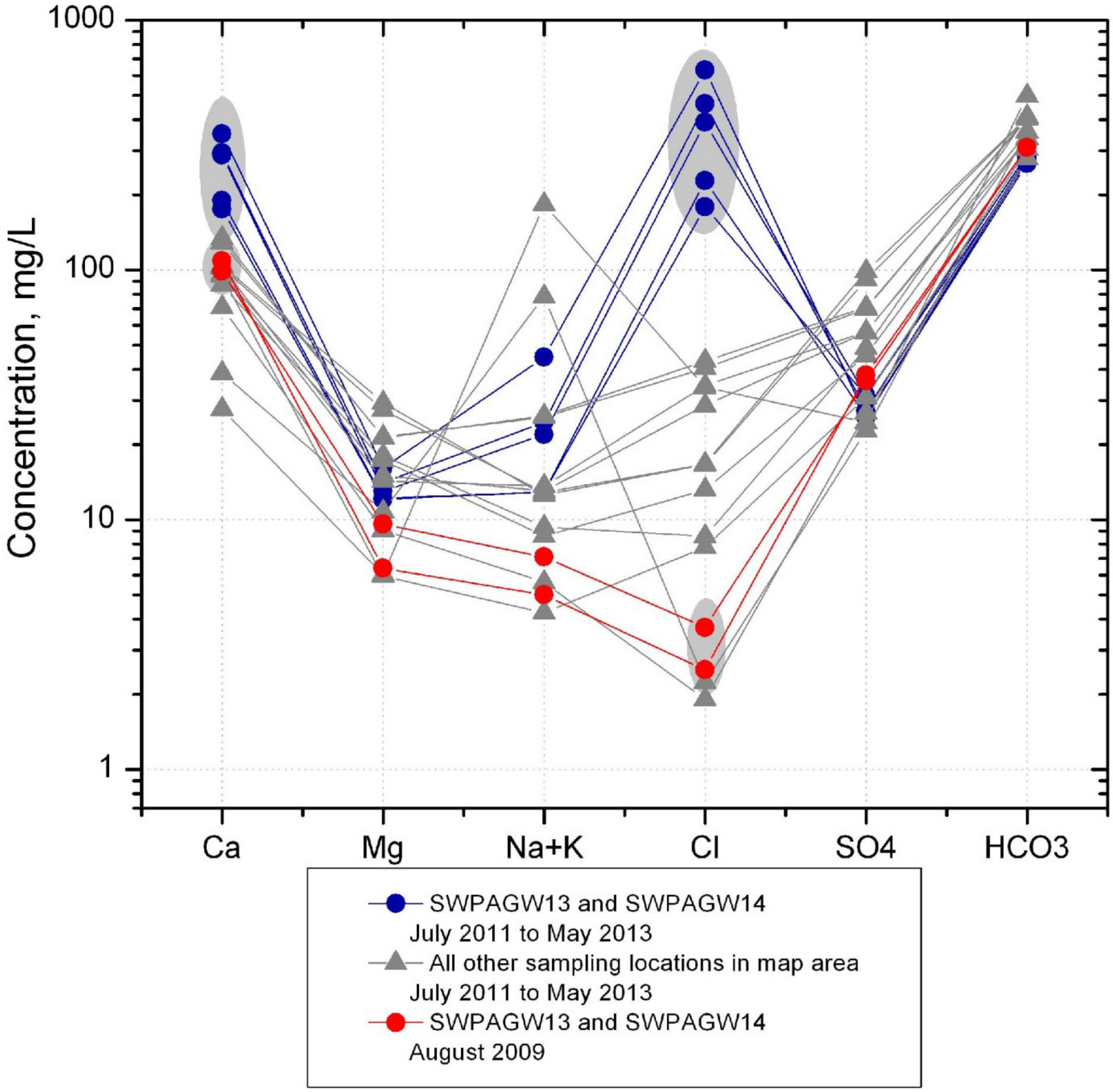


Figure 32. Schoeller diagram showing the major ion composition of shallow ground water, springs, and surface water in the southern area. Data are shown for locations SWPAGW13 and SWPAGW14 before (August 2009) and after construction of the Yeager impoundment (July 2011 to May 2013). The shaded ovals highlight changes in chloride and calcium concentrations at locations SWPAGW13 and SWPAGW14 (see text).

Based on detailed background assessment and evaluation of existing data, potential candidate causes for the issues concerning ground water chemistry at locations SWPAGW13 and SWPAGW14 include: historical land use, current drilling processes and practices, historical drilling practices, naturally occurring sources, and road salt, as described below (see Appendix C).

- The EDR search indicated that there are two abandoned coal mines about 1.5 miles northeast of location SWPAGW13. Mines could affect ground water quality and are a candidate cause; however, there are limited data on the regional ground water hydrology that would allow for a definite cause-and-effect linkage. Other sampling locations in the vicinity of SWPAGW13 and SWPAGW14 would be expected to show related water quality impacts if the identified abandoned mines were a source term.
- One orphan CERCLIS landfill site was identified in the environmental records search; its location could not be accurately determined based on information available. Without further information about this landfill, particularly the location, it cannot be ruled out as a potential contributor to ground water quality impacts.
- Contaminant sources related to the Yeager Unit 7H well—such as poor casing cement integrity and potential leaks in the former Yeager reserve pit and impoundment—are potential causes. Evaluation of elevation contours indicates that locations SWPAGW13 and SWPAGW14 are likely hydraulically down gradient from the former reserve pit, and this source would be consistent with the time-dependent behavior of water chemistry, as noted above. Infiltration of chloride and associated constituents from impoundments into shallow ground water was previously studied in other natural gas extraction regions (e.g., Healy et al., 2008, 2011).
- Background reports on hydrology in Washington County (Newport, 1973; Williams et al., 1993) suggest that freshwater aquifers in some locations have been contaminated by brine, under artesian conditions, migrating upward from deeper, non-potable aquifers through historical oil and gas wells that were improperly abandoned or have corroded casings. Although specific candidate wells were not identified in this study, this source or other natural pathways of brine migration are considered to be a candidate cause. As indicated in previous sections, this scenario is inconsistent with Sr isotope data and [Cl/Br] ratio analysis.
- Road salt application to aid in snow and ice removal can impact shallow ground water and is considered as a candidate source (e.g., Howard and Beck, 1993; Williams et al., 1999; Blasius and Merritt, 2002). According to the Amwell Township Road Department, road salt is typically used for deicing state roads but not for county roads (Barale, 2013). The township used cinders that were generated from coal ash for deicing county roads. The nearest state road to the area of interest, Route 19, is over a mile away; therefore, an impact from road salt in the area of interest is not suspected. In addition, locations SWPAGW13 and SWPAGW14 are significantly higher in elevation compared to the adjacent county road and are unlikely to be impacted by runoff.
- Site-specific data relating to local hydrology and ground water chemistry are unavailable to provide more definitive assessments of the primary causes(s) and longevity of the ground water impact.

8. Iron and Manganese

Many of the homeowner concerns regarding water quality from their domestic wells were related to turbidity, taste, and staining properties of the water, particularly in the northern area. These water quality issues are frequently linked to concentrations of particulate and dissolved iron and manganese, and in some cases to elevated dissolved sulfide concentrations (Hem, 1985). Recall that dissolved sulfide was only detected at one location (SWPAGW06), so elevated sulfide levels were not indicated to be the cause of poor water quality at most of the sampling locations of this study. Previously, Williams et al. (1993) concluded that the primary issues with ground water quality within Washington County are occurrences of elevated levels of iron, manganese, dissolved solids, and hardness. Similar water quality issues have been documented in other parts of Pennsylvania (e.g., PA DEP, 1998). Based on their analysis of water samples collected to study the impacts of coal mining on water resources in Washington County, Williams et al. (1993) showed that more than 33% of the water samples they studied had dissolved iron concentrations higher than the SMCL (300 µg/L; n = 104), and 30% had dissolved manganese concentrations higher than the SMCL (50 µg/L; n = 91). Williams et al. (1993) noted that these elements are natural constituents of soils and rocks that can solubilize or precipitate in ground water, typically as a consequence of oxidation-reduction processes. Water quality data collected for this study are consistent with these historical observations and show the common occurrence and wide-ranging concentrations of iron and manganese in ground water at the locations sampled in Washington County (see Table 4 and Figure 33). Note that when iron and manganese were detected in water samples, concentrations in the unfiltered (total) sample were typically greater than in the filtered sample (see Figure 33). This relationship indicates the presence of particulate iron and/or manganese. Particulate iron and manganese may be transported in ground water as fine-grained or colloidal particles or might originate from accumulated solids present in the well bore that were suspended during well purging. Note that the formation of iron encrustations is known to negatively affect the performance of wells by reducing permeability and specific capacity (e.g., Walter, 1997; Houben, 2003).

The distributions of iron and manganese in ground water systems are largely controlled by redox reactions. At near-neutral pH conditions typical of ground water, both elements tend to be more soluble and mobile under conditions that are free of oxygen (anoxic). Under such conditions, iron and manganese are primarily present as the dissolved cations Fe^{2+} and Mn^{2+}. Mobile Fe^{2+} and Mn^{2+} may precipitate in the presence of dissolved oxygen to form insoluble solids of $Fe(OH)_3$ and MnO_2, and/or other related solids. In the presence of bicarbonate and carbonate, Fe^{2+} and Mn^{2+} may precipitate to form siderite ($FeCO_3$) or rhodochrosite ($MnCO_3$). The effects of pH and redox conditions on the mobility of manganese, for example, can be shown on an E_H-pH diagram. Figure 34 shows the primary stability fields of dissolved and solid forms of manganese as a function of pH and E_H for the system Mn-H_2O-CO_2 (total manganese concentration 10^{-6} mol/L, ~50 µg/L; bicarbonate concentration 10^{-3} mol/L, ~60 mg/L; ideal solution behavior assumed) at 25 °C and 1 atmosphere pressure. The data points plotted on the diagram are measured pH and E_H values estimated from ORP measurements from the ground water samples of this study. In most cases, field measurements of pH and ORP indicate that manganese should be present in the soluble and mobile form. Note that precipitation of manganese-containing minerals is favored with increasing pH and E_H. Sulfur is not considered in Figure 34; however, manganese sulfide (MnS, alabandite) is fairly soluble and would not be expected to precipitate based on the negligible dissolved sulfide concentrations present in most of the domestic wells. Concentrations of dissolved manganese and iron showed a negative correlation with E_H; i.e., higher concentrations of these elements were associated with lower E_H, or more reducing conditions, consistent with thermodynamic predictions (see Figure 35).

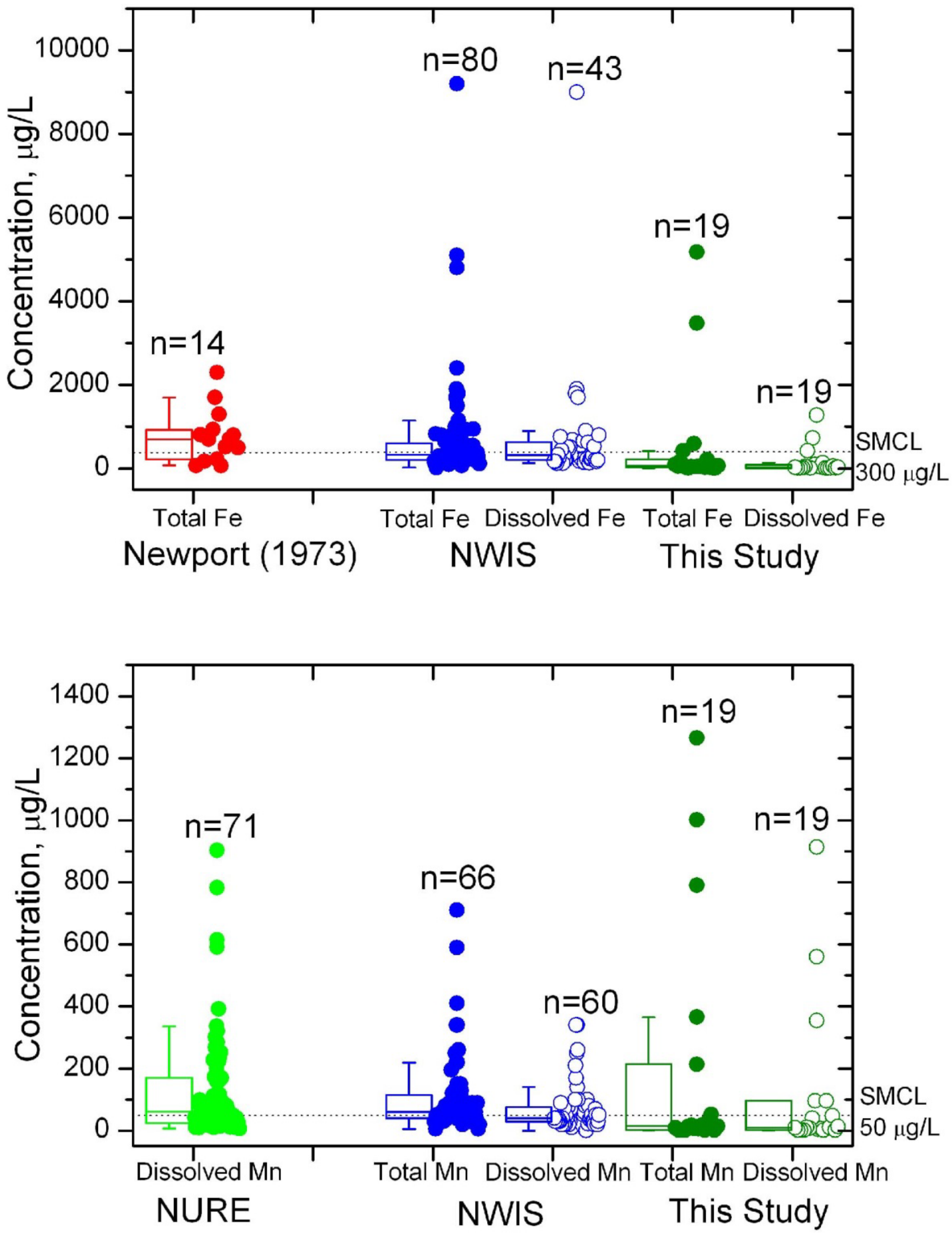


Figure 33. Iron and manganese concentrations in ground water from this study and historical data.

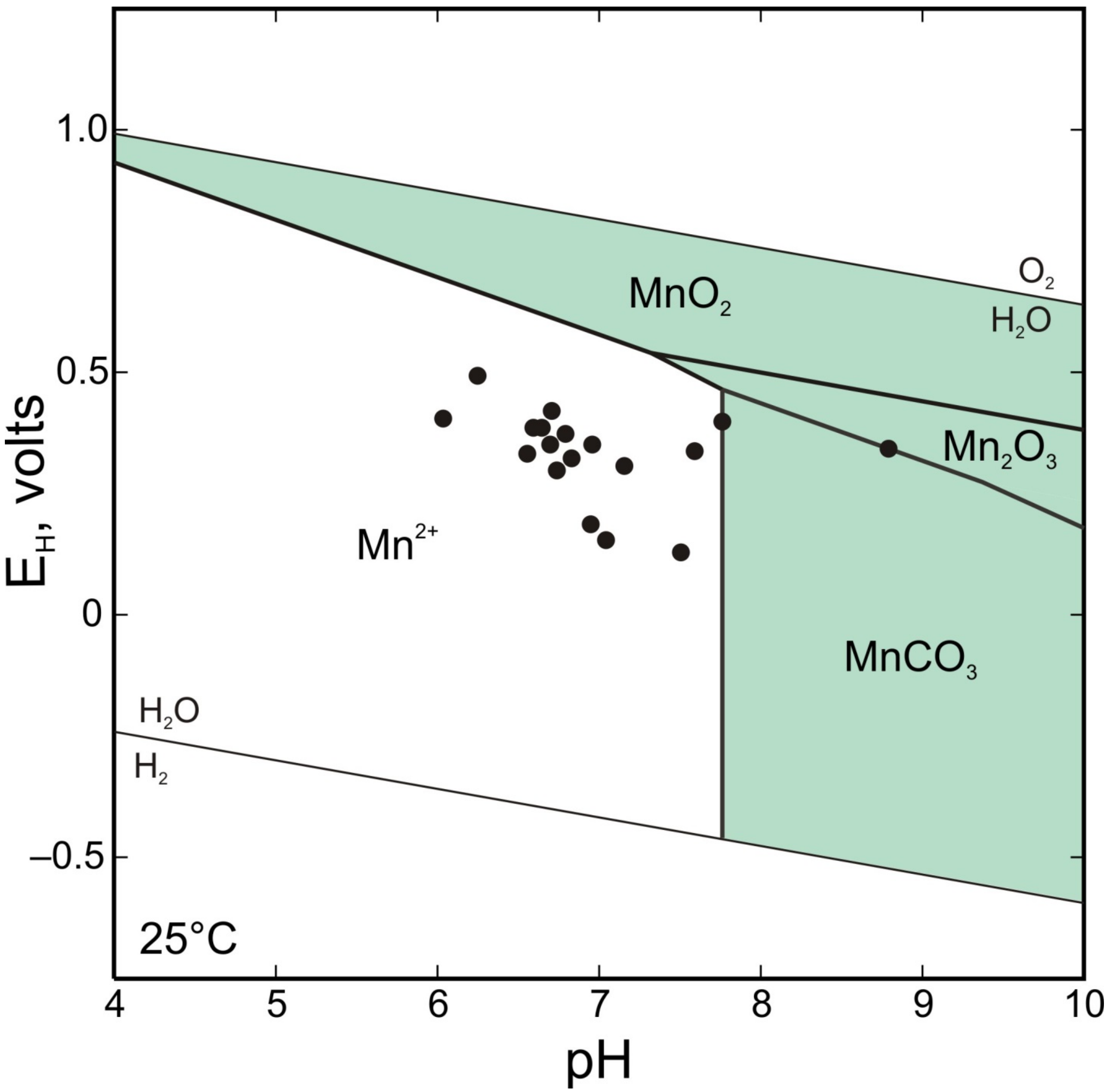


Figure 34. E_H-pH diagram for Mn (25°C, Mn = 10^{-6}, HCO_3^- = 10^{-3}). Data points are measured pH versus oxidation-reduction potential (ORP) values of ground water converted to E_H (voltage reading versus the standard hydrogen electrode). The shaded green area indicates the E_H-pH region in which manganese precipitation is expected.

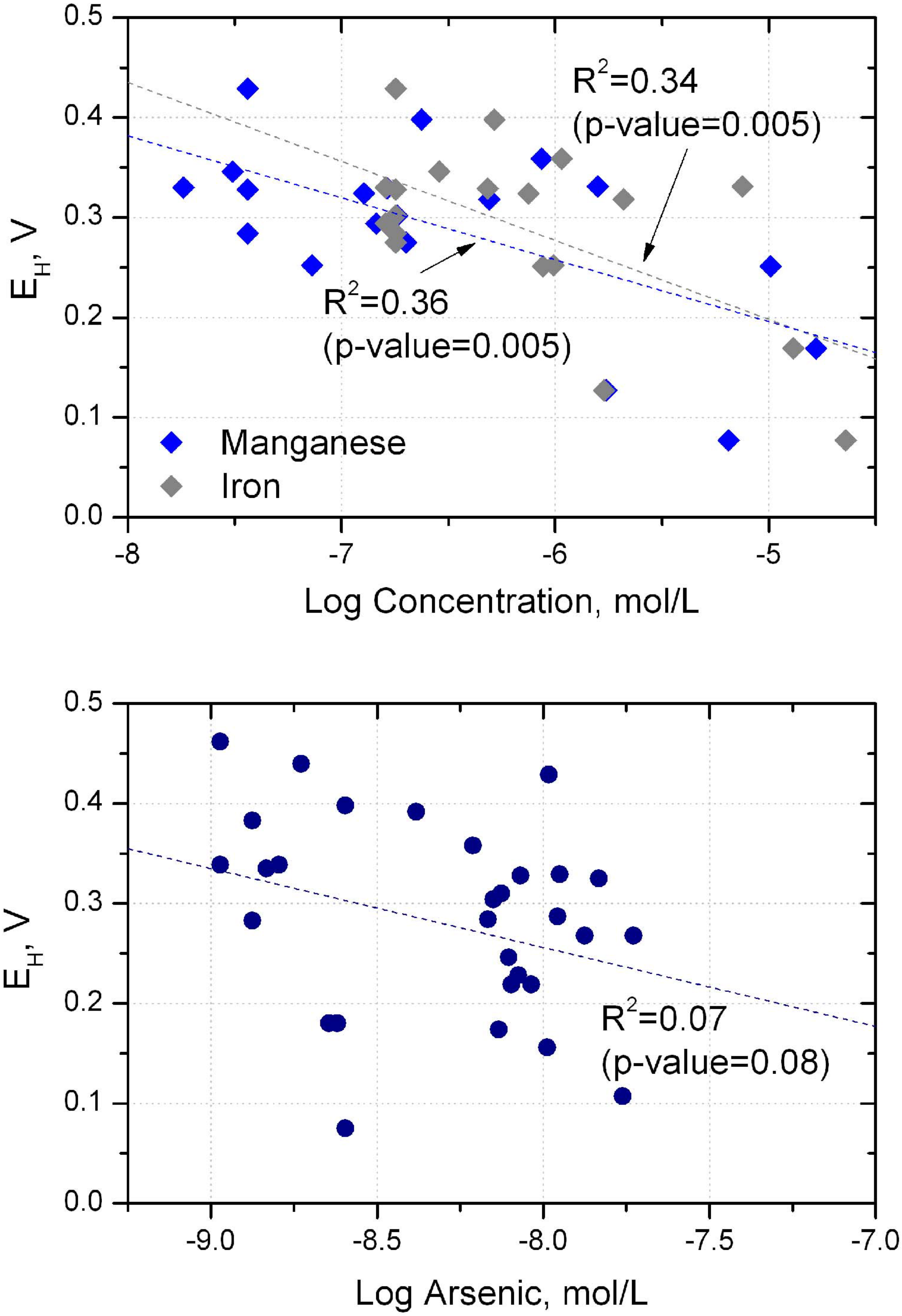


Figure 35. Concentrations of manganese, iron and arsenic as a function of redox potential (E_H).

Arsenic is a trace element that shows similar redox-related solubility characteristics and transport behavior to iron and manganese (Smedley and Kinniburgh, 2002). Dissolved arsenic concentrations measured in this study from ground water and springs ranged from <0.04 to 0.84 µg/L (cf. the arsenic MCL of 10 µg/L); the median concentration of arsenic was 0.54 µg/L (see Table 8). However, unlike iron and manganese, arsenic concentrations were poorly correlated with E_H ($R^2 = 0.07$; see Figure 35); the poor correlation with E_H and the low concentrations of dissolved arsenic in ground water may reflect low concentrations of arsenic in the aquifer solids.

While the occurrences of iron and manganese in ground water of Washington County, and indeed throughout the state, likely stem from geology and geochemical processes that result in the natural enrichment of these elements in regional aquifers, this water quality issue may be amplified in areas of active drilling. For example, Boyer et al. (2011) and Alawattegama et al. (2015) noted areas in Pennsylvania where water wells sampled before and after drilling activities showed increased levels of manganese and iron. Groat and Grimshaw (2012) suggested that these types of impacts may be related to vibrations and energy pulses put into the ground during drilling and/or other operations. These energy inputs could cause naturally formed particles containing iron and manganese to mobilize and possibly increase turbidity in domestic wells in the vicinity of gas development. The overall process that might be occurring would involve several key steps:

1. Dissolution of naturally occurring iron and manganese through redox-related processes.
2. Transport of iron and manganese through ground water seepage.
3. Slow oxidation and precipitation of iron and manganese solids in and around water wells that serve to provide conduits for air (oxygen) into the subsurface.
4. Gradual accumulation of Fe- and/or Mn-solids through time in and around water wells.
5. Transient high-energy events related to drilling or other operations (e.g., Fontenot et al., 2013).
6. Temporary pulses in domestic wells of high turbidity, increased staining, and poor water quality. Such transient events of increased turbidity, and related enrichment of iron and/or manganese, were not captured at any location during the sampling events conducted for this study.

9. Summary of Case Study Results

Washington County, Pennsylvania, is underlain by the Marcellus Shale, which serves as an unconventional reservoir of gas in the Appalachian Basin. Extensive drilling and production of Marcellus gas wells began in 2005, with a progressive increase in development thereafter. As of December 2013, approximately 1,435 wells were permitted in the Marcellus Shale in Washington County (PA DEP, 2013).

This retrospective case study was prompted by concerns about potential impacts on human health and the environment. The focus of the study was on potential effects on drinking water resources from current gas development in the Marcellus Shale. Environmental concerns include the potential for contamination of shallow ground water by stray gases (methane), fracturing chemicals associated with unconventional gas development, and deep formation waters (brine). Potential contaminant migration pathways connecting hydraulically fractured zones to shallow ground water include advective transport through sedimentary strata, fractures, faults, abandoned wells, and/or compromised boreholes. Surface features, such as impoundments and pits used for storage of flowback and produced water and other drilling wastes, also represent potential contaminant sources to shallow ground water and surface water. Overall, the quality of shallow ground water used for drinking water in Washington County is expected to be governed by a number of factors that modify the composition of infiltrated water, including geology, land use, past coal mining activities, agricultural activities, industrial operations, waste disposal, materials storage, deicing application and storage, and oil and gas development.

Washington County was selected for a retrospective case study in order to follow up on reported instances in the county of decreased water quality in domestic wells related to appearance, odor, and taste. The study focused on locations where homeowners expressed concerns about potential impacts to their wells from nearby hydraulic fracturing activities and surface disposal/storage of wastes. In this study, water quality samples were collected from 16 domestic wells, three springs, and three surface water locations in Amwell, Cross Creek, Hopewell, and Mount Pleasant Townships during three rounds in July 2011, March 2012, and May 2013. The domestic wells sampled ranged in depth from 50 to 160 feet below land surface (cf. the depth of the Marcellus Shale in Washington County, which is more than 5,000 feet below land surface). The water samples collected were analyzed for geochemical parameters (temperature, pH, specific conductance, ORP, dissolved oxygen, and turbidity), major cations and anions, nutrients, trace metals, VOCs, SVOCs, DRO, GRO, glycol ethers, low-molecular-weight acids, radionuclides, strontium isotope ratios ($^{87}Sr/^{86}Sr$), and selected stable isotopes ($\delta^{18}O_{H2O}$, $\delta^{2}H_{H2O}$, $\delta^{13}C_{DIC}$, $\delta^{13}C_{CH4}$, and $\delta^{2}H_{CH4}$).

The locations sampled in this study were not monitored extensively before drilling and gas production. Therefore, identification of specific changes in water quality inclusive of the pre-drilling and gas development time frame was not possible in most cases. The evaluation of new data from this study with respect to potential impacts from unconventional gas development included consideration of the chemicals used in hydraulic fracturing, analysis of dissolved gases and their isotopic compositions, analysis of deep brine geochemistry in relation to shallow ground water geochemistry, analysis of historical ground water quality in Washington County, and analysis of time-dependent geochemical trends. Land use factors and potential environmental stressors were also evaluated using available data. Historical water quality data from Washington County were collected from literature sources and online from the USGS NWIS and NURE databases. The historical data were used as points of reference for screening-level comparisons in order to illustrate regional concentration ranges typical in ground water and for constraining major water composition types that were encountered within Washington County before gas development in the Marcellus Shale. Table 10 summarizes the potential ground water and surface water impacts identified during this study.

Table 10. Potential ground water and surface water impacts identified in the retrospective case study in southwestern Pennsylvania.

Impacted Parameters	Study Area	Locations	Sample Type	Description	Potential Sources
Dissolved Methane	Northern	SWPAGW04 SWPAGW06 SWPAGW07 SWPAGW08	Ground water and Springs	Detections from 0.002 to 15.5 mg/L; consistent with biogenic and/or mixed biogenic and thermogenic sources	Drift gas; coal seams; long-term migration from deep shales, sandstones, and coal beds
	Southern	SWPAGW14 SWPAGW17			
Nitrate	Southern	SWPAGW10	Ground water	Primary MCL exceedance	Septic systems; animal manure; fertilizers
Total lead	Northern	SWPAGW09	Ground water	Primary MCL exceedance	Natural sources; pipe and/or solder corrosion
	Southern	SWPAGW12			
Iron and Manganese	Northern	SWPAGW02 SWPAGW04 SWPAGW06 SWPAGW09 SWPASW02	Ground water, Springs, Surface water	Secondary MCL exceedances	Natural sources; turbidity potentially influenced by drilling; coal-mine drainage
	Southern	SWPAGW11 SWPAGW12 SWPAGW14			
Aluminum	Northern	SWPAGW04 SWPAGW08 SWPAGW09	Ground water and Springs	Secondary MCL exceedances	Natural particulates; mineral content
	Southern	SWPAGW10 SWPAGW12 SWPAGW13 SWPAGW14			
Chloride	Northern	SWPAGW05 SWPASW02	Ground water, Springs, Surface water	Elevated concentrations compared to historical data; secondary MCL exceedances at location SWPAGW13	Historical land use; current and/or historical drilling practices; impoundments; reserve pits; natural sources of brine; road salt
	Southern	SWPAGW13 SWPAGW14			

Three ground water types were identified in this study based on major ion chemistry: calcium-bicarbonate, sodium-bicarbonate, and calcium-chloride. These water types coincide with major ion types represented in historical water quality databases, except that (i) the calcium-chloride type water was unique to this study; and (ii) the sodium-sulfate and calcium-sulfate water types were not identified in this study, but are prevalent in the NWIS database. The sodium-sulfate type compositions included in the NWIS data tend to be elevated in TDS and may be representative of more evolved water-rock interactions, perhaps involving weathering of sulfide minerals such as pyrite contained in coal and other sedimentary rocks.

Methane occurs naturally in ground water in southwestern Pennsylvania and is present within glacial deposits, Permian- and Pennsylvania-age coal seams/sedimentary deposits, as well as underlying Devonian-age strata, including the Marcellus Shale. Dissolved methane was detected in 24% of the ground water and spring samples collected in this study, at concentrations ranging from about 0.002 to 15.5 mg/L. In samples for which methane isotope values could be determined, the C and H isotope signatures were distinct from the reported thermogenic composition of methane from the Marcellus Shale. The isotopic signature in the sample with the highest methane concentration was consistent with a biogenic origin. Coal seams in the comparatively shallow Monongahela and Conemaugh Group aquifers could also provide a natural source of methane to shallow ground water. Historical water quality databases do not include information on dissolved gas concentrations and isotope compositions, which is a limitation for this study. Literature data from a neighboring region (north-central West Virginia), which has witnessed limited shale-gas development, shows similar methane concentration distributions and isotopic signatures as described here for Washington County. Data on the gas composition and stable isotope compositions of methane and other dissolved gases from glacial drift deposits, Pennsylvanian and Permian coal seams, and Devonian strata would be essential to support source identity evaluations for stray gas investigations in this area.

Evaluation of $^{87}Sr/^{86}Sr$, $\delta^{13}C_{DIC}$, $\delta^{18}O_{H2O}$, $\delta^{2}H_{H2O}$, [Cl/Br], and [SO_4/Cl] ratio data provides no clear evidence of contamination of shallow ground water with water produced from the Marcellus Shale or other deep brines. These geochemical techniques are sensitive and appropriate for detecting and assessing fluid mixing processes. They provide the most certainty when well-constrained end members are established, which for the purpose of evaluating potential impacts related to natural gas development would necessarily include pre-drilling and development data. The isotopes of radium (^{226}Ra and ^{228}Ra) have been noted to be elevated in flowback and produced water from some Marcellus Shale gas wells. These radiogenic isotopes were not detected in any of the samples collected for this study above an activity of 1 pC_i/L. Gross α and β radioactivity were detected above method reporting limits in one sample collected from a domestic well in May 2013 at activities of 6.3 and 10.3 pC_i/L, respectively. The gross α activity determined in the ground water from this well, 6.3 pC_i/L, was below EPA's maximum contaminant level of 15 pC_i/L.

The purpose of extensive analysis of organic chemicals was to evaluate the potential occurrence in ground water and surface water of chemicals documented as components of hydraulic fracturing fluids. Low-level detections of VOCs (toluene, benzene, chloroform, and acetone) and SVOCs (2-butoxyethanol, phenol, phthalates) and DRO compounds were observed at sampling locations on an inconsistent basis. There were no significant detections in ground water or surface samples of glycol ethers, gasoline-range organic compounds, or acetate. Concentrations of organic compounds did not exceed EPA's drinking water standards, and over the three rounds of sampling there were no significant and repeated detections at any location of organic chemicals known to be associated with the process of hydraulic fracturing. Lack of correlation with other potential indicators (e.g., elevated TDS, chloride, and barium concentrations) in ground water and surface water that contained low-level detections of organic compounds suggests that the infrequent detections of these compounds did not originate from hydraulic fracturing activities. Historical water quality databases include very little information on organic chemicals in ground water from Washington County.

Primary MCL exceedances were observed in this study at one location for nitrate and at two locations for total lead (Table 10). Sources of nitrate to ground water include septic systems, animal manure, and fertilizers applied to lawns and crops; nitrate and lead are not typically considered to be associated with hydraulic fracturing operations. A precise evaluation of the sources of nitrate and lead at the locations was beyond the scope of this project. Water quality data collected for this study are consistent with historical observations showing the common occurrence and wide-ranging concentrations of iron and manganese in ground water in Washington County, Pennsylvania; the presence of these elements is shown to be related to redox conditions. While the occurrences of iron and manganese in ground water of Washington County likely stem from geology and geochemical processes that result in the natural enrichment of these elements in regional aquifers, increased turbidity from iron and/or manganese particulates may be amplified in areas of active drilling. Boyer et al. (2011) and Alawattegama et al. (2015) noted a small number of wells in Pennsylvania where water samples collected before and after drilling activities showed increased levels of iron and manganese. Such impacts may be related to vibrations and energy pulses put into the ground during drilling and/or other operations (Groat and Grimshaw, 2012). These energy inputs could cause, in geochemically favorable environments, naturally formed particles containing iron and manganese to mobilize and possibly increase turbidity and may explain reported instances of reduced water quality isolated in time. Such transient events were not captured at any location during the sampling events of this study.

Elevated concentrations of chloride relative to historical water quality data and time-dependent concentration behavior, including water quality results that predate this study, indicate that an impact (elevated chloride) occurred at sampling locations of this study near the Yeager impoundment in Amwell Township. Based on detailed background assessment and evaluation of existing data, candidate causes for the issues concerning ground water chemistry at this location include: historical land use, current drilling processes and practices, historical drilling practices, naturally occurring sources, and road salt. County records and analysis of geochemical data collected for this study suggest that road salt and/or upwelling of deep brines are unlikely candidate causes for the water quality impact. The water quality trends with time suggest that the chloride anomaly is linked to sources associated with the impoundment site; site-specific data are unavailable to provide more definitive assessments of the primary causes(s) and longevity of the ground water impact. A plan for closure and reclamation of the impoundment site was submitted to the PA DEP in February 2014.

Key observations/findings from this study are summarized below.

- Dissolved methane was detected in 24% of the ground water and spring water samples collected in this study at concentrations that ranged from about 0.002 to 15.5 mg/L. The methane concentration in one domestic well sampled in this study was above the PA DEP action level of 7 mg/L. Multiple lines of evidence including the C and H isotope signature of methane, redox conditions, levels of sulfate and dissolved oxygen, and the isotope signature of inorganic carbon indicate that the origin of methane from this location was from CO_2 reduction, i.e., drift gas.
- Analysis of $^{87}Sr/^{86}Sr$, $\delta^{13}C_{DIC}$, $\delta^{18}O_{H2O}$, $\delta^{2}H_{H2O}$, gross α activity, gross β activity, ^{226}Ra and ^{228}Ra, [Cl/Br], and [SO_4/Cl] ratio data from the sampling locations selected for this study provide no clear evidence of contamination of shallow ground water by flowback or produced water from Marcellus Shale gas wells, Upper Devonian sands, and/or other deep brines. However, these multiple lines of evidence provided inconclusive results regarding brine impacts at

three locations due to a lack of pre-drilling and development data (SWPAGW05, SWPAGW09, and SWPASW02).

- There were no detections in this study of glycol ethers, GRO compounds, or acetate in ground water and surface samples collected in Washington County. Detections of VOCs and SVOCs were infrequent, below EPA's drinking water MCLs, and did not correlate with other potential indicators of hydraulic fracturing fluids, such as elevated chloride and/or the presence of glycol ethers.
- Primary MCL exceedances were observed in this study at one location for nitrate and at two locations for total lead; the occurrences of nitrate and lead in ground water are not considered to be associated with hydraulic fracturing operations.
- Secondary MCL exceedances for manganese and iron were common in homeowner wells; increased concentrations of these elements correlate with moderately reducing ground water conditions and are consistent with historical observations that demonstrate the natural enrichment of these elements in regional aquifers. Transient episodes of decreased water quality from increased concentrations of iron and/or manganese and increased turbidity may be amplified in areas of active drilling.
- Elevated concentrations of chloride relative to historical water quality data and time-dependent concentration behavior indicate that a recent ground water impact occurred at sampling locations near the Yeager impoundment in Amwell Township. The impact resulted in chloride concentrations in a drinking water supply that exceeded the secondary MCL and a shift in ground water chemistry toward a calcium-chloride composition. The impoundment site was used to store drilling wastes and wastewater associated with the hydraulic fracturing water cycle. Site-specific data relating to local hydrology and ground water chemistry are unavailable to provide more definitive assessments of the primary causes(s) and longevity of the ground water impact.

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Appendix A
QA/QC Summary
Retrospective Case Study in Southwestern Pennsylvania

U.S. Environmental Protection Agency
Office of Research and Development
Washington, DC

May 2015
EPA/600/R-14/084

Table of Contents

List of Tables

A.1. Introduction

This Appendix describes general Quality Assurance (QA) practices and the results of Quality Control (QC) samples, including discussion of chain of custody (COC), holding times, blank results, field duplicate results, laboratory QA/QC results, data usability, double lab comparisons, performance evaluation samples, Quality Assurance Project Plan (QAPP) additions and deviations, field QA/QC, application of data qualifiers, tentatively identified compounds (TICs), Audits of Data Quality (ADQ), and field and laboratory Technical System Audits (TSAs). All reported data for the Retrospective Case Study in Southwestern Pennsylvania met project requirements unless otherwise indicated by the application of data qualifiers in the final data summaries (see Appendix B). In rare cases, data were rejected as unusable and not reported.

A.1.1. July 2011 Sampling Event

The sampling and analytical activities for the July 2011 sampling event were conducted under a QAPP titled "Hydraulic Fracturing Retrospective Case Study, Marcellus Shale, Washington County, PA," version 0 approved on July 21, 2011. Deviations from this QAPP are described in Section A9. Twelve domestic wells, one spring, and three surface water locations were sampled during this event. A total of 340 samples were collected and delivered to six laboratories for analysis: Shaw Environmental, Ada, OK; EPA Office of Research and Development/National Risk Management Research Laboratory (ORD/NRMRL), Ada OK; EPA Region 8, Golden, CO; EPA Region 3, Fort Meade, MD; Isotech Laboratories, Inc., Champaign, IL; and U.S. Geological Survey (USGS) Laboratory, Denver, CO. Measurements were made for over 225 analytes per sample location. Of the 340 samples, 78 samples (23%) were QC samples including blanks, field duplicates, matrix spikes, and matrix spike duplicates.

A.1.2. March 2012 Sampling Event

The sampling and analytical activities for the March 2012 sampling event were conducted under a QAPP titled "Hydraulic Fracturing Retrospective Case Study, Marcellus Shale, Washington County, PA," version 1 approved on March 5, 2012. Specific changes made to the quality assurance documentation are described in the revised QAPP. Deviations from this QAPP are described in Section A9. An Addendum to version 1 approved on November 30, 2012 was prepared to document QC acceptance criteria for the reanalysis of samples for metals collected during the March 2012 sampling event. Ten domestic wells, three springs, and two surface water locations were sampled during this event. A total of 435 samples were collected and delivered to eight laboratories for analysis: Shaw Environmental, Ada, OK; EPA ORD/NRMRL, Ada OK; EPA Region 8, Golden, CO; EPA Region 3, Fort Meade, MD; Isotech Laboratories, Inc., Champaign, IL; ALS Environmental, Fort Collins, CO; USGS Laboratory, Denver, CO; and A4 Scientific, Inc., The Woodlands, TX. Measurements were made for over 230 analytes per sample location. Of the 435 samples, 135 samples (31%) were QC samples including blanks, field duplicates, matrix spikes, and matrix spike duplicates.

A.1.3. May 2013 Sampling Event

The sampling and analytical activities for the May 2013 sampling event were conducted under a QAPP titled "Hydraulic Fracturing Retrospective Case Study, Marcellus Shale, Washington County, PA," version 2 approved on April 22, 2013. Specific changes made to the quality assurance documentation are described in the revised QAPP. Deviations from the QAPP are described in Section A9. Eleven domestic wells, two springs, and two surface water locations were sampled during this event. A total of 529 samples were collected and delivered to eight laboratories for analysis: CB&I, Ada, OK; EPA ORD/NRMRL, Ada OK; SWRI, San Antonio, TX; EPA Region 8, Golden, CO; EPA Region 3, Fort Meade, MD; Isotech Laboratories, Inc., Champaign, IL; ALS Environmental, Fort Collins, CO; and USGS Laboratory, Denver, CO. Note that the Shaw Environmental Laboratory name changed to CB&I for the final round of sampling (same laboratory equipment, procedures, and staff). Measurements were made for over 235 analytes per sample location. Of the 529 samples, 222 samples (42%) were QC samples including blanks, field duplicates, matrix spikes, and matrix spike duplicates.

A final version of the QAPP titled "Hydraulic Fracturing Retrospective Case Study, Marcellus Shale, Washington County, PA," version 3 was approved on August 29, 2013. The QAPP is available at: http://www2.epa.gov/sites/production/files/2013-11/documents/hydraulic_fracturing_retrospective_case_study_marcellus_shale_washington_county_pa_revision_3.pdf.

A.2. Chain of Custody

Sample types, bottle types, sample preservation methods, analyte holding times, and the laboratories that received samples for analysis are listed in Table A1. Samples collected in the field were packed on ice into coolers for shipment by overnight delivery along with completed COC documents and temperature blank containers. In general, all samples collected in the field were successfully delivered to the laboratories responsible for conducting the analyses. The following sections describe any noted issues related to the sample shipments and potential impacts on data quality.

A.2.1. July 2011 Sampling

One cooler, delivered to the Robert S. Kerr Environmental Research Center (Ada, Oklahoma), was received without attached custody seals. This cooler included samples SWPAGW11, SWPAGW12, SWPAGW12dup, SWPAGW13, and a field blank collected on July 28, 2011. The analytical suites included with these samples were: metals, dissolved gases, volatile organic compounds (VOCs), low-molecular-weight acids, anions, nutrients, dissolved inorganic carbon (DIC)/dissolved organic carbon (DOC), and water isotopes. There is no expected impact on data quality for these parameters in the noted samples. One cooler sent to the EPA Region 3 Laboratory for glycol analysis containing samples from locations SWPAGW11, SWPAGW12, SWPAGW12dup, SWPAGW13 and a field blank arrived at the laboratory at a temperature of 17°C due to a delay in shipment. Glycols were not detected in any of the samples; these samples were qualified with the "J-" qualifier as estimated with a potential low bias. Some samples for Diesel Range Organics (DRO) analysis were not at the pH<2 preservation criterion; affected samples were qualified with the "J-" qualifier as estimated.

A.2.2. March 2012 Sampling

There were no noted issues related to COCs, temperature blanks, or preservation.

A.2.3. May 2013 Sampling

There were no noted issues related to COCs, temperature blanks, or preservation.

A.3. Holding Times

Holding times are the length of time a sample can be stored after collection and prior to analysis without significantly affecting the analytical results. Holding times vary with the analyte, sample matrix, and analytical methodology. Sample holding times for the various analyses conducted in this investigation are listed in Table A1 and range from 7 days to 6 months. Generally, estimated analyte concentrations for samples with holding time exceedances are considered to be biased low.

A.3.1. July 2011 Sampling

Glycol samples collected on 7/25/2011 and 7/26/2011 exceeded the 14-day holding time by 24 to 48 hours for diethylene glycol, triethylene glycol, and tetraethylene glycol. Affected samples were qualified with the "H" qualifier. Glycols were not detected in any of the samples during this event.

A.3.2. March 2012 Sampling

All samples met holding times.

A.3.3. May 2013 Sampling

All samples met holding times.

A.4. Blank Samples Collected During Sampling

An extensive series of blank samples was collected during all sampling events, including field blanks, equipment blanks, and trip blanks (Table A2). These quality control samples were intended to test for possible bias from potential sources of contamination during field sample collection, equipment cleaning, sample bottle transportation to and from the field, and laboratory procedures. The same source water was used for the preparation of all blank samples (Barnstead NANOpure Diamond UV water). Field blanks were collected to evaluate potential contamination from sample bottles and environmental sources. Equipment blanks were collected to determine whether cleaning procedures or sample equipment (filters, fittings, and tubing) potentially contributed to analyte detections. Trip blanks consisted of sealed serum bottles and VOA vials filled with NANOpure water. Trip blanks were used to evaluate whether VOA vials and dissolved gas serum bottles were contaminated during sample storage, sampling, or shipment to and from the field. All analyses have associated field and equipment blanks, except isotope ratio analyses for which no blank sampling schemes are appropriate. Sample bottle types, preservation, and holding times were applied to blank samples in the same way as they were applied to field samples (see Table A1).

The following criteria were used for flagging samples with potential blank contamination. Sample contamination was considered significant if analyte concentrations in blanks were above the method Quantitation Limit (QL) and if the analyte was present in an associated field sample at a level <10× the concentration in the blank. In cases where both the sample and its associated laboratory, equipment, field, or trip blank were between the Method Detection Limit (MDL) and the QL, the sample data were reported as less than the QL with a "U" qualifier. Blank samples were associated to field samples by dates of collection; for example, most sample shipments included both field samples and blank samples that were used for blank assessments. Results of blank analyses are reported in Tables A3-A12. In general, field blank samples were free from detections of a vast majority of analytes examined in this study. The following sections describe instances where blank detections were noted and potential impacts on data quality and usability. As previously stated, a majority of these blanks were free from detections or were less than the QL, and in these cases, the sample data are not affected and are not discussed in the following sections.

A.4.1. July 2011 Sampling

Nitrate was reported in one equipment blank collected on 7/27/2011 (see Table A3); several affected samples were qualified with the "B" qualifier as estimated, but in all cases the field samples showed higher levels of nitrate than were measured in the equipment blank.

There were detectable concentrations of toluene in one trip blank dated 7/21/2011 and one field blank collected on 7/26/2011 (see Table A6). Due to the trip blank detection above the QL, the results for two samples were qualified with the "B" qualifier: SWPAGW04 and SWPASW01.

For the low-molecular-weight acids, acetate was found to be a significant contaminant in the field and equipment blanks; consequently, the acetate data were rejected (see Table A7). The source of acetate contamination was later determined to be the preservative.

One equipment blank collected on 7/27/11 for semi-volatile organic compound (SVOC) analysis had blank detection of 2-butoxyethanol above the QL of 0.50 µg/L (see Table A10). This blank detection affected three samples: SWPAGW08, SWPAGW10, and SWPASW03, which were qualified. Other samples analyzed for 2-butoxyethanol were above the QL and not qualified; however, all 2-butoxyethanol detections in this set of data are suspect due to the high level detected in the equipment blank, i.e., the concentration detected in the equipment blank was higher than any detected level in the samples. The source of this contamination appears to be from the sampling equipment or containers, although other sources cannot be ruled out.

For gasoline range organic (GRO) samples, all field blanks had detectable concentrations (see Table A11). However, with the exception of SWPASW01, all field GRO samples were less than the QL, so no impact to the data is suggested for these samples. In the case of SWPASW01, the sample was qualified for GRO.

A.4.2. March 2012 Sampling

Two field blanks and one equipment blank had concentrations of nitrate + nitrite above the QL. These blank detections resulted in the application of several "B" qualifiers to the nitrate + nitrite concentration data; the source of this contamination is unknown, but in general, concentrations of nitrate + nitrite were greater in the samples compared to levels in the blanks with detections above the QL.

There were numerous detections in blank samples submitted for inductively coupled plasma mass spectrometry (ICP-MS) analysis by the EPA Superfund Analytical Services Contract Laboratory Program (CLP) laboratory, including dissolved and total aluminum (Al), total cadmium (Cd), total chromium (Cr), dissolved and total copper (Cu), dissolved and total nickel (Ni), and total lead (Pb) (see Tables A4 and A5). In one case, the total Cd concentration in a field blank was 134 µg/L. These blank detections were likely related to laboratory contamination and in only one case (for dissolved Ni) did these detections have an impact on data quality because concentrations of these elements in the samples were negligible and below the QL.

Formate and propionate were identified at detectable concentrations in some of the blank samples (see Table A7). In the case of formate, all blank samples had significant concentrations and consequently formate data were rejected. Propionate was detected at concentrations above the QL in a field blank and an equipment blank, affecting one sample which was qualified with a "B." Follow-up studies indicated that the likely source of contamination for formate was from the sample containers. Formate was not reported in the last round of sampling for this reason.

For SVOC analytes, there was a single detection above the QL of bis-(2-ethylhexyl) phthalate in a field blank collected on 3/24/2013 (see Table A10). There was no impact on data quality because none of the samples had detectable concentrations of this chemical.

There was a detection of DRO at the QL in one of the equipment blanks (see Table A11). Two samples were affected and qualified with a "B." For GRO, several blanks had concentrations above the QL; however, there was no impact on data quality because none of the samples contained levels of GRO above the QL.

A.4.3. May 2013 Sampling

Several equipment blanks and one field blank had detections of DOC both above and below the QL (see Table A3). The blanks above the QL resulted in the qualification of several samples with the "B" qualifier. One equipment blank for Total Kjeldahl Nitrogen (TKN) collected on 5/17/2013 showed a detection above the QL; this impacted two samples that were qualified with the "B" qualifier.

There were low level detections, both above and below the QL, in equipment and/or field blanks of dissolved Al, calcium (Ca), cobalt (Co), Cr, Cu, iron (Fe), Pb, Si, Sr, titanium (Ti), and zinc (Zn) (see Table A4). In most cases, these detections had no impact on data quality, with the exceptions of certain samples for dissolved Al, dissolved Cu, and dissolved Pb that had the "B" qualifier applied. For total metals, there were detections in field and equipment blanks for total arsenic (As), Ca, Cu, Fe, sodium (Na), Pb, selenium (Se), Si, Sr, thorium (Th), Ti, vanadium (V), and Zn (see Table A5). Those with detections greater than the QL led to the application of the "B" qualifier for some samples for total As, Cu, Pb, V, and Zn. The source of this contamination is likely the laboratory.

For SVOC analytes, there was a single detection above the QL of bis-(2-ethylhexyl) phthalate in a field blank collected on 5/18/2013 (see Table A10). There was no impact on data quality because none of the affected samples had detectable concentrations of this chemical.

DRO was detected above the QL in one equipment blank collected on 5/20/2013; this detection impacted none of the samples because DRO detections were not observed in any samples collected on that date.

A.5. Field Duplicate Samples

Field duplicate samples were collected to measure the reproducibility and precision of field sampling and analytical procedures. The relative percent difference (RPD) was calculated to compare concentration differences between the primary (sample 1) and duplicate sample (sample 2) using the following equation:

$$\text{RPD (\%)} = ABS\left(\frac{2 \times (\text{sample 1} - \text{sample 2})}{(\text{sample 1} + \text{sample 2})}\right) \times 100$$

RPDs were calculated when the constituents in both the primary sample and duplicate sample were >5× the method QLs. Sample results were qualified if RPDs were >30%. The results of field duplicate analyses are provided in Tables A13-A25.

A.5.1. All Sampling Events

The only parameters that required qualification based on RPDs not meeting the 30% criterion were total Fe and total Mn in the May 2013 sampling event. RPDs for one of the field duplicate pairs (SWPAGW04/SWPAGW04d) were 32.0% and 32.5%, respectively, for these analytes. Overall reproducibility of the multiple field duplicates was very good as shown on the cumulative percent diagram below (Figure A1). RPD values of field duplicates from the first two rounds of sampling follow a similar pattern, with 100% of the calculated RPD values less than 10%. Over 65% of the duplicate analyses agreed to within 1%. During the third round of sampling, additional ICP-MS analyses were completed. These analyses of trace metals tended to have overall higher RPD values. The third round of sampling showed that over 90% of the duplicates agreed to within 15%.

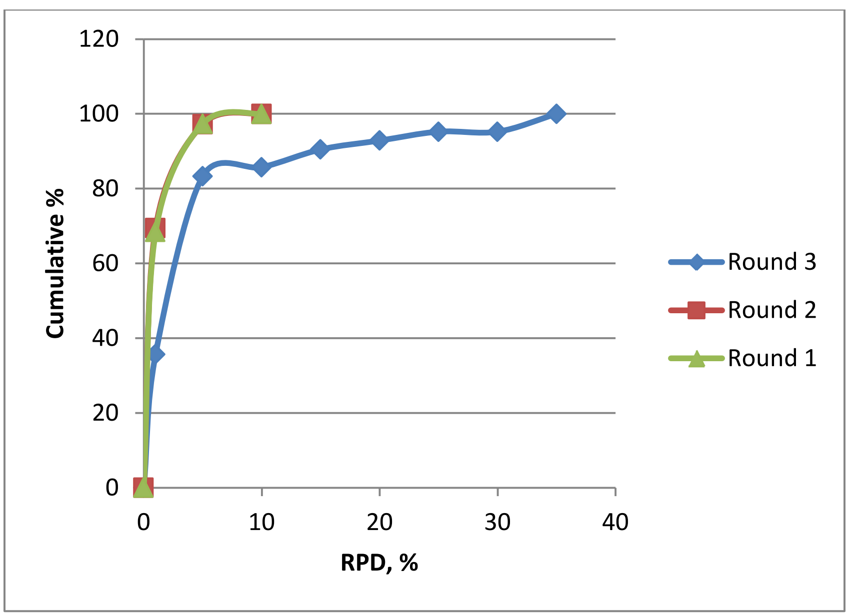

Figure A1. Cumulative % diagram showing the percent agreement of duplicate samples collected during the three rounds of sampling for this case study.

A.6. Laboratory QA/QC Results and Data Usability Summary

The QA/QC requirements for laboratory analyses conducted as part of this case study are provided in the QAPPs. Table A26 summarizes laboratory QA/QC results identified during sample analysis, such as laboratory duplicate analysis, laboratory blank analysis, matrix spike results, calibration, continuing calibration checks, and field QC. Impacts on data quality and usability, as well as any issues noted in the QA/QC results, are presented in Table A26. Data qualifiers are listed in Table A28. Many of the specific QA/QC observations noted in the Audits of Data Quality are summarized in Table A26.

A majority of the reported data met project requirements. Data that did not meet QA/QC requirements specified in the QAPP are indicated by the application of data qualifiers in the final data summaries (see Appendix B). Data determined to be unusable were rejected and qualified with an "R." Depending on the data qualifier, data usability is affected to varying degrees. For example, data qualified with a "B" would not be appropriate to use when the sample concentration is relatively close to the blank concentration. But as the sample data increase in concentration and approach 10x the blank concentration, they may be more appropriate to use. Data with a "J" flag are usable with the understanding that the concentration is approximate, but the analyte is positively identified. A "J+" or "J-" qualifier indicates a potential positive or negative bias, respectively. An "H" qualifier, for exceeding sample holding time, is considered a negative bias. An "*" indicates that the data are less precise than project requirements. Each case is evaluated to determine the extent that data are usable or not (see Table A26).

A.7. Double-lab Comparisons

No double-lab comparisons were conducted for this case study.

A.8. Performance Evaluation Samples

A series of performance evaluation (PE) samples were analyzed by the laboratories conducting critical analyses to support the Hydraulic Fracturing Retrospective Case Studies. The PE samples were analyzed as part of the normal QA/QC standard operating procedures, and in the case of certified laboratories, as part of the certification process and to maintain certification for that laboratory. The results of the PE tests are presented in tabular form in the Wise County, Texas Retrospective Case Study QA/QC Appendix and not repeated here. These tables show the results of 1354 tests; 98.6% of the reported values fell within the acceptance range. For the ORD/NRMRL Laboratory a total of 95 tests were performed with 96.9% of the reported values falling within the acceptable range. Similarly, for the Shaw Environmental Laboratory, a total of 835 tests were performed, with 98.7% of the reported values falling within the acceptable range. The EPA Region 8 Laboratory had a total of 424 tests performed with 98.8% of the reported values falling within the acceptable range. These PE sample results demonstrate the high quality of the analytical data reported here. Analytes not falling within the acceptable range were examined, and corrective action was undertaken to ensure data quality in future analysis.

A.9. QAPP Additions and Deviations

The July 2011 sampling was conducted using the "Hydraulic Fracturing Retrospective Case Study, Marcellus Shale, Washington County, PA" revision 0 QAPP. The March 2012 sampling was conducted using “Hydraulic Fracturing Retrospective Case Study, Marcellus Shale, Washington County, PA” revision 1 QAPP. The May 2013 sampling was conducted using the “Hydraulic Fracturing Retrospective Case Study, Marcellus Shale, Washington County, PA” revision 2 QAPP.

During the first two sampling events several field and equipment blanks were not collected as described in the QAPP. In cases when a particular blank was not collected on a day of sampling, blank results from the previous day were used to evaluate application of qualifiers in situations where there were detections in the blank samples. There was no expected impact on data quality resulting from this QAPP deviation. As described previously, blank contamination issues did not impact a vast majority of the analytes determined for this case study.

An additional deviation from planned analyses described in the QAPP was that all of the ICP-MS metals data were not reported from the July 2011 sampling event. These data were not reported because of concerns about the data quality and because the samples could not be re-analyzed within the specified sample holding time. Instead, ICP-OES data were reported for the ICP-MS metals As, Cd, Cr, Cu, Ni, Pb, and Se. ICP-MS data were collected for the March 2012 and May 2013 sampling events. In general, the ICP-OES trace metal data cannot be compared with the subsequent ICP-MS data due to the large differences in QLs and MDLs for the ICP-OES and ICP-MS methods, respectively. Therefore, trace metal evaluations only consider data collected during the last two sampling events. Information about the concentrations of As, Cd, Cr, Cu, Ni, Pb, and Se from the first round of sampling is considered to be for screening-level evaluation.

Analysis of the original ICP-MS results for the March 2012 sampling event indicated that the laboratory did not analyze interference check solutions (ICSs) as described in EPA Method 6020A. These ICSs would have enabled the laboratory to evaluate the analytical method’s ability to appropriately handle known potential interferences and other matrix effects. In ICP-MS analysis, the ICS is used to verify that interference levels are corrected by the data system within quality control limits. Because of the importance of this missing quality control check, it was deemed necessary to reject the data from the original analysis. Because samples were within the method holding time, reanalysis was conducted by the EPA Superfund Analytical Services CLP for Al, As, Cd, Cr, Cu, Ni, Pb, Sb, Se, Th, Tl, and uranium (U) by ICP-MS. This additional work was completed under an Addendum to revision 1 of the QAPP. The CLP ICP-MS data were reported for both dissolved and total metals for the metals listed above for the samples collected during the March 2012 sampling event.

A.10. Field QA/QC

A YSI Model 556 electrode and flow-cell assembly was used to measure temperature, specific conductance, pH, oxidation-reduction potential (ORP), and dissolved oxygen. YSI electrodes were calibrated in the morning of each sampling day. Performance checks were conducted after initial calibration, midday and at the end of each day. NIST-traceable buffer solutions (4.00, 7.00 and/or 10.01) were used for pH calibration and for continuing checks. Orion ORP standard was used for calibration of redox potential measurements. Oakton conductivity standard was used for calibration of specific conductance measurements. Dissolved oxygen sensors were calibrated with air and checked with zero-oxygen solutions to ensure good performance at low oxygen levels. Table A27 provides the results of initial, midday and end-of-the-day performance checks. Prior to field deployment, the electrode assembly and meter were checked to confirm good working order. Field performance checks were within acceptance limits (Table A27).

Field parameters for this case study consisted of turbidity, alkalinity, total dissolved sulfide species (ΣH_2S), and ferrous iron. Because field measurements of ferrous iron and dissolved sulfide sometimes required dilution and because all sample preparations and measurements were made in an uncontrolled environment (i.e., the field), concentration data for these parameters are qualified in all cases as estimated. Turbidity was measured using a Hach 2100Q Portable Turbimeter and was calibrated using a Hach 2100Q StablCal Calibration Set. The Hach 2100Q StablCal Calibration Set consists of the 20 nephelometric turbidity unit (NTU), 100 NTU, and 800 NTU standards with a 10 NTU calibration verification standard. For alkalinity measurements, a Hach Model AL-DT Digital Titrator was used. The total dissolved sulfide and ferrous iron measurements were collected using Hach DR2700 and DR890 spectrometers, respectively. The equipment used for measuring alkalinity, total dissolved sulfide species, and ferrous iron was tested in the lab prior to field deployment using known standards. In the field, a blank sample was measured to confirm that no cross contamination occurred. This was also the case for turbidity; however, a 10 NTU standard was also used to verify the calibration.

A.11. Data Qualifiers

Data qualifiers and their definitions are listed in Table A28. Many factors can impact the quality of data reported for environmental samples, including factors related to sample collection in the field, transport of samples to laboratories, and the analyses conducted by various laboratories. The list of qualifiers in Table A28 is based on the Data Qualifier Definitions presented in the EPA CLP National Functional Guidelines for Superfund Organic Methods Data Review (USEPA/540/R-01, 2008), and the EPA CLP National Functional Guidelines for Superfund Inorganic Methods Data Review (USEPA/540/R/10/011, 2010), with the addition of data qualifiers "H" and "B", which are necessary for communicating issues that occur during analysis in laboratories not bound by the CLP statement of work. The "R" qualifier is used in cases where it was determined that data needed to be rejected. Data rejection can occur for many reasons, which must be explained in QA/QC narratives. Conditions regarding the application of qualifiers include:

- If the analyte was not detected, then it was reported as <QL and qualified with U.
- If the analyte concentration was between the MDL and QL, then it was qualified with J.
- If the analyte concentration was <QL, then the B qualifier was not applied.
- If both an analyte and an associated blank concentration were between the MDL and QL, then the sample results were reported as <QL and qualified with U.
- For samples associated with high matrix spike recoveries, the J+ qualifier was not applied if the analyte was <QL.
- For samples associated with low matrix spike recoveries, the J- qualifier was applied to the analyte with low recovery regardless of analyte concentration (< or > QL).

A.12. Tentatively Identified Compounds

The EPA Region 8 Laboratory reported tentatively identified compounds (TICs) from SVOC analyses. Several SVOC TICs were identified in samples and blanks (see Table A29). To be identified as a TIC, a peak had to have an area at least 10% as large as the area of the nearest internal standard and a match quality greater than 80. The TIC match quality is based on the number and ratio of the major fragmentation ions. A perfect match has a value of 99. Although the TIC report is essentially a qualitative report, an estimated concentration was calculated based on a response factor of 1.00 and the area of the nearest internal standard. The search for TICs included the whole chromatogram from approximately 3.0 to 41.0 minutes for SVOCs. TICs are compounds that can be detected, but, without the analysis of standards, cannot be confirmed or reliably quantified. Oftentimes, TICs are representative of a class of compounds rather than indicating a specific compound. Only the top TIC was reported for each peak.

A.13. Audits of Data Quality

An Audit of Data Quality (ADQ) was performed for each sampling event per EPA's NRMRL standard operating procedure (SOP), "Performing Audits of Data Quality (ADQs)," to verify that the requirements of the QAPP were properly implemented for the analysis of critical analytes for samples submitted to laboratories identified in the QAPP associated with this project. The ADQs were performed by a QA support contractor, Neptune and Company, Inc., and reviewed by NRMRL QA staff. NRMRL QA staff provided the ADQ results to the project Principal Investigator for response and assisted in the implementation of corrective actions. The ADQ process is an important element of Category I (highest of four levels in EPA ORD) Quality Assurance Projects, which this study operated under for all aspects of ground water and surface water sample collection and analysis.

Complete data packages were provided to the auditors for the July 2011, March 2012, and May 2013 sampling events. A complete data package consisted of the following: sample information; method information; data summary; laboratory reports; raw data, including QC results; and data qualifiers. The QAPP was used to identify data quality indicator requirements and goals, and a checklist was prepared based on the types of data collected. The data packages were reviewed against the checklist by tracing a representative set of the data in detail from raw data and instrument readouts through data transcription or transference through data manipulation (either manually or electronically by commercial or customized software) and through data reduction to summary data, data calculations, and final reported data. All calibration and QA/QC data were reviewed for all available data packages. Data summary spreadsheets prepared by the Principal Investigator were also reviewed to determine whether data had been accurately transcribed from lab summary reports and appropriately qualified based on lab and field QC results.

The ADQ focused on the critical analytes, as identified in revision 3 of the QAPP. These are GRO; DRO; VOCs including alcohols (naphthalene, acrylonitrile, benzene, toluene, ethylbenzene, xylenes, ethanol, isopropyl alcohol and tert butyl alcohol); trace elements [As, Se, Sr, barium (Ba), and boron (B)]; major cations [Ca, magnesium (Mg), Na, and potassium (K)]; and major anions (chloride, nitrate + nitrite, sulfate). Also included in the ADQ were the glycols and all metals analyzed. The non-conformances identified in an ADQ may consist of the following categories: finding (a deficiency that has or may have a significant effect on the quality of the reported results; a corrective action response is required), or observation (a deficiency that does not have a significant effect on the quality of the reported results; a corrective action response is required). The ADQ for the July 2011 sampling event noted a series of five observations; the March 2012 sampling event had two findings and six observations; the March 2012 CLP ICP-MS metals analysis had two findings and three observations; and, the May 2013 event had eight observations. The ADQ findings and observations that had an impact on data quality and usability are found in Table A26 along with the corrective actions taken and data qualifications. All findings and observations were resolved through corrective actions.

A.14. Laboratory Technical System Audits

Laboratory Technical Systems Audits (TSAs) were conducted early in the project to allow for identification and correction of any issues that may affect data quality. Laboratory TSAs focused on the critical target analytes. Laboratory TSAs were conducted on-site at the ORD/NRMRL Laboratory and Shaw Environmental [both laboratories are located at the Robert S. Kerr Research Center, Ada, OK] and at the EPA Region 8 Laboratory (Golden, CO) which analyzed for SVOCs, DRO and GRO. Detailed checklists, based on the procedures and requirements specified in the QAPP, related SOPs, and EPA Methods, were prepared and used during the TSAs. These audits were conducted with contract support from Neptune and Co., with oversight by NRMRL QA Staff. The QA Manager tracked implementation and completion of any necessary corrective actions. The TSAs took place in July 2011. The TSAs found good QA practices in place at each laboratory. There were no findings and six observations across the three laboratories audited. All observations were resolved through corrective actions. The observations had no impact on the sample data quality.

A.15. Field TSAs

For Category 1 QA projects, TSAs are conducted on both field and laboratory activities. Detailed checklists, based on the procedures and requirements specified in the QAPP, SOPs, and EPA Methods were prepared and used during the TSAs. The field TSA took place during the second sampling event in March 2012 (audit date: March 26, 2012). The sample collection, documentation, field measurements (and calibration), and sample handling were performed according to the QAPP. No findings and two observations were noted in the field TSA related to sample labeling and collection of dissolved gas samples. All observations were resolved through corrective actions. There was no impact on the sample data quality.

Appendix A Tables

Table A1. Sample containers, preservation, and holding times for water samples.

Sample Type	Analysis Method (Lab Method)	Sample Bottles/ # of bottles[1]	Preservation/ Storage	Holding Time(s)	Sampling Rounds[2]
Dissolved gases	Shaw Environmental[3]: No EPA Method (RSKSOP-194v4 &-175v5)	60 mL serum bottles/2	No headspace TSP[4], pH >10; refrigerate ≤6°C[5]	14 days	1, 2, 3
Dissolved Metals (Filtered)	Shaw Environmental: EPA Methods 200.7 & 6020A (RSKSOP-213v4 & -257v2 or -332v0)	125 mL plastic bottle/1	HNO_3, pH<2	6 months (Hg 28 days)	1, 2
Dissolved Metals (Filtered)	EPA Region 7 RASP Contract Southwest Research Institute: EPA Methods 200.7 & 6020A	1 L plastic bottle/1	HNO_3, pH<2	6 months	3
Dissolved Hg (Filtered)	EPA Region 7 RASP Contract Southwest Research Institute: EPA Method 7470A	1 L plastic bottle/1	HNO_3, pH<2	28 days	3
Total Metals (Unfiltered)	Shaw Environmental: Analysis- EPA Methods 200.7 & 6020A (RSKSOP-213v4 & -257v2 or -332v0); and Digestion- EPA Method 3015A (RSKSOP-179v3)	125 mL plastic bottle/1	HNO_3, pH<2	6 months	1, 2
Total Metals (Unfiltered)	EPA Region 7 RASP Contract Southwest Research Institute: EPA Methods 200.7 & 6020A; and Digestion EPA Method 200.7	1 L plastic bottle/1	HNO_3, pH<2	6 months	3
Total Hg (Unfiltered)	EPA Region 7 RASP Contract Southwest Research Institute: EPA Method 7470A; and Digestion EPA Method 200.7	1 L plastic bottle/1	HNO_3, pH<2	28 days	3

Table A1. Sample containers, preservation, and holding times for water samples (cont.).

Sample Type	Analysis Method (Lab Method)	Sample Bottles/ # of bottles[1]	Preservation/ Storage	Holding Time(s)	Sampling Rounds[2]
Trace Metals (Total and Dissolved)	EPA CLP Inorganic Statement of Work (SOW) ISM01.3, Exhibit D – Part B,"Analytical Methods for Inductively Coupled Plasma – Mass Spectrometry", with modifications as noted in QAPP revision 1 addendum	125 mL plastic bottle/1 for each total and dissolved fraction	HNO_3, pH<2	6 months	2
Sulfate (SO_4), Chloride (Cl), Fluoride (F), Bromide (Br)	ORD/NRMRL (Ada): EPA Method 6500 (RSKSOP-276v3)	30 mL plastic bottle/1	Refrigerate ≤6°C	28 days	1, 2, 3
Br	ORD/NRMRL (Ada): No EPA Method (RSKSOP-214v5)	30 mL plastic bottle/1	Refrigerate ≤6°C	28 days	3
Br	ORD/NRMRL (Ada): EPA Method 6500 (RSKSOP-288v3)	30 mL plastic bottle/1	Refrigerate ≤6°C	28 days	3
Nitrate+Nitrite (NO_3+NO_2)	ORD/NRMRL (Ada): EPA Method 353.1 (RSKSOP-214v5)	60 mL plastic bottle/1	H_2SO_4, pH<2; refrigerate ≤6°C	28 days	1, 2, 3
Ammonia (NH_3)	ORD/NRMRL (Ada): EPA Method 350.1 (RSKSOP-214v5)	60 mL plastic bottle/1	H_2SO_4, pH<2; refrigerate ≤6°C	28 days	1, 2, 3
Total Kjeldahl Nitrogen	ORD/NRMRL (Ada): EPA Method 351.2 (RSKSOP-214v5)	60 mL plastic bottle/1	H_2SO_4, pH<2; refrigerate ≤6°C	28 days	3
Dissolved Inorganic Carbon (DIC)	ORD/NRMRL (Ada): EPA Method 9060A (RSKSOP-330v0)	40 mL clear glass VOA vial/2	Refrigerate ≤6°C	14 days	1, 2, 3
Dissolved Organic Carbon (DOC)	ORD/NRMRL (Ada): EPA Method 9060A (RSKSOP-330v0)	40 mL clear glass VOA vial/2	H_3PO_4; refrigerate ≤6°C	28 days	1, 2, 3

Table A1. Sample containers, preservation, and holding times for water samples (cont.).

Sample Type	Analysis Method (Lab Method)	Sample Bottles/ # of bottles[1]	Preservation/ Storage	Holding Time(s)	Sampling Rounds[2]
Volatile Organic Compounds (VOC)	Shaw Environmental: EPA Method 5021A + 8260C (RSKSOP-299v1)	40 mL amber glass VOA vial/2	No headspace TSP[4], pH >10; refrigerate ≤6°C	14 days	1, 2
Volatile Organic Compounds (VOC)	EPA Region 7 RASP Contract Southwest Research Institute: EPA Methods 8260B	40 mL amber glass VOA vial/4	No headspace HCl, pH <2; refrigerate ≤6°C	14 days	3
Low Molecular Weight Acids	Shaw Environmental[3]: No EPA Method (RSKSOP-112v6)	40 mL amber glass VOA vial/2	TSP[4], pH >10; refrigerate ≤6°C	30 days	1, 2, 3
Semi-volatile organic compounds (SVOC)	EPA Region 8: EPA Method 8270D (ORGM-515 r1.1)	1 L amber glass bottle/2	Refrigerate ≤6°C	7 days extraction, 30 days after extraction	1, 2, 3
Diesel Range Organics (DRO)	EPA Region 8: EPA Method 8015D (ORGM-508 r1.0)	1L amber glass bottle/2	HCl, pH<2; refrigerate ≤6°C	7 days extraction, 40 days after extraction	1, 2, 3
Gasoline Range Organics (GRO)	EPA Region 8: EPA Method 8015D (ORGM-506 r1.0)	40 mL amber VOA vial/2	No headspace HCl, pH <2; refrigerate ≤6°C	14 days	1, 2, 3
Glycols	EPA Region 3: No EPA Method (R3 Method[6])	40 mL amber VOA vial/2	Refrigerate ≤6°C	14 days	1, 2, 3
$^{87}Sr/^{86}Sr$ Isotope Analysis	USGS: No EPA Method (Thermal ionization mass spectrometry)	500 mL plastic bottle/2	Refrigerate ≤6°C	6 months	1, 2, 3
^{226}Ra	ALS SOP783v9 (EPA Method 903.1)	1 L plastic/1	HNO_3, pH<2; room temperature	6 months	2, 3
^{228}Ra	ALS SOP746v9 (EPA Method 904.0)	2 L plastic/1	HNO_3, pH<2; room temperature	6 months	2, 3

Table A1. Sample containers, preservation, and holding times for water samples (cont.).

Sample Type	Analysis Method (Lab Method)	Sample Bottles/ # of bottles[1]	Preservation/ Storage	Holding Time(s)	Sampling Rounds[2]
Gross Alpha/Beta	ALS SOP702v20 & 724v11 (EPA Method 900.0)	1 L plastic/1	HNO_3, pH<2; room temperature	6 months	2, 3
O, H stable isotopes of water	Shaw Environmental: No EPA Method (RSKSOP-296v0); IRMS	20 ml glass VOA vial/1	Refrigerate ≤6°C	Stable	1
O, H stable isotopes of water	Shaw Environmental[3]: No EPA Method (RSKSOP-334v0); CRDS	20 ml glass VOA vial/1	Refrigerate ≤6°C	Stable	2, 3
$\delta^{13}C$ of inorganic carbon	Isotech; gas stripping and IRMS (No EPA Method)	60 mL plastic bottle/1	Refrigerate ≤6°C	14 days	1, 2, 3
$\delta^{13}C$ and $\delta^{2}H$ of methane	Isotech; gas stripping and IRMS (No EPA Method)	1 L plastic bottle/1	Caplet of benzalkonium chloride; refrigerate ≤6°C	3 months	1, 2, 3

[1] Spare bottles were made available for laboratory QC samples and for replacement of compromised samples (broken bottle, QC failures, etc.).

[2] Sampling rounds occurred in July 2011 (round 1), March 2012 (round 2), and May 2013 (round 3).

[3] Analyses in round 3 were performed by CB&I (name changed from Shaw).

[4] Trisodium phosphate.

[5] Above freezing point of water.

[6] EPA Methods 8000C and 8321 were followed for method development and QA/QC; method based on ASTM D773-11.

Table A2. Field QC samples for ground water and surface water analysis.

QC Sample	Purpose	Method	Frequency	Acceptance Criteria/ Corrective Actions
Trip Blanks (VOCs and Dissolved Gases only)	Assess contamination during transportation.	Fill bottles with reagent water and preserve, take to field and return without opening.	One in an ice chest with VOA and dissolved gas samples.	<QL Samples were flagged when the analyte concentration was >QL, but <10X the concentration found in the blank.
Equipment Blanks	Assess contamination from field equipment, sampling procedures, decontamination procedures, sample container, preservative, and shipping.	Apply only to samples collected via equipment, such as filtered samples: Reagent water is filtered and collected into bottles and preserved same as filtered samples.	One per day of sampling.	
Field Blanks[1]	Assess contamination introduced from sample container with applicable preservation.	In the field, reagent water is collected into sample containers with preservatives.	One per day of sampling.	
Field Duplicates	Represent precision of field sampling, analysis, and site heterogeneity.	One or more samples collected immediately after original sample.	One in every 10 samples, or if <10 samples collected for a water type (ground or surface), collect a duplicate for one sample.	RPD<30% for results > 5X the QL. Affected data were flagged as needed.
Temperature Blanks	Measure temperature of samples in the cooler.	Water sample that is transported in cooler to lab.	One per cooler.	The temperature was recorded by the receiving lab upon receipt.[2]

[1] Blank samples were not required for isotope ratio measurements, including $^{18}O/^{16}O$, H^2/H, and $^{13}C/^{12}C$. [2]The PI was notified if the samples arrived with no ice and/or if the temperature recorded from the temperature blank was >6°C.

Table A3. DOC, DIC, Ammonia, and Anion Blanks.

Sample ID	Date Collected	DOC	DIC	NO_3 + NO_2	TKN	NH_3	Br	Cl	SO_4^{2}	F
Units		mg/L	mg/L	mg N/L	mg N/L	mg N/L	mg/L	mg/L	mg/L	mg/L
July 2011										
SWPA Field Blk 01	7/25/2011	<0.50	<1.00	<0.10	NA	<0.10	<1.00	<1.00	<1.00	<0.20
SWPA Fld Blk 02	7/26/2011	<0.50	<1.00	<0.10	NA	<0.10	<1.00	<1.00	<1.00	<0.20
SWPA Eq Blk 01	7/27/2011	<0.50	<1.00	0.21	NA	<0.10	<1.00	<1.00	<1.00	<0.20
MDL		0.07	0.02	0.01		0.01	0.14	0.07	0.14	0.04
QL		0.50	1.00	0.10		0.10	1.00	1.00	1.00	0.20
Detections in samples		16/18	18/18	17/18		2/18	14/18	18/18	18/18	17/18
Concentration min		0.54	33.2	0.19		0.18	0.48	1.86	14.4	0.06
Concentration max		1.80	103	17.7		0.27	2.40	631	98.9	1.24
March 2012										
SWPA F Blank01	3/23/2012	<0.50	<1.00	0.28	NA	<0.10	<1.00	<1.00	<1.00	<0.20
SWPA F Blank02	3/24/2012	<0.50	<1.00	0.43	NA	<0.10	<1.00	<1.00	<1.00	<0.20
SWPA F Blank03	3/26/2012	<0.50	<1.00	<0.10	NA	<0.10	<1.00	<1.00	<1.00	<0.20
SWPA Eq Blank01	3/23/2012	0.07	<1.00	0.27	NA	<0.10	<1.00	<1.00	<1.00	<0.20
SWPA Eq Blank02	3/26/2012	<0.50	<1.00	<0.10	NA	<0.10	<1.00	<1.00	<1.00	<0.20
MDL		0.07	0.02	0.01		0.01	0.13	0.11	0.05	0.03
QL		0.50	1.00	0.10		0.10	1.00	1.00	1.00	0.20
Detections in samples		16/17	17/17	17/17		3/17	13/17	17/17	17/17	16/17
Concentration min		0.52	49.2	0.38		0.14	0.44	1.91	4.51	0.03
Concentration max		1.99	119	23		0.27	3.03	462	91.6	2.03

NA, not analyzed.

Table A3. DOC, DIC, Ammonia, and Anion Blanks (cont.).

Sample ID	Date Collected	DOC	DIC	NO_3 + NO_2	TKN	NH_3	Br	Cl	SO_4^2	F
Units		mg/L	mg/L	mg N/L	mg N/L	mg N/L	mg/L	mg/L	mg/L	mg/L
May 2013										
SWPA F Blank01	5/17/2013	<0.25	<1.00	<0.10	0.07	<0.10	<1.00	<1.00	<1.00	<0.20
SWPA F Blank02	5/18/2013	<0.25	<1.00	<0.10	<0.10	<0.10	<1.00	<1.00	<1.00	<0.20
SWPA F Blank03	5/19/2013	<0.25	<1.00	<0.10	<0.10	<0.10	<1.00	<1.00	<1.00	<0.20
SWPA F Blank04	5/20/2013	0.05	<1.00	<0.10	<0.10	<0.10	<1.00	<1.00	<1.00	<0.20
SWPA Eq Blank01	5/17/2013	0.45	<1.00	0.01	0.36	<0.10	<1.00	0.22	<1.00	<0.20
SWPA Eq Blank02	5/18/2013	0.08	<1.00	<0.10	<0.10	<0.10	<1.00	<1.00	<1.00	<0.20
SWPA Eq Blank03	5/19/2013	0.12	<1.00	0.01	<0.10	<0.10	<1.00	<1.00	<1.00	<0.20
SWPA Eq Blank04	5/20/2013	0.56	<1.00	0.01	<0.10	<0.10	<1.00	<1.00	<1.00	<0.20
MDL		0.05	0.09	0.01	0.03	0.02	0.17	0.13	0.16	0.05
QL		0.25	1.00	0.10	0.10	0.10	1.00	1.00	1.00	0.20
Detections in samples		15/15	15/15	15/17	13/17	5/17	10/17	17/17	17/17	14/17
Concentration min		0.39	24.2	0.02	0.05	0.08	0.20	1.93	14.6	0.06
Concentration max		1.85	98.3	1.46	0.51	0.29	2.23	390	52.4	1.15

Table A4. Dissolved Metal Blanks.

Sample ID	Date Collected	Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	Hg
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011														
SWPA Field Blk 01	7/25/2011	<14	<494	<20	<333	<4	<10	<0.29	<4	<4	<7	<20	<67	NA
SWPA Fld Blk 02	7/26/2011	<14	<494	<20	<333	<4	<10	<0.29	<4	<4	<7	<20	<67	NA
SWPA Eq Blk 01	7/27/2011	<14	<494	<20	<333	<4	<10	<0.29	<4	<4	<7	<20	<67	NA
MDL		4	148	6	100	1	3	0.09	1	1	2	6	20	
QL		14	494	20	333	4	10	0.29	4	4	7	20	67	
Detections in samples		3/18	0/18	0/18	1/18	18/18	0/18	18/18	0/18	2/18	0/18	9/18	4/18	
Concentration min		4	<494	<20	256	34	<10	12.4	<4	1	<7	7	23	
Concentration max		5	<494	<20	256	465	<10	351	<4	1	<7	60	1060	
March 2012														
SWPA F Blank01	3/23/2012	<14	<20.0	<1.0	<333	<4	<10	<0.29	<1.0	<4	<2.0	<2.0	<67	NA
SWPA F Blank02	3/24/2012	<14	7.7	<1.0	<333	<4	<10	<0.29	<1.0	<4	<2.0	0.47	<67	NA
SWPA F Blank03	3/26/2012	<14	4.1	<1.0	<333	<4	<10	<0.29	<1.0	<4	<2.0	0.55	<67	NA
SWPA Eq Blank01	3/23/2012	<14	<20.0	<1.0	<333	<4	<10	<0.29	<1.0	<4	<2.0	0.52	<67	NA
SWPA Eq Blank02	3/26/2012	<14	<20.0	<1.0	<333	<4	<10	<0.29	<1.0	<4	<2.0	<2.0	<67	NA
MDL		4	3.7	0.44	100	1	3	0.09	0.22	1	0.43	0.46	20	
QL		14	20.0	1.0	333	4	10	0.29	1.0	4	2.0	2.0	67	
Detections in samples		0/17	3/17	16/17	2/17	17/17	0/17	17/17	1/17	0/17	0/17	6/17	5/17	
Concentration min		<14	15.7	0.51	109	33	<10	6.21	0.31	<4	<2.0	<2.0	26	
Concentration max		<14	28.7	1.4	246	438	<10	298	0.31	<4	<2.0	11.0	2750	

NA, not analyzed.

Table A4. Dissolved Metal Blanks (cont.).

Sample ID	Date Collected	Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	Hg
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
May 2013														
SWPA F Blank01	5/17/2013	<10	<20	<0.20	<40	<5.0	<5.0	<0.10	<0.20	<5.0	<2.0	<0.50	<100	<0.20
SWPA F Blank02	5/18/2013	<10	<20	<0.20	<40	<5.0	<5.0	<0.10	<0.20	<5.0	<2.0	<0.50	<100	<0.20
SWPA F Blank03	5/19/2013	<10	<20	<0.20	<40	<5.0	<5.0	<0.10	<0.20	<5.0	<2.0	<0.50	31	<0.20
SWPA F Blank04	5/20/2013	<10	<20	<0.20	<40	<5.0	<5.0	<0.10	<0.20	<5.0	<2.0	1.6	<100	<0.20
SWPA Eq Blank01	5/17/2013	<10	<20	<0.20	<40	<5.0	<5.0	<0.10	<0.20	<5.0	<2.0	<0.50	<100	<0.20
SWPA Eq Blank02	5/18/2013	<10	21	<0.20	<40	<5.0	<5.0	<0.10	<0.20	<5.0	<2.0	<0.50	<100	<0.20
SWPA Eq Blank03	5/19/2013	<10	<20	<0.20	<40	<5.0	<5.0	<0.10	<0.20	<5.0	<2.0	<0.50	<100	<0.20
SWPA Eq Blank04	5/20/2013	<10	<20	<0.20	<40	<5.0	<5.0	0.14	<0.20	1.3	0.31	2.7	<100	<0.20
MDL		1.4	3.5	0.04	4.2	0.1	0.1	0.009	0.10	1.0	0.30	0.20	14	0.01
QL		10	20	0.2	40	5.0	5.0	0.10	0.20	5.0	2.0	0.50	100	0.20
Detects		2/17	2/17	15/17	13/17	17/17	0/17	17/17	0/17	3/17	5/17	15/17	14/17	0/17
Min		2.2	<20	0.08	11	85	<5.0	17.4	<0.20	1.7	0.32	0.24	27	<0.20
Max		2.9	136	0.84	236	407	<5.0	288	<0.20	2.0	1.3	78.6	888	<0.20

Table A4. Dissolved Metal Blanks (cont.).

Sample ID	Date Collected	K	Li	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Se	Si
Units		mg/L	µg/L	mg/L	µg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	µg/L	µg/L	mg/L
July 2011														
SWPA Field Blk 01	7/25/2011	<0.35	NA	<0.10	<14	<17	<1.71	<84	<0.06	<17	<0.46	R	<30	<0.43
SWPA Fld Blk 02	7/26/2011	<0.35	NA	<0.10	<14	<17	<1.71	<84	<0.06	<17	<0.46	R	<30	<0.43
SWPA Eq Blk 01	7/27/2011	<0.35	NA	<0.10	<14	<17	<1.71	<84	<0.06	<17	<0.46	R	<30	<0.43
MDL		0.11		0.03	4	5	0.51	25	0.02	5	0.14		9	0.13
QL		0.35		0.10	14	17	1.71	84	0.06	17	0.46		30	0.43
Detections in samples		18/18		18/18	8/18	1/18	18/18	0/18	0/18	0/18	18/18		0/18	18/18
Concentration min		0.76		3.85	18	26	4.44	<84	<0.06	<17	5.66		<30	4.58
Concentration max		1.63		27.5	929	26	160	<84	<0.06	<17	31.4		<30	11.2
March 2012														
SWPA F Blank01	3/23/2012	<0.35	NA	<0.10	<14	<17	<1.71	<1.0	<0.06	<1.0	<0.46	<2.0	<5.0	<0.43
SWPA F Blank02	3/24/2012	<0.35	NA	<0.10	<14	<17	<1.71	21.2	<0.06	<1.0	<0.46	<2.0	<5.0	<0.43
SWPA F Blank03	3/26/2012	<0.35	NA	<0.10	<14	<17	<1.71	6.0	<0.06	<1.0	<0.46	<2.0	<5.0	<0.43
SWPA Eq Blank01	3/23/2012	<0.35	NA	<0.10	<14	<17	<1.71	0.29	<0.06	<1.0	<0.46	<2.0	<5.0	<0.43
SWPA Eq Blank02	3/26/2012	<0.35	NA	<0.10	<14	<17	<1.71	<1.0	<0.06	<1.0	<0.46	<2.0	<5.0	<0.43
MDL		0.11		0.03	4	5	0.51	0.22	0.02	0.20	0.14	0.44	1.0	0.13
QL		0.35		0.10	14	17	1.71	1.0	0.06	1.0	0.46	2.0	5.0	0.43
Detections in samples		17/17		17/17	8/17	0/17	17/17	4/17	2/17	4/17	17/17	0/17	3/17	17/17
Concentration min		0.89		4.43	20	<17	3.33	0.63	0.02	0.23	1.53	<2.0	1.8	4.55
Concentration max		1.82		29.4	1060	<17	265	3.0	0.06	0.46	32.0	<2.0	4.2	9.70

NA, not analyzed. R, data rejected due to potential spectral interferences.

Table A4. Dissolved Metal Blanks (cont.).

Sample ID	Date Collected	K	Li	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Se	Si
Units		mg/L	µg/L	mg/L	µg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	µg/L	µg/L	mg/L
May 2013														
SWPA F Blank01	5/17/2013	<0.50	<10	<0.05	<5.0	<0.50	<0.25	<0.20	<0.05	<0.20	NA	<0.20	<2.0	<0.10
SWPA F Blank02	5/18/2013	<0.50	<10	<0.05	<5.0	<0.50	<0.25	<0.20	<0.05	<0.20	NA	<0.20	<2.0	<0.10
SWPA F Blank03	5/19/2013	<0.50	<10	<0.05	<5.0	<0.50	<0.25	<0.20	<0.05	<0.20	NA	<0.20	<2.0	<0.10
SWPA F Blank04	5/20/2013	<0.50	<10	<0.05	<5.0	<0.50	<0.25	<0.20	<0.05	<0.20	NA	<0.20	<2.0	0.03
SWPA Eq Blank01	5/17/2013	<0.50	<10	<0.05	<5.0	<0.50	<0.25	<0.20	<0.05	<0.20	NA	<0.20	<2.0	<0.10
SWPA Eq Blank02	5/18/2013	<0.50	<10	<0.05	<5.0	<0.50	<0.25	<0.20	<0.05	<0.20	NA	<0.20	<2.0	<0.10
SWPA Eq Blank03	5/19/2013	<0.50	<10	<0.05	<5.0	<0.50	<0.25	<0.20	<0.05	<0.20	NA	<0.20	<2.0	<0.10
SWPA Eq Blank04	5/20/2013	<0.50	<10	<0.05	<5.0	<0.50	<0.25	<0.20	<0.05	0.27	NA	<0.20	<2.0	<0.10
MDL		0.046	0.4	0.003	0.2	0.15	0.008	0.20	0.005	0.05		0.10	0.4	0.005
QL		0.50	10	0.05	5.0	0.50	0.25	0.20	0.05	0.20		0.20	2.0	0.10
Detects		17/17	17/17	17/17	17/17	7/17	17/17	17/17	5/17	7/17		3/17	0/17	17/17
Min		0.95	3.7	5.42	0.42	0.52	5.48	0.7	0.01	0.16		0.10	<2.0	3.76
Max		2.12	18.8	29.7	750	6.3	182	10.2	0.06	1.4		0.20	<2.0	9.02

NA, not analyzed.

Table A4. Dissolved Metal Blanks (cont.).

Sample ID	Date Collected	Sr	Th	Ti	Tl	U	V	Zn
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011								
SWPA Field Blk 01	7/25/2011	<4	NA	<7	R	NA	<10	<50
SWPA Fld Blk 02	7/26/2011	<4	NA	<7	R	NA	<10	<50
SWPA Eq Blk 01	7/27/2011	<4	NA	<7	R	NA	<10	<50
MDL		1		2			3	15
QL		4		7			10	50
Detections in samples		18/18		0/18			4/18	15/18
Concentration min		200		<7			3	17
Concentration max		1530		<7			5	245
March 2012								
SWPA F Blank01	3/23/2012	<4	<1.0	<7	<1.0	<1.0	<10	<50
SWPA F Blank02	3/24/2012	<4	<1.0	<7	<1.0	<1.0	<10	<50
SWPA F Blank03	3/26/2012	<4	<1.0	<7	<1.0	<1.0	<10	<50
SWPA Eq Blank01	3/23/2012	<4	<1.0	<7	<1.0	<1.0	<10	<50
SWPA Eq Blank02	3/26/2012	<4	<1.0	<7	<1.0	<1.0	<10	<50
MDL		1	0.29	2	0.20	0.20	3	15
QL		4	1.0	7	1.0	1.0	10	50
Detections in samples		17/17	0/17	0/17	0/17	15/17	0/17	0/17
Concentration min		86	<1.0	<7	<1.0	0.46	<10	<50
Concentration max		1050	<1.0	<7	<1.0	1.6	<10	<50

NA, not analyzed. R, data rejected due to spectral interferences.

Table A4. Dissolved Metal Blanks (cont.).

Sample ID	Date Collected	Sr	Th	Ti	Tl	U	V	Zn
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
May 2013								
SWPA F Blank01	5/17/2013	<2.0	<0.20	<5.0	<0.20	<0.20	<0.20	<5.0
SWPA F Blank02	5/18/2013	<2.0	<0.20	<5.0	<0.20	<0.20	<0.20	<5.0
SWPA F Blank03	5/19/2013	<2.0	<0.20	<5.0	<0.20	<0.20	<0.20	<5.0
SWPA F Blank04	5/20/2013	0.12	<0.20	<5.0	<0.20	<0.20	<0.20	<5.0
SWPA Eq Blank01	5/17/2013	<2.0	<0.20	0.28	<0.20	<0.20	<0.20	<5.0
SWPA Eq Blank02	5/18/2013	0.18	<0.20	<5.0	<0.20	<0.20	<0.20	0.5
SWPA Eq Blank03	5/19/2013	0.18	<0.20	<5.0	<0.20	<0.20	<0.20	1.4
SWPA Eq Blank04	5/20/2013	0.83	<0.20	<5.0	<0.20	<0.20	<0.20	2.4
MDL		0.1	0.10	0.2	0.05	0.05	0.02	0.5
QL		2.0	0.20	5.0	0.20	0.20	0.20	5.0
Detects		17/17	1/17	14/17	0/17	15/17	11/17	5/17
Min		215	0.16	0.25	<0.20	0.08	0.04	3.9
Max		1220	0.16	2.7	<0.20	0.93	0.50	16.6

Table A5. Total Metal Blanks.

Sample ID	Date Collected	Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	Hg
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011														
SWPA Field Blk 01	7/25/2011	<16	<548	<22	<370	<4	<11	<0.32	<4	<4	<8	<22	<74	NA
SWPA Fld Blk 02	7/26/2011	<16	<548	<22	<370	<4	<11	<0.32	<4	<4	<8	<22	<74	NA
SWPA Eq Blk 01	7/27/2011	<16	<548	<22	<370	<4	<11	<0.32	<4	<4	<8	<22	<74	NA
MDL		4	164	7	111	1	3	0.10	1	1	2	7	22	
QL		16	548	22	370	4	11	0.32	4	4	8	22	74	
Detections in samples		0/18	5/18	0/18	1/18	18/18	0/18	18/18	2/18	0/18	3/18	6/18	11/18	
Concentration min		<16	182	<22	247	35	<11	12.9	2	<4	4	27	25	
Concentration max		<16	1030	<22	247	493	<11	352	2	<4	7	70	3040	
March 2012														
SWPA F Blank01	3/23/2012	<16	<20.0	<1.0	<370	<4	<11	<0.32	<1.0	<4	<2.0	0.51	<74	NA
SWPA F Blank02	3/24/2012	<16	17.6	<1.0	<370	<4	<11	<0.32	134	<4	0.50	1.1	<74	NA
SWPA F Blank03	3/26/2012	<16	4.9	<1.0	<370	<4	<11	<0.32	<1.0	<4	<2.0	<2.0	<74	NA
SWPA Eq Blank01	3/23/2012	<16	<20.0	<1.0	<370	<4	<11	<0.32	<1.0	<4	<2.0	<2.0	<74	NA
SWPA Eq Blank02	3/26/2012	<16	<20.0	<1.0	<370	<4	<11	<0.32	<1.0	<4	<2.0	<2.0	<74	NA
MDL		4	3.7	0.44	111	1	3	0.10	0.22	1	0.43	0.46	22	
QL		16	20	1.0	370	4	11	0.32	1.0	4	2.0	2.0	74	
Detections in samples		0/17	6/17	17/17	1/17	17/17	0/17	17/17	0/17	0/17	1/17	11/17	10/17	
Concentration min		<16	21.8	0.44	246	33	<11	6.46	<1.0	<4	0.73	0.63	41	
Concentration max		<16	469	2.3	246	446	<11	309	<1.0	<4	0.73	24.9	3080	

NA, not analyzed.

Table A5. Total Metal Blanks (cont.).

Sample ID	Date Collected	Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	Hg
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
May 2013														
SWPA F Blank01	5/17/2013	<10	<20	<0.20	<20	<2.5	<2.5	<0.05	<0.20	<2.5	<2.0	<0.50	<50	<0.20
SWPA F Blank02	5/18/2013	<10	<20	<0.20	<20	<2.5	<2.5	<0.05	<0.20	<2.5	<2.0	<0.50	22	<0.20
SWPA F Blank03	5/19/2013	<10	<20	<0.20	<20	<2.5	<2.5	<0.05	<0.20	<2.5	<2.0	<0.50	<50	<0.20
SWPA F Blank04	5/20/2013	<10	<20	0.24	<20	<2.5	<2.5	<0.05	<0.20	<2.5	<2.0	1.1	<50	<0.20
SWPA Eq Blank01	5/17/2013	<10	<20	0.30	<20	<2.5	<2.5	<0.05	<0.20	<2.5	<2.0	<0.50	14	<0.20
SWPA Eq Blank02	5/18/2013	<10	<20	0.23	<20	<2.5	<2.5	<0.05	<0.20	<2.5	<2.0	1.0	<50	<0.20
SWPA Eq Blank03	5/19/2013	<10	<20	0.21	<20	<2.5	<2.5	<0.05	<0.20	<2.5	<2.0	0.54	<50	<0.20
SWPA Eq Blank04	5/20/2013	<10	<20	0.23	<20	<2.5	<2.5	<0.05	<0.20	<2.5	<2.0	<0.50	<50	<0.20
MDL		0.6	3.5	0.04	2.1	0.05	0.05	0.004	0.10	0.5	0.3	0.20	7	0.01
QL		10	20	0.2	20	2.5	2.5	0.05	0.20	2.5	2.0	0.50	50	0.20
Detects		2/17	7/17	17/17	16/17	17/17	1/17	17/17	0/17	3/17	1/17	17/17	16/17	2/17
Min		0.8	26.3	0.23	3.1	81	0.21	19.0	<0.20	0.54	15.8	0.59	44	0.01
Max		2.9	2380	5.9	230	675	0.21	274	<0.20	10.8	15.8	74	10200	0.02

Table A5. Total Metal Blanks (cont.).

Sample ID	Date Collected	K	Li	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Se	Si
Units		mg/L	µg/L	mg/L	µg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	µg/L	µg/L	mg/L
July 2011														
SWPA Field Blk 01	7/25/2011	<0.39	NA	<0.11	<16	<19	<1.90	<93	<0.07	<19	<0.51	R	<33	0.16
SWPA Fld Blk 02	7/26/2011	<0.39	NA	<0.11	<16	<19	<1.90	<93	<0.07	<19	<0.51	R	<33	<0.48
SWPA Eq Blk 01	7/27/2011	<0.39	NA	<0.11	5	<19	<1.90	<93	<0.07	<19	<0.51	R	<33	<0.48
MDL		0.12		0.03	4	6	0.57	28	0.02	6	0.15		10	0.14
QL		0.39		0.11	16	19	1.90	93	0.07	19	0.51		33	0.48
Detections in samples		18/18		18/18	8/18	0/18	18/18	0/18	3/18	2/18	18/18		0/18	18/18
Concentration min		0.78		4.03	33.7	<19	4.75	<93	0.03	14	4.78		<33	4.42
Concentration max		1.80		28.1	1580	<19	157	<93	0.04	17	28.8		<33	11.0
March 2012														
SWPA F Blank01	3/23/2012	<0.39	NA	<0.11	<16	<19	<1.90	<1.0	<0.07	<1.0	<0.51	<2.0	<5.0	<0.48
SWPA F Blank02	3/24/2012	<0.39	NA	<0.11	<16	<19	<1.90	1.3	<0.07	0.47	<0.51	<2.0	<5.0	<0.48
SWPA F Blank03	3/26/2012	<0.39	NA	<0.11	<16	<19	<1.90	<1.0	<0.07	<1.0	<0.51	<2.0	<5.0	<0.48
SWPA Eq Blank01	3/23/2012	<0.39	NA	<0.11	<16	<19	<1.90	<1.0	<0.07	<1.0	0.25	<2.0	<5.0	<0.48
SWPA Eq Blank02	3/26/2012	<0.39	NA	<0.11	<16	<19	<1.90	<1.0	<0.07	<1.0	<0.51	<2.0	<5.0	<0.48
MDL		0.12		0.03	4	6	0.57	0.22	0.02	0.20	0.15	0.44	1.0	0.14
QL		0.39		0.11	16	19	1.90	1.0	0.07	1.0	0.51	2.0	5.0	0.48
Detections in samples		17/17		17/17	9/17	0/17	17/17	7/17	3/17	6/17	17/17	0/17	2/17	17/17
Concentration min		0.93		4.40	16	<19	3.60	0.33	0.04	0.21	1.39	<2.0	3.0	4.26
Concentration max		1.93		29.9	2200	<19	265	0.80	0.08	4.3	27.9	<2.0	5.3	9.23

NA, not analyzed. R, data rejected due to potential spectral interferences.

Table A5. Total Metal Blanks (cont.).

Sample ID	Date Collected	K	Li	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Se	Si
Units		mg/L	µg/L	mg/L	µg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	µg/L	µg/L	mg/L
May 2013														
SWPA F Blank01	5/17/2013	<0.25	<5.0	<0.03	<2.5	<0.50	<0.13	<0.20	<0.03	<0.20	NA	<0.20	0.55	<0.05
SWPA F Blank02	5/18/2013	<0.25	<5.0	<0.03	<2.5	<0.50	<0.13	<0.20	<0.03	<0.20	NA	<0.20	<2.0	<0.05
SWPA F Blank03	5/19/2013	<0.25	<5.0	<0.03	<2.5	<0.50	<0.13	<0.20	<0.03	<0.20	NA	<0.20	<2.0	<0.05
SWPA F Blank04	5/20/2013	<0.25	<5.0	<0.03	<2.5	<0.50	0.17	<0.20	<0.03	<0.20	NA	<0.20	0.47	0.05
SWPA Eq Blank01	5/17/2013	<0.25	<5.0	<0.03	<2.5	<0.50	<0.13	<0.20	<0.03	<0.20	NA	<0.20	<2.0	<0.05
SWPA Eq Blank02	5/18/2013	<0.25	<5.0	<0.03	<2.5	<0.50	<0.13	<0.20	<0.03	0.28	NA	<0.20	<2.0	<0.05
SWPA Eq Blank03	5/19/2013	<0.25	<5.0	<0.03	<2.5	<0.50	<0.13	<0.20	<0.03	<0.20	NA	<0.20	<2.0	<0.05
SWPA Eq Blank04	5/20/2013	<0.25	<5.0	<0.03	<2.5	<0.50	<0.13	<0.20	<0.03	<0.20	NA	<0.20	<2.0	<0.05
MDL		0.023	0.2	0.002	0.1	0.15	0.004	0.20	0.002	0.05		0.10	0.4	0.003
QL		0.25	5.0	0.03	2.5	0.50	0.13	0.20	0.03	0.20		0.20	2.0	0.05
Detects		17/17	17/17	17/17	17/17	11/17	17/17	17/17	9/17	11/17		3/17	6/17	17/17
Min		0.90	3.9	5.55	0.42	0.21	5.30	1.1	0.003	0.06		0.14	0.46	3.99
Max		2.40	18.2	28.2	857	6.1	175	17.5	0.22	25.6		0.20	1.10	9.46

NA, not analyzed.

Table A5. Total Metal Blanks (cont.).

Sample ID	Date Collected	Sr	Th	Ti	Tl	U	V	Zn
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011								
SWPA Field Blk 01	7/25/2011	1	NA	<8	R	NA	<11	<56
SWPA Fld Blk 02	7/26/2011	<4	NA	<8	R	NA	<11	<56
SWPA Eq Blk 01	7/27/2011	<4	NA	<8	R	NA	<11	<56
MDL		1		2			3	17
QL		4		8			11	56
Detections in samples		18/18		4/18			7/18	15/18
Concentration min		206		7			4	18
Concentration max		1560		28			5	641
March 2012								
SWPA F Blank01	3/23/2012	<4	<1.0	<8	<1.0	<1.0	<11	<56
SWPA F Blank02	3/24/2012	<4	<1.0	<8	<1.0	<1.0	<11	<56
SWPA F Blank03	3/26/2012	<4	<1.0	<8	<1.0	<1.0	<11	<56
SWPA Eq Blank01	3/23/2012	<4	<1.0	<8	<1.0	<1.0	<11	<56
SWPA Eq Blank02	3/26/2012	<4	<1.0	<8	<1.0	<1.0	<11	<56
MDL		1	0.29	2	0.20	0.20	3	17
QL		4	1.0	8	1.0	1.0	11	56
Detections in samples		17/17	0/17	11/17	0/17	15/17	0/18	1/18
Concentration min		84	<1.0	2	<1.0	0.46	<11	35
Concentration max		1030	<1.0	30	<1.0	2.0	<11	35

NA, not analyzed. R, data rejected due to potential spectral interferences.

Table A5. Total Metal Blanks (cont.).

Sample ID	Date Collected	Sr	Th	Ti	Tl	U	V	Zn
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
May 2013								
SWPA F Blank01	5/17/2013	<25	<0.20	0.16	<0.20	<0.20	0.34	1.3
SWPA F Blank02	5/18/2013	<25	<0.20	<2.5	<0.20	<0.20	0.38	0.34
SWPA F Blank03	5/19/2013	<25	<0.20	<2.5	<0.20	<0.20	0.38	<2.5
SWPA F Blank04	5/20/2013	0.16	<0.20	<2.5	<0.20	<0.20	2.3	0.44
SWPA Eq Blank01	5/17/2013	<25	0.16	<2.5	<0.20	<0.20	0.51	4.0
SWPA Eq Blank02	5/18/2013	0.10	<0.20	<2.5	<0.20	<0.20	0.35	2.8
SWPA Eq Blank03	5/19/2013	<25	<0.20	<2.5	<0.20	<0.20	0.34	3.8
SWPA Eq Blank04	5/20/2013	<25	<0.20	<2.5	<0.20	<0.20	0.54	3.6
MDL		0.1	0.10	0.1	0.05	0.05	0.02	0.3
QL		25	0.20	2.5	0.20	0.20	0.20	2.5
Detects		17/17	2/17	14/17	0/17	16/17	16/17	8/17
Min		220	0.18	0.50	<0.20	0.05	0.22	4.4
Max		1310	1.20	43.3	<0.20	0.92	6.1	39.8

Table A6. Volatile Organic Compound Blanks.

Sample ID	Date Collected	ethanol (64 17 5)	isopropanol (67 63 0)	acrylonitrile (107 13 1)	styrene (100 42 5)	acetone (67 64 1)	tert butyl Alcohol (75 65 0)	methyl tert butyl ether (1634 04 4)	diisopropyl ether (108 20 3)	ethyl tert butyl ether (637 92 3)	tert amyl methyl ether (994 05 8)	vinyl chloride (75 01 4)	1,1 dichloroethene (75 35 4)	carbon disulfide (75 15 0)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011														
SWPA Trip Blank	7/21/2011	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R	<0.5
SWPA Field Blk 01	7/25/2011	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R	<0.5
SWPA Fld Blk 02	7/26/2011	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R	<0.5
SWPA Fld Blk 03	7/27/2011	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R	<0.5
Field Blk 04	7/28/2011	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R	<0.5
SWPA Eq Blk 01	7/27/2011	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R	<0.5
MDL		12.4	6.4	6.8	0.16	0.63	2.8	0.41	0.12	0.17	0.15	0.18		0.07
QL		100	25	25	0.5	1.0	5.0	1.0	1.0	1.0	1.0	0.5		0.5
Detections in samples		0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18		0/18
Concentration min		<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5		<0.5
Concentration max		<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5		<0.5
March 2012														
SWPA F Blank01	3/23/2012	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R	<0.5
SWPA F Blank02	3/24/2012	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R	<0.5
SWPA F Blank03	3/26/2012	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R	<0.5
SWPA Eq Blank01	3/23/2012	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R	<0.5

R, data rejected. 1,1,2-trichloroethane is subject to alkaline hydrolysis to 1,1-dichloroethene. This reaction could be supported by the sample preservative (trisodium phosphate).

Table A6. Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	ethanol (64 17 5)	isopropanol (67 63 0)	acrylonitrile (107 13 1)	styrene (100 42 5)	acetone (67 64 1)	tert butyl Alcohol (75 65 0)	methyl tert butyl ether (1634 04 4)	diisopropyl ether (108 20 3)	ethyl tert butyl ether (637 92 3)	tert amyl methyl ether (994 05 8)	vinyl chloride (75 01 4)	1,1 dichloroethene (75 35 4)	carbon disulfide (75 15 0)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
March 2012 (cont.)														
SWPA Eq Blank02	3/26/2012	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R	<0.5
SWPA Trip Blank01	3/23/2012	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R	<0.5
SWPA Trip Blank02	3/26/2012	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R	<0.5
MDL		12.4	6.4	6.8	0.16	0.63	2.8	0.41	0.12	0.17	0.15	0.18		0.07
QL		100	25	25	0.5	1.0	5.0	1.0	1.0	1.0	1.0	0.5		0.5
Detections in samples		0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17		0/17
Concentration min		<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5		<0.5
Concentration max		<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5		<0.5

R, data rejected. 1,1,2-trichloroethane is subject to alkaline hydrolysis to 1,1-dichloroethene. This reaction could be supported by the sample preservative (trisodium phosphate).

Table A6. Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	ethanol (64 17 5)	isopropanol (67 63 0)	acrylonitrile (107 13 1)	styrene (100 42 5)	acetone (67 64 1)	tert butyl Alcohol (75 65 0)	methyl tert butyl ether (1634 04 4)	diisopropyl ether (108 20 3)	ethyl tert butyl ether (637 92 3)	tert amyl methyl ether (994 05 8)	vinyl chloride (75 01 4)	1,1 dichloroethene (75 35 4)	carbon disulfide (75 15 0)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
May 2013														
SWPA F Blank01	5/17/2013	<100	<10	<1.0	<0.5	<1.0	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA F Blank02	5/18/2013	<100	<10	<1.0	<0.5	<1.0	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA F Blank03	5/19/2013	<100	<10	<1.0	<0.5	<1.0	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA F Blank04	5/20/2013	<100	<10	<1.0	<0.5	<1.0	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Eq Blank01	5/17/2013	<100	<10	<1.0	<0.5	<1.0	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Eq Blank02	5/18/2013	<100	<10	<1.0	<0.5	<1.0	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Eq Blank03	5/19/2013	<100	<10	<1.0	<0.5	<1.0	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Eq Blank04	5/20/2013	<100	<10	<1.0	<0.5	<1.0	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Trip Blank1	5/17/2013	<100	<10	<1.0	<0.5	<1.0	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Trip Blank2	5/18/2013	<100	<10	<1.0	<0.5	<1.0	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Trip Blank3	5/19/2013	<100	<10	<1.0	<0.5	<1.0	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Trip Blank4	5/20/2013	<100	<10	<1.0	<0.5	<1.0	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
MDL		63	7.4	0.07	0.05	0.28	4.9	0.07	0.08	0.11	0.51	0.14	0.09	0.10
QL		100	10	1.0	0.5	1.0	10	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Detections in samples		0/17	0/17	0/17	0/17	3/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17
Concentration min		<100	<10	<1.0	<0.5	0.48	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Concentration max		<100	<10	<1.0	<0.5	1.3	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Table A6. Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	methylene chloride (75 09 2)	trans 1,2 dichloroethene (156 60 5)	1,1 dichloroethane (75 34 3)	cis 1,2 dichoroethene (156 59 2)	chloroform (67 66 3)	1,1,1 trichloroethane (71 55 6)	carbon tetrachloride (56 23 5)	benzene (71 43 2)	1,2 dichloroethane (107 06 2)	trichloroethene (79 01 6)	toluene (108 88 3)	1,1,2 trichloroethane (79 00 5)	tetrachloroethene (127 18 4)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011														
SWPA Trip Blank	7/21/2011	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75	R	<0.5
SWPA Field Blk 01	7/25/2011	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	R	<0.5
SWPA Fld Blk 02	7/26/2011	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.59	R	<0.5
SWPA Fld Blk 03	7/27/2011	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	R	<0.5
Field Blk 04	7/28/2011	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	R	<0.5
SWPA Eq Blk 01	7/27/2011	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	R	<0.5
MDL		0.14	0.11	0.08	0.14	0.07	0.09	0.1	0.07	0.16	0.15	0.1		0.1
QL		1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5
Detections in samples		0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	2/18		0/18
Concentration min		<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.80		<0.5
Concentration max		<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.18		<0.5
March 2012														
SWPA F Blank01	3/23/2012	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	R	<0.5
SWPA F Blank02	3/24/2012	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.43	R	<0.5
SWPA F Blank03	3/26/2012	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	R	<0.5
SWPA Eq Blank01	3/23/2012	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	R	<0.5

R, data rejected. 1,1,2-trichloroethane is subject to alkaline hydrolysis to 1,1-dichloroethene. This reaction could be supported by the sample preservative (trisodium phosphate).

Table A6. Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	methylene chloride (75 09 2)	trans 1,2 dichloroethene (156 60 5)	1,1 dichloroethane (75 34 3)	cis 1,2 dichoroethene (156 59 2)	chloroform (67 66 3)	1,1,1 trichloroethane (71 55 6)	carbon tetrachloride (56 23 5)	benzene (71 43 2)	1,2 dichloroethane (107 06 2)	trichloroethene (79 01 6)	toluene (108 88 3)	1,1,2 trichloroethane (79 00 5)	tetrachloroethene (127 18 4)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
March 2012 (cont.)														
SWPA Eq Blank02	3/26/2012	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	R	<0.5
SWPA Trip Blank01	3/23/2012	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	R	<0.5
SWPA Trip Blank02	3/26/2012	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	R	<0.5
MDL		0.14	0.11	0.08	0.14	0.07	0.09	0.1	0.07	0.16	0.15	0.1		0.1
QL		1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5
Detections in samples		0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17		0/17
Concentration min		<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5
Concentration max		<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5

R, data rejected. 1,1,2-trichloroethane is subject to alkaline hydrolysis to 1,1-dichloroethene. This reaction could be supported by the sample preservative (trisodium phosphate).

Table A6. Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	methylene chloride (75 09 2)	trans 1,2 dichloroethene (156 60 5)	1,1 dichloroethane (75 34 3)	cis 1,2 dichloroethene (156 59 2)	chloroform (67 66 3)	1,1,1 trichloroethane (71 55 6)	carbon tetrachloride (56 23 5)	benzene (71 43 2)	1,2 dichloroethane (107 06 2)	trichloroethene (79 01 6)	toluene (108 88 3)	1,1,2 trichloroethane (79 00 5)	tetrachloroethene (127 18 4)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
May 2013														
SWPA F Blank01	5/17/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA F Blank02	5/18/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA F Blank03	5/19/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA F Blank04	5/20/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Eq Blank01	5/17/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Eq Blank02	5/18/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Eq Blank03	5/19/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Eq Blank04	5/20/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Trip Blank1	5/17/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Trip Blank2	5/18/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Trip Blank3	5/19/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Trip Blank4	5/20/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
MDL		0.10	0.07	0.06	0.10	0.05	0.09	0.09	0.05	0.04	0.12	0.07	0.07	0.13
QL		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Detections in samples		0/17	0/17	0/17	0/17	2/17	0/17	0/17	1/17	0/17	0/17	3/17	0/17	0/17
Concentration min		<0.5	<0.5	<0.5	<0.5	0.15	<0.5	<0.5	0.07	<0.5	<0.5	0.11	<0.5	<0.5
Concentration max		<0.5	<0.5	<0.5	<0.5	0.28	<0.5	<0.5	0.07	<0.5	<0.5	2.2	<0.5	<0.5

Table A6. Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	chlorobenzene (108 90 7)	ethylbenzene (100 41 4)	m+p xylene (108 38 3, 106 42 3)	o xylene (95 47 6)	isopropylbenzene (98 82 8)	1,3,5 trimethylbenzene (108 67 8)	1,2,4 trimethylbenzene (95 63 6)	1,3 dichlorobenzene (541 73 1)	1,4 dichlorobenzene (106 46 7)	1,2,3 trimethylbenzene (526 73 8)	1,2 dichlorobenzene (95 50 1)	naphthalene (91 20 3)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011													
SWPA Trip Blank	7/21/2011	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Field Blk 01	7/25/2011	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Fld Blk 02	7/26/2011	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Fld Blk 03	7/27/2011	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Field Blk 04	7/28/2011	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Eq Blk 01	7/27/2011	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
MDL		0.09	0.07	0.17	0.06	0.06	0.06	0.06	0.1	0.08	0.12	0.13	0.12
QL		0.5	1.0	2.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Detections in samples		0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18
Concentration min		<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Concentration max		<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
March 2012													
SWPA F Blank01	3/23/2012	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA F Blank02	3/24/2012	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA F Blank03	3/26/2012	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Eq Blank01	3/23/2012	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

R, data rejected. 1,1,2-trichloroethane is subject to alkaline hydrolysis to 1,1-dichloroethene. This reaction could be supported by the sample preservative (trisodium phosphate).

Table A6. Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	chlorobenzene (108 90 7)	ethylbenzene (100 41 4)	m+p xylene (108 38 3, 106 42 3)	o xylene (95 47 6)	isopropylbenzene (98 82 8)	1,3,5 trimethylbenzene (108 67 8)	1,2,4 trimethylbenzene (95 63 6)	1,3 dichlorobenzene (541 73 1)	1,4 dichlorobenzene (106 46 7)	1,2,3 trimethylbenzene (526 73 8)	1,2 dichlorobenzene (95 50 1)	naphthalene (91 20 3)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
March 2012 (Cont.)													
SWPA Eq Blank02	3/26/2012	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Trip Blank01	3/23/2012	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Trip Blank02	3/26/2012	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
MDL		0.09	0.07	0.17	0.06	0.06	0.06	0.06	0.1	0.08	0.12	0.13	0.12
QL		0.5	1.0	2.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Detections in samples		0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17
Concentration min		<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Concentration max		<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

R, data rejected. 1,1,2-trichloroethane is subject to alkaline hydrolysis to 1,1-dichloroethene. This reaction could be supported by the sample preservative (trisodium phosphate).

Table A6. Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	chlorobenzene (108 90 7)	ethylbenzene (100 41 4)	m+p xylene (108 38 3, 106 42 3)	o xylene (95 47 6)	isopropylbenzene (98 82 8)	1,3,5 trimethylbenzene (108 67 8)	1,2,4 trimethylbenzene (95 63 6)	1,3 dichlorobenzene (541 73 1)	1,4 dichlorobenzene (106 46 7)	1,2,3 trimethylbenzene (526 73 8)	1,2 dichlorobenzene (95 50 1)	naphthalene (91 20 3)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
May 2013													
SWPA F Blank01	5/17/2013	<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA F Blank02	5/18/2013	<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA F Blank03	5/19/2013	<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA F Blank04	5/20/2013	<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Eq Blank01	5/17/2013	<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Eq Blank02	5/18/2013	<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Eq Blank03	5/19/2013	<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Eq Blank04	5/20/2013	<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Trip Blank1	5/17/2013	<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Trip Blank2	5/18/2013	<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Trip Blank3	5/19/2013	<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPA Trip Blank4	5/20/2013	<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
MDL		0.08	0.06	0.15	0.06	0.07	0.08	0.03	0.09	0.07	0.15	0.05	0.08
QL		0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Detections in samples		0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17
Concentration min		<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Concentration max		<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Table A7. Low Molecular Weight Acid Blanks.

Sample ID	Date Collected	Lactate (50 21 5)	Formate (64 18 6)	Acetate (64 19 7)	Propionate (79 09 4)	Butyrate (107 92 6)	Isobutyrate (79 31 2
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
July 2011							
SWPA Field Blk 01	7/25/2011	<0.10	0.07	R	<0.10	<0.10	<0.10
SWPA Fld Blk 02	7/26/2011	<0.10	0.06	R	<0.10	<0.10	<0.10
SWPA Eq Blk 01	7/27/2011	<0.10	0.07	R	<0.10	<0.10	<0.10
MDL		0.01	0.01		0.02	0.01	0.01
QL		0.10	0.10		0.10	0.10	0.10
Detections in samples		0/18	14/18		0/18	0/18	0/18
Concentration min		<0.10	0.11		<0.10	<0.10	<0.10
Concentration max		<0.10	0.38		<0.10	<0.10	<0.10
March 2012							
SWPA F Blank01	3/23/2012	<0.10	R	<0.10	<0.10	<0.10	<0.10
SWPA F Blank02	3/24/2012	<0.10	R	<0.10	<0.10	<0.10	<0.10
SWPA F Blank03	3/26/2012	<0.10	R	0.05	0.10	<0.10	<0.10
SWPA Eq Blank01	3/23/2012	<0.10	R	<0.10	<0.10	<0.10	<0.10
SWPA Eq Blank02	3/26/2012	<0.10	R	0.06	0.11	<0.10	<0.10
MDL		0.01		0.01	0.02	0.01	0.01
QL		0.10		0.10	0.10	0.10	0.10
Detections in samples		2/17		0/17	1/17	0/17	0/17
Concentration min		0.04		<0.10	0.11	<0.10	<0.10
Concentration max		0.06		<0.10	0.11	<0.10	<0.10
May 2013							
SWPA F Blank01	5/17/2013	<0.10	NR	<0.10	<0.10	<0.10	<0.10
SWPA F Blank02	5/18/2013	<0.10	NR	<0.10	<0.10	<0.10	<0.10
SWPA F Blank03	5/19/2013	<0.10	NR	<0.10	<0.10	<0.10	<0.10
SWPA F Blank04	5/20/2013	<0.10	NR	<0.10	<0.10	<0.10	<0.10
SWPA Eq Blank01	5/17/2013	<0.10	NR	<0.10	<0.10	<0.10	<0.10
SWPA Eq Blank02	5/18/2013	<0.10	NR	<0.10	<0.10	<0.10	<0.10
SWPA Eq Blank03	5/19/2013	<0.10	NR	<0.10	<0.10	<0.10	<0.10
SWPA Eq Blank04	5/20/2013	<0.10	NR	<0.10	<0.10	<0.10	<0.10
MDL		0.02		0.01	0.02	0.02	0.02
QL		0.10		0.10	0.10	0.10	0.10
Detects		0/15		0/15	0/15	0/15	0/15
Min		<0.10		<0.10	<0.10	<0.10	<0.10
Max		<0.10		<0.10	<0.10	<0.10	<0.10

R, data rejected, formate contamination in preservative. NR, not reported.

Table A8. Dissolved Gas Blanks.

Sample ID	Date Collected	Methane (74-82-8)	Ethane (74-84-0)	Propane (74-98-6)	Butane (106-97-8)
Units		mg/L	mg/L	mg/L	mg/L
July 2011					
SWPA Trip Blank	7/21/2011	<0.0015	<0.0029	<0.0041	<0.0055
SWPA Field Blk 01	7/25/2011	<0.0015	<0.0029	<0.0041	<0.0055
SWPA Fld Blk 02	7/26/2011	<0.0015	<0.0029	<0.0041	<0.0055
SWPA Fld Blk 03	7/27/2011	<0.0015	<0.0029	<0.0041	<0.0055
Field Blk 04	7/28/2011	<0.0015	<0.0029	<0.0041	<0.0055
SWPA EqBL	7/27/2011	<0.0015	<0.0029	<0.0041	<0.0055
MDL		0.0002	0.0008	0.0008	0.0010
QL		0.0015	0.0029	0.0041	0.0055
Detections in samples		3/18	1/18	0/18	0/18
Concentration min		0.0276	0.0043	<0.0041	<0.0055
Concentration max		5.56	0.0043	<0.0041	<0.0055
March 2012					
SWPA F Blank01	3/23/2012	<0.0014	<0.0027	<0.0038	<0.0048
SWPA F Blank02	3/24/2012	<0.0014	<0.0027	<0.0038	<0.0048
SWPA F Blank03	3/26/2012	<0.0014	<0.0027	<0.0038	<0.0048
SWPA Eq Blank01	3/23/2012	<0.0014	<0.0027	<0.0038	<0.0048
SWPA Eq Blank02	3/26/2012	<0.0014	<0.0027	<0.0038	<0.0048
SWPA Trip Blank01	3/23/2012	<0.0014	<0.0027	<0.0038	<0.0048
SWPA Trip Blank02	3/26/2012	<0.0014	<0.0027	<0.0038	<0.0048
MDL		0.0003	0.0005	0.0007	0.0007
QL		0.0014	0.0027	0.0038	0.0048
Detections in samples		6/17	1/17	0/17	0/17
Concentration min		0.0016	0.291	<0.0038	<0.0048
Concentration max		15.50	0.291	<0.0038	<0.0048
May 2013					
SWPA F Blank01	5/17/2013	<0.0013	<0.0027	<0.0037	<0.0047
SWPA F Blank02	5/18/2013	<0.0013	<0.0027	<0.0037	<0.0047
SWPA F Blank03	5/19/2013	<0.0013	<0.0027	<0.0037	<0.0047
SWPA F Blank04	5/20/2013	<0.0013	<0.0027	<0.0037	<0.0047
SWPA Eq Blank01	5/17/2013	<0.0013	<0.0027	<0.0037	<0.0047
SWPA Eq Blank02	5/18/2013	<0.0013	<0.0027	<0.0037	<0.0047
SWPA Eq Blank03	5/19/2013	<0.0013	<0.0027	<0.0037	<0.0047
SWPA Eq Blank04	5/20/2013	<0.0013	<0.0027	<0.0037	<0.0047
SWPA Trip Blank1	5/17/2013	<0.0013	<0.0027	<0.0037	<0.0047
SWPA Trip Blank2	5/18/2013	<0.0013	<0.0027	<0.0037	<0.0047
SWPA Trip Blank3	5/19/2013	<0.0013	<0.0027	<0.0037	<0.0047
SWPA Trip Blank4	5/20/2013	<0.0013	<0.0027	<0.0037	<0.0047
MDL		0.0002	0.0008	0.0004	0.0003
QL		0.0013	0.0027	0.0037	0.0047
Detects		1/15	1/15	0/15	0/15
Min		<0.0013	<0.0027	<0.0037	<0.0047
Max		5.35	0.0045	<0.0037	<0.0047

Table A9. Glycol Blanks.

Sample ID	Date Collected	2 butoxyethanol (111 76 2)	Diethylene glycol (111 46 6)	Triethylene glycol (112 27 6)	Tetraethylene glycol (112 60 7)
Units		µg/L	µg/L	µg/L	µg/L
July 2011					
SWPA Fld Blk 01	7/25/2011	<5	<50	<5	<25
SWPA Fld Blk 02	7/26/2011	<5	<50	<5	<25
Field Blk04	7/28/2011	<5	<50	<5	<25
EQ Blk-01	7/27/2011	<5	<50	<5	<25
QL		5	50	5	25
Detections in samples		0/18	0/18	0/18	0/18
Concentration min		<5	<50	<5	<25
Concentration max		<5	<50	<5	<25
March 2012					
SWPA F Blank01	3/23/2012	<10	<25	<25	<50
SWPA F Blank02	3/24/2012	<10	<25	<25	<50
SWPA F Blank03	3/26/2012	<10	<25	<25	<50
SWPA Eq Blank01	3/23/2012	<10	<25	<25	<50
SWPA Eq Blank02	3/26/2012	<10	<25	<25	<50
QL		10	25	25	50
Detections in samples		0/17	0/17	0/17	0/17
Concentration min		<10	<25	<25	<50
Concentration max		<10	<25	<25	<50
May 2013					
SWPA F Blank01	5/17/2013	<10	<10	<10	<10
SWPA F Blank02	5/18/2013	<10	<10	<10	<10
SWPA F Blank03	5/19/2013	<10	<10	<10	<10
SWPA F Blank04	5/20/2013	<10	<10	<10	<10
SWPA Eq Blank01	5/17/2013	<10	<10	<10	<10
SWPA Eq Blank02	5/18/2013	<10	<10	<10	<10
SWPA Eq Blank03	5/19/2013	<10	<10	<10	<10
SWPA Eq Blank04	5/20/2013	<10	<10	<10	<10
QL		10	10	10	10
Detects		0/15	0/15	0/15	0/15
Min		<10	<10	<10	<10
Max		<10	<10	<10	<10

Table A10. Semi-Volatile Organic Compound Blanks.

Sample ID	Date Collected	R (+) limonene (5989 27 5)	1,2,4 trichlorobenzene (120 82 1)	1,2 dichlorobenzene (95 50 1)	1,2 dinitrobenzene (528 29 0)	1,3 dichlorobenzene (541 73 1)	1,3 dimethyladamantane (702 79 4)	1,3 dinitrobenzene (99 65 0)	1,4 dichlorobenzene (106 46 7)	1,4 dinitrobenzene (100 25 4)	1 methylnaphthalene (90 12 0)	2,3,4,6 tetrachlorophenol (58 90 2)	2,3,5,6 tetrachlorophenol (935 95 5)	2,4,5 trichlorophenol (95 95 4)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011														
SWPA Field Blank	7/25/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
SWPA FLD BLk 02	7/26/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
SWPA Eq BLk-01	7/27/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
QL		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Detections in samples		0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18
Concentration min		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Concentration max		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
March 2012														
SWPA F Blank01	3/23/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00
SWPA F Blank02	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00
SWPA F Blank03	3/26/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00
SWPA Eq Blank01	3/23/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00
SWPA Eq Blank02	3/26/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00
QL		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00
Detections in samples		0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17
Concentration min		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00
Concentration max		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00

Table A10. Semi-Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	R (+) limonene (5989 27 5)	1,2,4 trichlorobenzene (120 82 1)	1,2 dichlorobenzene (95 50 1)	1,2 dinitrobenzene (528 29 0)	1,3 dichlorobenzene (541 73 1)	1,3 dimethyladamantane (702 79 4)	1,3 dinitrobenzene (99 65 0)	1,4 dichlorobenzene (106 46 7)	1,4 dinitrobenzene (100 25 4)	1 methylnaphthalene (90 12 0)	2,3,4,6 tetrachlorophenol (58 90 2)	2,3,5,6 tetrachlorophenol (935 95 5)	2,4,5 trichlorophenol (95 95 4)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
May 2013														
SWPA F Blank01	5/17/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00
SWPA F Blank02	5/18/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00
SWPA F Blank03	5/19/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00
SWPA F Blank04	5/20/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00
SWPA Eq Blank01	5/17/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00
SWPA Eq Blank02	5/18/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00
SWPA Eq Blank03	5/19/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00
SWPA Eq Blank04	5/20/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00
QL		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00
Detects		0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15
Min		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00
Max		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<2.00

Table A10. Semi-Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	2,4,6 trichlorophenol (88 06 2)	2,4 dichlorophenol (120 83 2)	2,4 dimethylphenol (105 67 9)	2,4 dinitrophenol (51 28 5)	2,4dinitrotoluene (121 14 2)	2,6 dinitrotoluene (606 20 2)	2 butoxyethanol (111 76 2)	2 chloronaphthalene (91 58 7)	2 chlorophenol (95 57 8)	2 methylnaphthalene (91 57 6)	2 methylphenol (95 48 7)	2 nitroaniline (88 74 4)	2 nitrophenol (88 75 5)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011														
SWPA Field Blank	7/25/2011	<0.50	<0.50	<0.50	<5.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
SWPA FLD BLk 02	7/26/2011	<0.50	<0.50	<0.50	<5.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
SWPA Eq BLk-01	7/27/2011	<0.50	<0.50	<0.50	<5.00	<0.50	<0.50	3.61	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
QL		0.50	0.50	0.50	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Detections in samples		0/18	0/18	0/18	0/18	0/18	0/18	9/18	0/18	0/18	0/18	0/18	0/18	0/18
Concentration min		<0.50	<0.50	<0.50	<5.00	<0.50	<0.50	0.54	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Concentration max		<0.50	<0.50	<0.50	<5.00	<0.50	<0.50	2.92	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
March 2012														
SWPA F Blank01	3/23/2012	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00
SWPA F Blank02	3/24/2012	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00
SWPA F Blank03	3/26/2012	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00
SWPA Eq Blank01	3/23/2012	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00
SWPA Eq Blank02	3/26/2012	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00
QL		2.00	2.00	2.00	3.00	1.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	2.00
Detections in samples		0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17
Concentration min		<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00
Concentration max		<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00

Table A10. Semi-Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	2,4,6 trichlorophenol (88 06 2)	2,4 dichlorophenol (120 83 2)	2,4 dimethylphenol (105 67 9)	2,4 dinitrophenol (51 28 5)	2,4dinitrotoluene (121 14 2)	2,6 dinitrotoluene (606 20 2)	2 butoxyethanol (111 76 2)	2 chloronaphthalene (91 58 7)	2 chlorophenol (95 57 8)	2 methylnaphthalene (91 57 6)	2 methylphenol (95 48 7)	2 nitroaniline (88 74 4)	2 nitrophenol (88 75 5)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
May 2013														
SWPA F Blank01	5/17/2013	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00
SWPA F Blank02	5/18/2013	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00
SWPA F Blank03	5/19/2013	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00
SWPA F Blank04	5/20/2013	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00
SWPA Eq Blank01	5/17/2013	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00
SWPA Eq Blank02	5/18/2013	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00
SWPA Eq Blank03	5/19/2013	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00
SWPA Eq Blank04	5/20/2013	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00
QL		2.00	2.00	2.00	3.00	1.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	2.00
Detects		0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15
Min		<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00
Max		<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<2.00

Table A10. Semi-Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	3&4 methylphenol (108 39 4 &106 44 5)	3,3' dichlorobenzidine (91 94 1)	3 nitroaniline (99 09 2)	4,6 dinitro 2 methylphenol (534 52 1)	4 bromophenyl phenyl ether (101 55 3)	4 chloro 3 methylphenol (59 50 7)	4 chloroaniline (106 47 8)	4 chlorophenyl phenyl ether (7005 72 3)	4 nitroaniline (100 01 6)	4 nitrophenol (100 02 7)	Acenaphthene (83 32 9)	Acenaphthylene (208 96 8)	Adamantane (281 23 2)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011														
SWPA Field Blank	7/25/2011	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<2.50	<0.50	<0.50	<0.50
SWPA FLD BLk 02	7/26/2011	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<2.50	<0.50	<0.50	<0.50
SWPA Eq BLk-01	7/27/2011	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<2.50	<0.50	<0.50	<0.50
QL		0.50	1.00	0.50	0.50	0.50	0.50	1.00	0.50	0.50	2.50	0.50	0.50	0.50
Detections in samples		0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18
Concentration min		<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<2.50	<0.50	<0.50	<0.50
Concentration max		<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<2.50	<0.50	<0.50	<0.50
March 2012														
SWPA F Blank01	3/23/2012	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00
SWPA F Blank02	3/24/2012	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00
SWPA F Blank03	3/26/2012	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00
SWPA Eq Blank01	3/23/2012	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00
SWPA Eq Blank02	3/26/2012	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00
QL		5.00	1.00	3.00	2.00	1.00	2.00	3.00	1.00	3.00	3.00	1.00	1.00	1.00
Detections in samples		0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17
Concentration min		<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00
Concentration max		<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00

Table A10. Semi-Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	3&4 methylphenol (108 39 4 & 106 44 5)	3,3' dichlorobenzidine (91 94 1)	3 nitroaniline (99 09 2)	4,6 dinitro 2 methylphenol (534 52 1)	4 bromophenyl phenyl ether (101 55 3)	4 chloro 3 methylphenol (59 50 7)	4 chloroaniline (106 47 8)	4 chlorophenyl phenyl ether (7005 72 3)	4 nitroaniline (100 01 6)	4 nitrophenol (100 02 7)	Acenaphthene (83 32 9)	Acenaphthylene (208 96 8)	Adamantane (281 23 2)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
May 2013														
SWPA F Blank01	5/17/2013	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00
SWPA F Blank02	5/18/2013	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00
SWPA F Blank03	5/19/2013	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00
SWPA F Blank04	5/20/2013	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00
SWPA Eq Blank01	5/17/2013	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00
SWPA Eq Blank02	5/18/2013	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00
SWPA Eq Blank03	5/19/2013	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00
SWPA Eq Blank04	5/20/2013	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00
QL		5.00	1.00	3.00	2.00	1.00	2.00	3.00	1.00	3.00	3.00	1.00	1.00	1.00
Detects		0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15
Min		<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00
Max		<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00	<1.00	<1.00	<1.00

Table A10. Semi-Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	Aniline (62 53 3)	Anthracene (120 12 7)	Azobenzene (103 33 3)	Benzo(a)anthracene (56 55 3)	Benzo(a)pyrene (50 32 3)	Benzo(b)fluoranthene (205 99 2)	Benzo(g,h,i)perylene (191 24 2)	Benzo(k)fluoranthene (207 08 9)	Benzoic Acid (65 85 0)	Benzyl alcohol (100 51 6)	Bis (2 chloroethoxy)methane (111 91 1)	Bis (2 chloroethyl)ether (111 44 4)	Bis (2 chloroisopropyl)ether (108 60 1)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011														
SWPA Field Blank	7/25/2011	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.00	<0.50	<0.50	<0.50	<0.50
SWPA FLD BLk 02	7/26/2011	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.00	<0.50	<0.50	<0.50	<0.50
SWPA Eq BLk-01	7/27/2011	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.00	<0.50	<0.50	<0.50	<0.50
QL		1.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	5.00	0.50	0.50	0.50	0.50
Detections in samples		0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18
Concentration min		<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.00	<0.50	<0.50	<0.50	<0.50
Concentration max		<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.00	<0.50	<0.50	<0.50	<0.50
March 2012														
SWPA F Blank01	3/23/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
SWPA F Blank02	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
SWPA F Blank03	3/26/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
SWPA Eq Blank01	3/23/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
SWPA Eq Blank02	3/26/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
QL		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.00	1.00	1.00	1.00	1.00
Detections in samples		0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17
Concentration min		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
Concentration max		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00

Table A10. Semi-Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	Aniline (62 53 3)	Anthracene (120 12 7)	Azobenzene (103 33 3)	Benzo(a)anthracene (56 55 3)	Benzo(a)pyrene (50 32 3)	Benzo(b)fluoranthene (205 99 2)	Benzo(g,h,i)perylene (191 24 2)	Benzo(k)fluoranthene (207 08 9)	Benzoic Acid (65 85 0)	Benzyl alcohol (100 51 6)	Bis (2 chloroethoxy)methane (111 91 1)	Bis (2 chloroethyl)ether (111 44 4)	Bis (2 chloroisopropyl)ether (108 60 1)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
May 2013														
SWPA F Blank01	5/17/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
SWPA F Blank02	5/18/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
SWPA F Blank03	5/19/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
SWPA F Blank04	5/20/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
SWPA Eq Blank01	5/17/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
SWPA Eq Blank02	5/18/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
SWPA Eq Blank03	5/19/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
SWPA Eq Blank04	5/20/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
QL		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.00	1.00	1.00	1.00	1.00
Detects		0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15
Min		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
Max		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00

Table A10. Semi-Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	Bis (2 ethylhexyl) adipate (103 23 1)	Bis (2 ethylhexyl) phthalate (117 81 7)	Butyl benzyl phthalate (85 68 7)	Carbazole (86 74 8)	Chrysene (218 01 9)	Dibenz(a,h)anthracene (53 70 3)	Dibenzofuran (132 64 9)	Diethyl phthalate (84 66 2)	Dimethyl phthalate (131 11 3)	Di n butyl phthalate (84 74 2)	Di n octyl phthalate (117 84 0)	Diphenylamine (122 39 4)	Fluoranthene (206 44 0)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011														
SWPA Field Blank	7/25/2011	<1.00	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
SWPA FLD BLk 02	7/26/2011	<1.00	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
SWPA Eq BLk-01	7/27/2011	<1.00	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.60	<0.50	<0.50	<0.50
QL		1.00	1.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Detections in samples		0/18	4/18	2/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18
Concentration min		<1.00	1.06	1.40	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Concentration max		<1.00	2.17	2.16	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
March 2012														
SWPA F Blank01	3/23/2012	<1.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPA F Blank02	3/24/2012	<1.00	2.88	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPA F Blank03	3/26/2012	<1.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPA Eq Blank01	3/23/2012	<1.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPA Eq Blank02	3/26/2012	<1.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
QL		1.00	2.00	2.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Detections in samples		0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	1/17	0/17	0/17
Concentration min		<1.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.13	<1.00	<1.00
Concentration max		<1.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.13	<1.00	<1.00

Table A10. Semi-Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	Bis (2 ethylhexyl) adipate (103 23 1)	Bis (2 ethylhexyl) phthalate (117 81 7)	Butyl benzyl phthalate (85 68 7)	Carbazole (86 74 8)	Chrysene (218 01 9)	Dibenz(a,h)anthracene (53 70 3)	Dibenzofuran (132 64 9)	Diethyl phthalate (84 66 2)	Dimethyl phthalate (131 11 3)	Di n butyl phthalate (84 74 2)	Di n octyl phthalate (117 84 0)	Diphenylamine (122 39 4)	Fluoranthene (206 44 0)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
May 2013														
SWPA F Blank01	5/17/2013	<1.00	<2.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPA F Blank02	5/18/2013	<1.00	8.80	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPA F Blank03	5/19/2013	<1.00	<2.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPA F Blank04	5/20/2013	<1.00	<2.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPA Eq Blank01	5/17/2013	<1.00	<2.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPA Eq Blank02	5/18/2013	<1.00	<2.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPA Eq Blank03	5/19/2013	<1.00	<2.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPA Eq Blank04	5/20/2013	<1.00	<2.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
QL		1.00	2.00	1.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Detects		0/15	1/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15
Min		<1.00	4.34	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Max		<1.00	4.34	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00

Table A10. Semi-Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	Fluorene (86 73 7)	Hexachlorobenzene (118 74 1)	Hexachlorobutadiene (87 68 3)	Hexachlorocyclopentadiene (77 47 4)	Hexachloroethane (67 72 1)	Indeno(1,2,3 cd)pyrene (193 39 5)	Isophorone (78 59 1)	Naphthalene (91 20 3)	Nitrobenzene (98 95 3)	N nitrosodimethylamine (62 75 9)	N nitrosodi n propylamine (621 64 7)	Pentachlorophenol (87 86 5)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011													
SWPA Field Blank	7/25/2011	<0.50	<0.50	<1.00	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.00
SWPA FLD BLk 02	7/26/2011	<0.50	<0.50	<1.00	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.00
SWPA Eq BLk-01	7/27/2011	<0.50	<0.50	<1.00	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.00
QL		0.50	0.50	1.00	0.50	1.00	0.50	0.50	0.50	0.50	0.50	0.50	1.00
Detections in samples		0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18	0/18
Concentration min		<0.50	<0.50	<1.00	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.00
Concentration max		<0.50	<0.50	<1.00	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.00
March 2012													
SWPA F Blank01	3/23/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPA F Blank02	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPA F Blank03	3/26/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPA Eq Blank01	3/23/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPA Eq Blank02	3/26/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
QL		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Detections in samples		0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17
Concentration min		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Concentration max		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00

Table A10. Semi-Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	Fluorene (86 73 7)	Hexachlorobenzene (118 74 1)	Hexachlorobutadiene (87 68 3)	Hexachlorocyclopentadiene (77 47 4)	Hexachloroethane (67 72 1)	Indeno(1,2,3 cd)pyrene (193 39 5)	Isophorone (78 59 1)	Naphthalene (91 20 3)	Nitrobenzene (98 95 3)	N nitrosodimethylamine (62 75 9)	N nitrosodi n propylamine (621 64 7)	Pentachlorophenol (87 86 5)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
May 2013													
SWPA F Blank01	5/17/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00
SWPA F Blank02	5/18/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00
SWPA F Blank03	5/19/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00
SWPA F Blank04	5/20/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00
SWPA Eq Blank01	5/17/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00
SWPA Eq Blank02	5/18/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00
SWPA Eq Blank03	5/19/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00
SWPA Eq Blank04	5/20/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00
QL		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00
Detects		0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15	0/15
Min		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00
Max		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00

Table A10. Semi-Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	Phenanthrene (85 01 8)	Phenol (108 95 2)	Pyrene (129 00 0)	Pyridine (110 86 1)	Squalene (111 02 4)	Terpiniol (98 55 5)	tri (2 butoxyethyl) phosphate (78 51 3)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011								
SWPA Field Blank	7/25/2011	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<1.00
SWPA FLD BLk 02	7/26/2011	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<1.00
SWPA Eq BLk-01	7/27/2011	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<1.00
QL		0.50	0.50	0.50	0.50	1.00	0.50	1.00
Detections in samples		0/18	2/18	0/18	0/18	0/18	0/18	0/18
Concentration min		<0.50	1.31	<0.50	<0.50	<1.00	<0.50	<1.00
Concentration max		<0.50	1.39	<0.50	<0.50	<1.00	<0.50	<1.00
March 2012								
SWPA F Blank01	3/23/2012	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
SWPA F Blank02	3/24/2012	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
SWPA F Blank03	3/26/2012	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
SWPA Eq Blank01	3/23/2012	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
SWPA Eq Blank02	3/26/2012	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
QL		1.00	2.00	1.00	1.00	2.00	1.00	1.00
Detections in samples		0/17	0/17	0/17	0/17	0/17	0/17	0/17
Concentration min		<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
Concentration max		<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00

Table A10. Semi-Volatile Organic Compound Blanks (cont.).

Sample ID	Date Collected	Phenanthrene (85 01 8)	Phenol (108 95 2)	Pyrene (129 00 0)	Pyridine (110 86 1)	Squalene (111 02 4)	Terpiniol (98 55 5)	tri (2 butoxyethyl) phosphate (78 51 3)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
May 2013								
SWPA F Blank01	5/17/2013	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
SWPA F Blank02	5/18/2013	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
SWPA F Blank03	5/19/2013	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
SWPA F Blank04	5/20/2013	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
SWPA Eq Blank01	5/17/2013	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
SWPA Eq Blank02	5/18/2013	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
SWPA Eq Blank03	5/19/2013	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
SWPA Eq Blank04	5/20/2013	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
QL		1.00	2.00	1.00	1.00	2.00	1.00	1.00
Detects		0/15	0/15	0/15	0/15	0/15	0/15	0/15
Min		<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
Max		<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00

Table A11. DRO/GRO Blanks.

Sample ID	Date Collected	GRO/TPH	DRO
Units		µg/L	µg/L
July 2011			
SWPA Field Blank	7/25/2011	27.0	<20.0
SWPA FLD BLk 02	7/26/2011	25.7	<21.1
SWPA Eq BLk-01	7/27/2011	24.4	<21.1
QL		20.0	20.0
Detections in samples		1/18	9/18
Concentration min		<20.0	<20.0
Concentration max		25.4	73.8
March 2012			
SWPA F Blank01	3/23/2012	<20.0	<20.0
SWPA F Blank02	3/24/2012	<20.0	<20.0
SWPA F Blank03	3/26/2012	20.0	<20.0
SWPA Eq Blank01	3/23/2012	24.2	20.0
SWPA Eq Blank02	3/26/2012	27.4	<20.0
QL		20.0	20.0
Detections in samples		0/17	8/17
Concentration min		<20.0	<20.0
Concentration max		<20.0	87.9
May 2013			
SWPA F Blank01	5/17/2013	<20.0	<20.0
SWPA F Blank02	5/18/2013	<20.0	<20.0
SWPA F Blank03	5/19/2013	<20.0	<20.0
SWPA F Blank04	5/20/2013	<20.0	<20.0
SWPA Eq Blank01	5/17/2013	<20.0	<20.0
SWPA Eq Blank02	5/18/2013	<20.0	<20.0
SWPA Eq Blank03	5/19/2013	<20.0	<20.0
SWPA Eq Blank04	5/20/2013	<20.0	24.6
QL		20.0	20.0
Detects		0/15	2/15
Min		<20.0	<20.0
Max		<20.0	51.2

Table A12. Gross Alpha, Gross Beta, Ra-226, and Ra-228 Blanks.

Sample ID	Date Collected	Gross Alpha	Gross Beta	Ra 226	Ra 228
Units		pCi/L	pCi/L	pCi/L	pCi/L
March 2012					
SWPA F Blank01	3/23/2012	<3.0	<4.0	<1.0	<1.0
SWPA F Blank02	3/24/2012	<3.0	<4.0	<1.0	<1.0
SWPA F Blank03	3/26/2012	<3.0	<4.0	<1.0	<1.0
SWPA Eq Blank01	3/23/2012	<3.0	<4.0	<1.0	<1.0
SWPA Eq Blank02	3/26/2012	<3.0	<4.0	<1.0	<1.0
RL		3.0	4.0	1.0	1.0
Detections in samples		0/17	0/17	0/17	0/17
Concentration min		<3.0	<4.0	<1.0	<1.0
Concentration max		<3.0	<4.0	<1.0	<1.0
May2013					
SWPA F Blank01	5/17/2013	<3.0	<4.0	<1.0	<1.0
SWPA F Blank02	5/18/2013	<3.0	<4.0	<1.0	<1.0
SWPA F Blank03	5/19/2013	<3.0	<4.0	<1.0	<1.0
SWPA F Blank04	5/20/2013	<3.0	<4.0	<1.0	<1.0
SWPA Eq Blank01	5/17/2013	<3.0	<4.0	<1.0	<1.0
SWPA Eq Blank02	5/18/2013	<3.0	<4.0	<1.0	<1.0
SWPA Eq Blank03	5/19/2013	<3.0	<4.0	<1.0	<1.0
SWPA Eq Blank04	5/20/2013	<3.0	<4.0	<1.0	<1.0
QL		3.0	4.0	1.0	1.0
Detects		1/15	1/15	0/15	0/15
Min		6.3	10.3	<1.0	<1.0
Max		6.3	10.3	<1.0	<1.0

Samples for gross alpha, gross beta, Ra-226, and Ra-228 were not collected during the July 2011 sampling event.

Table A13. DOC, DIC, Ammonia, and Anion Duplicates.

Sample ID	Date Collected	DOC	DIC	NO_3 + NO_2	NH_3	Br	Cl	SO_4^{2}	F	TKN
Units		mg/L	mg/L	mg N/L	mg N/L	mg/L	mg/L	mg/L	mg/L	mg/L
July 2011										
5× QL		2.50	5.0	0.50	0.50	5.00	5.00	5.00	1.00	
SWPAGW05-0711	7/26/2011	0.80	103	0.49	<0.10	1.00	75.7	53.9	0.11	NA
SWPAGW05d-0711	7/26/2011	0.86	102	0.50	<0.10	1.00	75.7	53.8	0.11	NA
RPD (%)		NC	1.0	NC	NC	NC	0.0	0.2	NC	NC
SWPAGW12-0711	7/28/2011	0.83	70.2	4.54	<0.10	1.99	28.7	56.2	0.09	NA
SWPAGW12d-0711	7/28/2011	0.84	70.2	4.53	<0.10	1.94	28.6	55.6	0.07	NA
RPD (%)		NC	0.0	0.2	NC	NC	0.3	1.1	NC	NC
March 2012										
5× QL		2.50	5.00	0.50	0.50	5.00	5.00	5.00	1.00	
SWPAGW08-0312	3/24/2012	0.55	55.6	2.26	<0.10	0.72	12.7	36.0	0.09	NA
SWPAGW08d-0312	3/24/2012	0.54	55.4	2.24	<0.10	0.71	12.6	36.2	0.09	NA
RPD (%)		NC	0.4	0.9	NC	NC	0.8	0.6	NC	NC
SWPAGW13-0312	3/24/2012	0.52	55.6	1.21	<0.10	<1.00	462	27.3	0.05	NA
SWPAGW13d-0312	3/24/2012	0.54	55.7	1.10	<0.10	<1.00	455	26.2	0.07	NA
RPD (%)		NC	0.2	9.5	NC	NC	1.5	4.1	NC	NC
May 2013										
5x QL		1.25	5.00	0.50	0.50	5.00	5.00	5.00	1.00	0.15
SWPAGW02-0513	5/18/2013	0.69	60.7	0.05	<0.10	1.54	14.8	38.4	0.17	<0.10
SWPAGW02d-0513	5/18/2013	0.66	60.4	0.05	<0.10	1.55	14.7	38.2	0.14	<0.10
RPD (%)		NC	0.5	NC	NC	NC	0.7	0.5	NC	NC
SWPAGW07-0513	5/19/2013	0.62	24.2	1.09	<0.10	<1.00	111	35.1	<0.20	0.09
SWPAGW07d-0513	5/19/2013	0.63	25.1	1.10	<0.10	<1.00	112	34.9	<0.20	0.10
RPD (%)		NC	3.7	0.9	NC	NC	0.9	0.6	NC	NC

NA, not analyzed. NC, not calculated.

Table A14. Dissolved Metal Duplicates.

Sample ID	Date Collected	Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011													
5× QL		70	2470	100	1665	20	50	1.5	20	20	35	100	335
SWPAGW05-0711	7/26/2011	4	<494	<20	<333	175	<10	125	<4	<4	<7	11	<67
SWPAGW05d-0711	7/26/2011	<14	<494	<20	<333	175	<10	126	<4	1	<7	9	<67
RPD (%)		NC	NC	NC	NC	0.0	NC	0.8	NC	NC	NC	NC	NC
SWPAGW12-0711	7/28/2011	<14	<494	<20	<333	37	<10	103	<4	<4	<7	21	<67
SWPAGW12d-0711	7/28/2011	<14	<494	<20	<333	37	<10	102	<4	<4	<7	20	<67
RPD (%)		NC	NC	NC	NC	0.0	NC	1.0	NC	NC	NC	NC	NC
March 2012													
5× QL		70	100	5	1665	20	50	1.5	5	20	10	10	335
SWPAGW08-0312	3/24/2012	<14	28.1	0.69	<333	129	<10	91.3	<1.0	<4	<2.0	3.6	<67
SWPAGW08d-0312	3/24/2012	<14	<20.0	0.60	<333	129	<10	89.2	<1.0	<4	<2.0	3.5	<67
RPD (%)		NC	NC	NC	NC	0.0	NC	2.3	NC	NC	NC	NC	NC
SWPAGW13-0312	3/24/2012	<14	<20.0	1.0	<333	223	<10	295	<1.0	<4	<2.0	<2.0	<67
SWPAGW13d-0312	3/24/2012	<14	<20.0	1.4	<333	223	<10	298	<1.0	<4	<2.0	<2.0	<67
RPD (%)		NC	NC	NC	NC	0.0	NC	1.0	NC	NC	NC	NC	NC
May 2013													
5x QL		50	100	1.0	200	25	25	0.5	1.0	25	10	2.5	500
SWPAGW02-0513	5/18/2013	<10	<20	0.17	11	97	<5.0	75.8	<0.20	<5.0	0.32	0.57	122
SWPAGW02d-0513	5/18/2013	<10	<20	0.18	24	99	<5.0	76.3	<0.20	<5.0	<2.0	0.52	101
RPD (%)		NC	NC	NC	NC	2.0	NC	0.7	NC	NC	NC	NC	NC
SWPAGW07-0513	5/19/2013	<10	<20	0.12	17	85	<5.0	59.1	<0.20	<5.0	<2.0	78	<100
SWPAGW07d-0513	5/19/2013	2.9	<20	0.08	14	86	<5.0	60.0	<0.20	<5.0	<2.0	79	<100
RPD (%)		NC	NC	NC	NC	1.2	NC	1.5	NC	NC	NC	1.4	NC

NC, not calculated.

Table A14. Dissolved Metal Duplicates (cont.).

Sample ID	Date Collected	Hg	K	Li	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb
Units		µg/L	mg/L	µg/L	mg/L	µg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	µg/L
July 2011													
5× QL		NA	1.8	NA	0.5	70	85	8.6	420	0.3	85	2.3	R
SWPAGW05-0711	7/26/2011	NA	1.57	NA	19.6	<14	<17	47.8	<84	<0.06	<17	17.3	R
SWPAGW05d-0711	7/26/2011	NA	1.55	NA	19.7	<14	26	47.9	<84	<0.06	<17	17.7	R
RPD (%)			NC		0.5	NC	NC	0.2	NC	NC	NC	2.3	
SWPAGW12-0711	7/28/2011	NA	1.04	NA	15.0	18	<17	12.0	<84	<0.06	<17	18.0	R
SWPAGW12d-0711	7/28/2011	NA	1.03	NA	14.9	19	<17	12.0	<84	<0.06	<17	17.9	R
RPD (%)			NC		0.7	NC	NC	0.0	NC	NC	NC	0.6	
March 2012													
5× QL		NA	1.8	NA	0.5	70	85	8.6	5	0.3	5	2.3	10
SWPAGW08-0312	3/24/2012	NA	1.24	NA	8.75	20	<17	6.14	<1.0	<0.06	<1.0	13.0	<2.0
SWPAGW08d-0312	3/24/2012	NA	1.24	NA	8.57	20	<17	6.11	<1.0	<0.06	<1.0	12.5	<2.0
RPD (%)			NC		2.1	NC	NC	NC	NC	NC	NC	3.9	NC
SWPAGW13-0312	3/24/2012	NA	1.21	NA	14.1	<14	<17	23.3	<1.0	<0.06	<1.0	11.1	<2.0
SWPAGW13d-0312	3/24/2012	NA	1.22	NA	14.3	<14	<17	23.3	<1.0	<0.06	<1.0	10.8	<2.0
RPD (%)			NC		1.4	NC	NC	0.0	NC	NC	NC	2.7	NC
May 2013													
5xQL		1.0	2.5	50	0.25	25	2.5	1.3	1.0	0.25	1.0	NA	1.0
SWPAGW02-0513	5/18/2013	<0.20	1.18	3.9	22.7	78	0.52	7.32	3.1	<0.05	<0.20	NA	<0.20
SWPAGW02d-0513	5/18/2013	<0.20	1.24	5.0	23.2	80	0.57	7.52	3.5	<0.05	<0.20	NA	<0.20
RPD (%)		NC	NC	NC	2.2	2.5	NC	2.7	12.1	NC	NC		NC
SWPAGW07-0513	5/19/2013	<0.20	1.34	3.7	10.4	0.4	<0.50	39.0	2.6	<0.05	0.84	NA	<0.20
SWPAGW07d-0513	5/19/2013	<0.20	1.30	4.2	10.6	0.7	<0.50	39.2	3.0	<0.05	0.82	NA	<0.20
RPD (%)		NC	NC	NC	1.9	NC	NC	0.5	14.3	NC	NC		NC

NA, not analyzed. NC, not calculated. R, data rejected.

Table A14. Dissolved Metal Duplicates (cont.).

Sample ID	Date Collected	Se	Si	Sr	Th	Ti	Tl	U	V	Zn
Units		µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011										
5× QL		150	2.2	20	NA	35	R	NA	50	250
SWPAGW05-0711	7/26/2011	<30	6.01	1530	NA	<7	R	NA	<10	29
SWPAGW05d-0711	7/26/2011	<30	6.11	1530	NA	<7	R	NA	<10	26
RPD (%)		NC	1.7	0.0		NC			NC	NC
SWPAGW12-0711	7/28/2011	<30	6.10	310	NA	<7	R	NA	<10	245
SWPAGW12d-0711	7/28/2011	<30	6.07	300	NA	<7	R	NA	3	243
RPD (%)		NC	0.5	3.3		NC			NC	NC
March 2012										
5× QL		25	2.2	20	5	35	5	5	50	250
SWPAGW08-0312	3/24/2012	<5.0	5.33	201	<1.0	<7	<1.0	0.55	<10	<50
SWPAGW08d-0312	3/24/2012	<5.0	5.33	201	<1.0	<7	<1.0	0.50	<10	<50
RPD (%)		NC	0.0	0.0	NC	NC	NC	NC	NC	NC
SWPAGW13-0312	3/24/2012	3.2	5.60	690	<1.0	<7	<1.0	0.88	<10	<50
SWPAGW13d-0312	3/24/2012	4.2	5.60	690	<1.0	<7	<1.0	0.86	<10	<50
RPD (%)		NC	0.0	0.0	NC	NC	NC	NC	NC	NC
May 2013										
5xQL		10	0.5	10	1.0	25	1.0	1.0	1.0	25
SWPAGW02-0513	5/18/2013	<2.0	4.05	455	<0.20	0.61	<0.20	0.63	<0.20	<5.0
SWPAGW02d-0513	5/18/2013	<2.0	4.07	458	<0.20	0.59	<0.20	0.64	<0.20	<5.0
RPD (%)		NC	0.5	0.7	NC	NC	NC	NC	NC	NC
SWPAGW07-0513	5/19/2013	<2.0	5.42	229	<0.20	0.81	<0.20	0.14	0.05	17
SWPAGW07d-0513	5/19/2013	<2.0	5.50	218	<0.20	0.81	<0.20	<0.20	0.04	16
RPD (%)		NC	1.5	4.9	NC	NC	NC	NC	NC	NC

NA, not analyzed. NC, not calculated.

Table A15. Total Metal Duplicates.

Sample ID	Date Collected	Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011													
5×QL		80	2740	110	1850	20	55	1.6	20	20	40	110	370
SWPAGW05-0711	7/26/2011	<16	<548	<22	<370	178	<11	127	<4	<4	<8	<22	<74
SWPAGW05d-0711	7/26/2011	<16	<548	<22	<370	176	<11	127	<4	<4	<8	<22	<74
RPD (%)		NC	NC	NC	NC	1.1	NC	0.0	NC	NC	NC	NC	NC
SWPAGW12-0711	7/28/2011	<16	986	<22	<370	76	<11	104	2	<4	7	47	835
SWPAGW12d-0711	7/28/2011	<16	881	<22	<370	74	<11	105	2	<4	6	45	749
RPD (%)		NC	NC	NC	NC	2.7	NC	1.0	NC	NC	NC	NC	10.9
March 2012													
5× QL		80	100	5	1850	20	55	1.6	5	20	10	10	370
SWPAGW08-0312	3/24/2012	<16	54.8	0.50	<370	129	<11	93.5	<1.0	<4	<2.0	4.1	41
SWPAGW08d-0312	3/24/2012	<16	55.5	0.48	<370	130	<11	93.9	<1.0	<4	<2.0	4.4	48
RPD (%)		NC	NC	NC	NC	0.8	NC	0.4	NC	NC	NC	NC	NC
SWPAGW13-0312	3/24/2012	<16	<20.0	0.87	<370	222	<11	309	<1.0	<4	<2.0	<2.0	<74
SWPAGW13d-0312	3/24/2012	<16	<20.0	1.9	<370	222	<11	306	<1.0	<4	<2.0	<2.0	<74
RPD (%)		NC	NC	NC	NC	0.0	NC	1.0	NC	NC	NC	NC	NC
May 2013													
5xQL		50	100	1	100	12.5	12.5	0.25	1.00	12.5	10.0	2.5	250
SWPAGW02-0513	5/18/2013	<10	<20	1.3	24	102	<2.5	73.3	<0.20	<2.5	<2.0	0.80	902
SWPAGW02d-0513	5/18/2013	<10	<20	1.1	26	100	<2.5	73.9	<0.20	<2.5	<2.0	0.85	653
RPD (%)		NC	NC	16.7	NC	2.0	NC	0.8	NC	NC	NC	NC	32
SWPAGW07-0513	5/19/2013	<10	<20	0.23	23	81	<2.5	56.1	<0.20	<2.5	<2.0	72	<50
SWPAGW07d-0513	5/19/2013	<10	<20	0.32	27	83	<2.5	57.8	<0.20	<2.5	<2.0	74	44
RPD (%)		NC	NC	NC	NC	2.4	NC	3.0	NC	NC	NC	2.7	NC

NC, not calculated.

Table A15. Total Metal Duplicates (cont.).

Sample ID	Date Collected	Hg	K	Li	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb
Units		µg/L	mg/L	µg/L	mg/L	µg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	µg/L
July 2011													
5×QL			2.0		0.6	80	95	9.5	465	0.4	95	2.6	
SWPAGW05-0711	7/26/2011	NA	1.61	NA	20.1	<16	<19	48.0	<93	<0.07	<19	16.1	R
SWPAGW05d-0711	7/26/2011	NA	1.61	NA	19.9	<16	<19	47.9	<93	<0.07	<19	16.1	R
RPD (%)		NC	0.0	NC	1.0	NC	NC	0.2	NC	NC	NC	0.0	
SWPAGW12-0711	7/28/2011	NA	1.28	NA	15.2	1580	<19	12.4	<93	<0.07	17	16.3	R
SWPAGW12d-0711	7/28/2011	NA	1.23	NA	15.4	1490	<19	12.5	<93	<0.07	14	16.3	R
RPD (%)		NC	NC	NC	1.3	5.9	NC	0.8	NC	NC	NC	0.0	
March 2012													
5× QL			2.0		0.6	80	95	9.5	5	0.4	5	2.6	10
SWPAGW08-0312	3/24/2012	NA	1.24	NA	8.63	33	<19	6.27	<1.0	<0.07	<1.0	11.2	<2.0
SWPAGW08d-0312	3/24/2012	NA	1.27	NA	8.69	35	<19	6.26	<1.0	<0.07	<1.0	11.4	<2.0
RPD (%)		NC	NC	NC	0.7	NC	NC	NC	NC	NC	NC	1.8	NC
SWPAGW13-0312	3/24/2012	NA	1.23	NA	14.2	<16	<19	23.6	<1.0	<0.07	<1.0	9.73	<2.0
SWPAGW13d-0312	3/24/2012	NA	1.28	NA	14.1	<16	<19	23.5	<1.0	<0.07	<1.0	9.93	<2.0
RPD (%)		NC	NC	NC	0.7	NC	NC	0.4	NC	NC	NC	2.0	NC
May 2013													
5xQL		1.0	1.25	25	0.15	12.5	2.5	0.63	1.00	0.15	1		1
SWPAGW02-0513	5/18/2013	<0.20	1.18	4.2	22.0	508	0.66	7.46	3.7	<0.03	<0.20	NA	<0.20
SWPAGW02d-0513	5/18/2013	<0.20	1.18	4.4	22.2	366	0.68	7.26	3.0	<0.03	<0.20	NA	<0.20
RPD (%)		NC	NC	NC	0.9	32.5	NC	2.7	20.9	NC	NC		NC
SWPAGW07-0513	5/19/2013	<0.20	1.28	3.9	9.68	0.5	0.21	37.4	2.6	0.01	0.82	NA	<0.20
SWPAGW07d-0513	5/19/2013	<0.20	1.28	4.0	10.0	0.4	<0.50	37.9	2.4	<0.03	0.91	NA	<0.20
RPD (%)		NC	0	NC	3.3	13.3	NC	1.3	8.0	NC	NC		NC

NA, not analyzed. NC, not calculated. R, data rejected.

Table A15. Total Metal Duplicates (cont.).

Sample ID	Date Collected	Se	Si	Sr	Th	Ti	Tl	U	V	Zn
Units		µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011										
5×QL		165	2.4	20		40			55	280
SWPAGW05-0711	7/26/2011	<33	5.85	1560	NA	<8	R	NA	<11	23
SWPAGW05d-0711	7/26/2011	<33	5.81	1560	NA	<8	R	NA	4	23
RPD (%)		NC	0.7	0.0	NC	NC		NC	NC	NC
SWPAGW12-0711	7/28/2011	<33	7.17	325	NA	13	R	NA	4	641
SWPAGW12d-0711	7/28/2011	<33	6.91	330	NA	9	R	NA	5	632
RPD (%)		NC	3.7	1.5	NC	NC		NC	NC	1.4
March 2012										
5× QL		25	2.4	20	5	40	5	5	55	280
SWPAGW08-0312	3/24/2012	<5.0	5.02	197	<1.0	3	<1.0	0.51	<11	<56
SWPAGW08d-0312	3/24/2012	<5.0	5.05	197	<1.0	3	<1.0	0.52	<11	<56
RPD (%)		NC	0.6	0.0	NC	NC	NC	NC	NC	NC
SWPAGW13-0312	3/24/2012	3.0	5.31	683	<1.0	3	<1.0	0.93	<11	<56
SWPAGW13d-0312	3/24/2012	5.3	5.32	675	<1.0	3	<1.0	1.0	<11	<56
RPD (%)		NC	0.2	1.2	NC	NC	NC	NC	NC	NC
May 2013										
5xQL		10	0.25	125	1.00	12.5	1.00	1.00	1.0	12.5
SWPAGW02-0513	5/18/2013	0.46	3.99	475	<0.20	0.50	<0.20	0.66	0.53	<2.5
SWPAGW02d-0513	5/18/2013	0.76	4.02	475	<0.20	0.64	<0.20	0.66	0.53	<2.5
RPD (%)		NC	0.7	0.0	NC	NC	NC	NC	NC	NC
SWPAGW07-0513	5/19/2013	<2.0	5.19	228	0.18	0.72	<0.20	0.06	0.28	10.3
SWPAGW07d-0513	5/19/2013	1.10	5.31	220	<0.20	0.64	<0.20	0.05	0.50	11.0
RPD (%)		NC	2.3	3.6	NC	NC	NC	NC	NC	NC

NA, not analyzed. NC, not calculated. R, data rejected.

Table A16. Volatile Organic Compound Duplicates.

Sample ID	Date Collected	ethanol (64 17 5)	isopropanol (67 63 0)	acrylonitrile (107 13 1)	styrene (100 42 5)	acetone (67 64 1)	tert butyl Alcohol (75 65 0)	methyl tert butyl ether (1634 04 4)	diisopropyl ether (108 20 3)	ethyl tert butyl ether (637 92 3)	tert amyl methyl ether (994 05 8)	vinyl chloride (75 01 4)	1,1 dichloroethene (75 35 4)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011													
5× QL		500	125	125	2.5	5	25	5	5	5	5	2.5	
SWPAGW05-0711	7/26/2011	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R
SWPAGW05d-0711	7/26/2011	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW12-0711	7/28/2011	<100	<25.0	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R
SWPAGW12d-0711	7/28/2011	<100	<25.0	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
March 2012													
5× QL		500	125	125	2.5	5	25	5	5	5	5	2.5	
SWPAGW08-0312	3/24/2012	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R
SWPAGW08d-0312	3/24/2012	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NA, not analyzed. NC, not calculated. R, data rejected.

Table A16. Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	ethanol (64 17 5)	isopropanol (67 63 0)	acrylonitrile (107 13 1)	styrene (100 42 5)	acetone (67 64 1)	tert butyl Alcohol (75 65 0)	methyl tert butyl ether (1634 04 4)	diisopropyl ether (108 20 3)	ethyl tert butyl ether (637 92 3)	tert amyl methyl ether (994 05 8)	vinyl chloride (75 01 4)	1,1 dichloroethene (75 35 4)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
March 2012													
5× QL		500	125	125	2.5	5	25	5	5	5	5	2.5	
SWPAGW13-0312	3/24/2012	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R
SWPAGW13d-0312	3/24/2012	<100	<25	<25	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.5	R
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
May 2013													
5xQL		500	100	5	2.5	5	50	2.5	2.5	2.5	2.5	2.5	2.5
SWPAGW02-0513	5/18/2013	<100	<10	<1.0	<0.5	<1.0	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPAGW02d-0513	5/18/2013	<100	<10	<1.0	<0.5	<1.0	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW07-0513	5/19/2013	<100	<10	<1.0	<0.5	<1.0	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPAGW07d-0513	5/19/2013	<100	<10	<1.0	<0.5	<1.0	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NA, not analyzed. NC, not calculated. R, data rejected.

Table A16. Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	carbon disulfide (75 15 0)	methylene chloride (75 09 2)	trans 1,2 dichloroethene (156 60 5)	1,1 dichloroethane (75 34 3)	cis 1,2 dichoroethene (156 59 2)	chloroform (67 66 3)	1,1,1 trichloroethane (71 55 6)	carbon tetrachloride (56 23 5)	benzene (71 43 2)	1,2 dichloroethane (107 06 2)	trichloroethene (79 01 6)	toluene (108 88 3)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011													
5× QL		2.5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
SWPAGW05-0711	7/26/2011	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPAGW05d-0711	7/26/2011	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW12-0711	7/28/2011	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPAGW12d-0711	7/28/2011	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
March 2012													
5× QL		2.5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
SWPAGW08-0312	3/24/2012	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPAGW08d-0312	3/24/2012	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated.

Table A16. Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	carbon disulfide (75 15 0)	methylene chloride (75 09 2)	trans 1,2 dichloroethene (156 60 5)	1,1 dichloroethane (75 34 3)	cis 1,2 dichoroethene (156 59 2)	chloroform (67 66 3)	1,1,1 trichloroethane (71 55 6)	carbon tetrachloride (56 23 5)	benzene (71 43 2)	1,2 dichloroethane (107 06 2)	trichloroethene (79 01 6)	toluene (108 88 3)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
March 2012													
5× QL		2.5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
SWPAGW13-0312	3/24/2012	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPAGW13d-0312	3/24/2012	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
May 2013													
5× QL		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
SWPAGW02-0513	5/18/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPAGW02d-0513	5/18/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW07-0513	5/19/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPAGW07d-0513	5/19/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated.

Table A16. Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	1,1,2 trichloroethane (79 00 5)	tetrachloroethene (127 18 4)	chlorobenzene (108 90 7)	ethylbenzene (100 41 4)	m+p xylene (108 38 3, 106 42 3)	o xylene (95 47 6)	isopropylbenzene (98 82 8)	1,3,5 trimethylbenzene (108 67 8)	1,2,4 trimethylbenzene (95 63 6)	1,3 dichlorobenzene (541 73 1)	1,4 dichlorobenzene (106 46 7)	1,2,3 trimethylbenzene (526 73 8)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011													
5× QL			2.5	2.5	5	10	2.5	2.5	2.5	2.5	2.5	2.5	2.5
SWPAGW05-0711	7/26/2011	R	<0.5	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPAGW05d-0711	7/26/2011	R	<0.5	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW12-0711	7/28/2011	R	<0.5	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPAGW12d-0711	7/28/2011	R	<0.5	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
March 2012													
5× QL			2.5	2.5	5	10	2.5	2.5	2.5	2.5	2.5	2.5	2.5
SWPAGW08-0312	3/24/2012	R	<0.5	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPAGW08d-0312	3/24/2012	R	<0.5	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated. R, data rejected.

Table A16. Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	1,1,2 trichloroethane (79 00 5)	tetrachloroethene (127 18 4)	chlorobenzene (108 90 7)	ethylbenzene (100 41 4)	m+p xylene (108 38 3, 106 42 3)	o xylene (95 47 6)	isopropylbenzene (98 82 8)	1,3,5 trimethylbenzene (108 67 8)	1,2,4 trimethylbenzene (95 63 6)	1,3 dichlorobenzene (541 73 1)	1,4 dichlorobenzene (106 46 7)	1,2,3 trimethylbenzene (526 73 8)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
March 2012													
5× QL			2.5	2.5	5	10	2.5	2.5	2.5	2.5	2.5	2.5	2.5
SWPAGW13-0312	3/24/2012	R	<0.5	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPAGW13d-0312	3/24/2012	R	<0.5	<0.5	<1.0	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
May 2013													
5xQL		2.5	2.5	2.5	2.5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
SWPAGW02-0513	5/18/2013	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPAGW02d-0513	5/18/2013	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW07-0513	5/19/2013	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
SWPAGW07d-0513	5/19/2013	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated. R, data rejected.

Table A16. Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	1,2 dichlorobenzene (95 50 1)	naphthalene (91 20 3)
Units		µg/L	µg/L
July 2011			
5× QL		2.5	2.5
SWPAGW05-0711	7/26/2011	<0.5	<0.5
SWPAGW05d-0711	7/26/2011	<0.5	<0.5
RPD (%)		NC	NC
SWPAGW12-0711	7/28/2011	<0.5	<0.5
SWPAGW12d-0711	7/28/2011	<0.5	<0.5
RPD (%)		NC	NC
March 2012			
5× QL		2.5	2.5
SWPAGW08-0312	3/24/2012	<0.5	<0.5
SWPAGW08d-0312	3/24/2012	<0.5	<0.5
RPD (%)		NC	NC

NC, not calculated.

Table A16. Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	1,2 dichlorobenzene (95 50 1)	naphthalene (91 20 3)
Units		µg/L	µg/L
March 2012			
5× QL		2.5	2.5
SWPAGW13-0312	3/24/2012	<0.5	<0.5
SWPAGW13d-0312	3/24/2012	<0.5	<0.5
RPD (%)		NC	NC
May 2013			
5xQL		2.5	2.5
SWPAGW02-0513	5/18/2013	<0.5	<0.5
SWPAGW02d-0513	5/18/2013	<0.5	<0.5
RPD (%)		NC	NC
SWPAGW07-0513	5/19/2013	<0.5	<0.5
SWPAGW07d-0513	5/19/2013	<0.5	<0.5
RPD (%)		NC	NC

NC, not calculated.

Table A17. Low Molecular Weight Acid Duplicates.

Sample ID	Date Collected	Lactate (50 21 5)	Formate (64 18 6)	Acetate (64 19 7)	Propionate (79 09 4)	Butyrate (107 92 6)	Isobutyrate (79 31 2)
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
July 2011							
5× QL		0.50	0.50		0.50	0.50	0.50
SWPAGW05-0711	7/26/2011	<0.10	0.19	R	<0.10	<0.10	<0.10
SWPAGW05d-0711	7/26/2011	<0.10	0.21	R	<0.10	<0.10	<0.10
RPD (%)		NC	NC	NC	NC	NC	NC
SWPAGW12-0711	7/28/2011	<0.10	0.14	R	<0.10	<0.10	<0.10
SWPAGW12d-0711	7/28/2011	<0.10	0.13	R	<0.10	<0.10	<0.10
RPD (%)		NC	NC	NC	NC	NC	NC
March 2012							
5× QL		0.50		0.50	0.50	0.50	0.50
SWPAGW08-0312	3/24/2012	<0.10	R	<0.10	<0.10	<0.10	<0.10
SWPAGW08d-0312	3/24/2012	<0.10	R	<0.10	<0.10	<0.10	<0.10
RPD (%)		NC	NC	NC	NC	NC	NC
SWPAGW13-0312	3/24/2012	<0.10	R	<0.10	<0.10	<0.10	<0.10
SWPAGW13d-0312	3/24/2012	<0.10	R	<0.10	<0.10	<0.10	<0.10
RPD (%)		NC	NC	NC	NC	NC	NC
May 2013							
5× QL		0.50		0.50	0.50	0.50	0.50
SWPAGW02-0513	5/18/2013	<0.10	NA	<0.10	<0.10	<0.10	<0.10
SWPAGW02d-0513	5/18/2013	<0.10	NA	<0.10	<0.10	<0.10	<0.10
RPD (%)		NC	NC	NC	NC	NC	NC
SWPAGW07-0513	5/19/2013	<0.10	NA	<0.10	<0.10	<0.10	<0.10
SWPAGW07d-0513	5/19/2013	<0.10	NA	<0.10	<0.10	<0.10	<0.10
RPD (%)		NC	NC	NC	NC	NC	NC

NC, not calculated. R, data rejected. NA, not analyzed.

Table A18. Dissolved Gas Duplicates.

Sample ID	Date Collected	Methane (74 82 8)	Ethane (74 84 0)	Propane (74 98 6)	Butane (106 97 8)
Units		mg/L	mg/L	mg/L	mg/L
July 2011					
5× QL		0.0075	0.0145	0.0205	0.0275
SWPAGW05-0711	7/26/2011	<0.0015	<0.0029	<0.0041	<0.0055
SWPAGW05d-0711	7/26/2011	<0.0015	<0.0029	<0.0041	<0.0055
RPD (%)		NC	NC	NC	NC
SWPAGW12-0711	7/28/2011	<0.0015	<0.0029	<0.0041	<0.0055
SWPAGW12d-0711	7/28/2011	<0.0015	<0.0029	<0.0041	<0.0055
RPD (%)		NC	NC	NC	NC
March 2012					
5× QL		0.0070	0.0135	0.0190	0.0240
SWPAGW08-0312	3/24/2012	0.0016	<0.0027	<0.0038	<0.0048
SWPAGW08d-0312	3/24/2012	0.0017	<0.0027	<0.0038	<0.0048
RPD (%)		NC	NC	NC	NC
SWPAGW13-0312	3/24/2012	<0.0014	<0.0027	<0.0038	<0.0048
SWPAGW13d-0312	3/24/2012	<0.0014	<0.0027	<0.0038	<0.0048
RPD (%)		NC	NC	NC	NC
May 2013					
5× QL		0.0065	0.0135	0.0185	0.0235
SWPAGW02-0513 A	5/18/2013	<0.0013	<0.0027	<0.0037	<0.0047
SWPAGW02d-0513 A	5/18/2013	<0.0013	<0.0027	<0.0037	<0.0047
RPD (%)		NC	NC	NC	NC
SWPAGW07-0513 A	5/19/2013	<0.0013	<0.0027	<0.0037	<0.0047
SWPAGW07d-0513 A	5/19/2013	<0.0013	<0.0027	<0.0037	<0.0047
RPD (%)		NC	NC	NC	NC

NC, not calculated.

Table A19. Glycol Duplicates.

Sample ID	Date Collected	2 butoxyethanol (111 76 2)	Diethylene glycol (111 46 6)	Triethylene glycol (112 27 6)	Tetraethylene glycol (112 60 7)
Units		µg/L	µg/L	µg/L	µg/L
July 2011					
5× QL		25	250	25	125
SWPAGW05-0711	7/26/2011	<5	<50	<5	<25
SWPAGW05d-0711	7/26/2011	<5	<50	<5	<25
RPD (%)		NC	NC	NC	NC
SWPAGW12-0711	7/28/2011	<5	<50	<5	<25
SWPAGW12d-0711	7/28/2011	<5	<50	<5	<25
RPD (%)		NC	NC	NC	NC
March 2012					
5× QL		50	125	125	250
SWPAGW08-0312	3/24/2012	<10	<25	<25	<50
SWPAGW08d-0312	3/24/2012	<10	<25	<25	<50
RPD (%)		NC	NC	NC	NC
SWPAGW13-0312	3/24/2012	<10	<25	<25	<50
SWPAGW13d-0312	3/24/2012	<10	<25	<25	<50
RPD (%)		NC	NC	NC	NC
May 2013					
5× QL		50	50	50	50
SWPAGW02-0513	5/18/2013	<10	<10	<10	<10
SWPAGW02d-0513	5/18/2013	<10	<10	<10	<10
RPD (%)		NC	NC	NC	NC
SWPAGW07-0513	5/19/2013	<10	<10	<10	<10
SWPAGW07d-0513	5/19/2013	<10	<10	<10	<10
RPD (%)		NC	NC	NC	NC

NC, not calculated.

Table A20. Semi-Volatile Organic Compound Duplicates.

Sample ID	Date Collected	R (+) limonene (5989 27 5)	1,2,4 trichlorobenzene (120 82 1)	1,2 dichlorobenzene (95 50 1)	1,2 dinitrobenzene (528 29 0)	1,3 dichlorobenzene (541 73 1)	1,3 dimethyladamantane (702 79 4)	1,3 dinitrobenzene (99 65 0)	1,4 dichlorobenzene (106 46 7)	1,4 dinitrobenzene (100 25 4)	1 methylnaphthalene (90 12 0)	2,3,4,6 tetrachlorophenol (58 90 2)	2,3,5,6 tetrachlorophenol (935 95 5)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011													
5× QL		2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
SWPAGW05-0711	7/26/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
SWPAGW05d-0711	7/26/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW12-0711	7/28/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
SWPAGW12d-0711	7/28/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
March 2012													
5× QL		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	10.0	10.0
SWPAGW08-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00
SWPAGW08d-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated.

Table A20. Semi-Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	R (+) limonene (5989 27 5)	1,2,4 trichlorobenzene (120 82 1)	1,2 dichlorobenzene (95 50 1)	1,2 dinitrobenzene (528 29 0)	1,3 dichlorobenzene (541 73 1)	1,3 dimethyladamantane (702 79 4)	1,3 dinitrobenzene (99 65 0)	1,4 dichlorobenzene (106 46 7)	1,4 dinitrobenzene (100 25 4)	1 methylnaphthalene (90 12 0)	2,3,4,6 tetrachlorophenol (58 90 2)	2,3,5,6 tetrachlorophenol (935 95 5)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
March 2012													
5× QL		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	10.0	10.0
SWPAGW13-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00
SWPAGW13d-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
May 2013													
5× QL		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	10.0	10.0
SWPAGW02-0513	5/18/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00
SWPAGW02d-0513	5/18/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW07-0513	5/19/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00
SWPAGW07d-0513	5/19/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated.

Table A20. Semi-Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	2,4,5 trichlorophenol (95 95 4)	2,4,6 trichlorophenol (88 06 2)	2,4 dichlorophenol (120 83 2)	2,4 dimethylphenol (105 67 9)	2,4 dinitrophenol (51 28 5)	2,4dinitrotoluene (121 14 2)	2,6 dinitrotoluene (606 20 2)	2 butoxyethanol (111 76 2)	2 chloronaphthalene (91 58 7)	2 chlorophenol (95 57 8)	2 methylnaphthalene (91 57 6)	2 methylphenol (95 48 7)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011													
5× QL		2.50	2.50	2.50	2.50	25.00	2.50	2.50	2.50	2.50	2.50	2.50	2.50
SWPAGW05-0711	7/26/2011	<0.50	<0.50	<0.50	<0.50	<5.00	<0.50	<0.50	1.00	<0.50	<0.50	<0.50	<0.50
SWPAGW05d-0711	7/26/2011	<0.50	<0.50	<0.50	<0.50	<5.00	<0.50	<0.50	0.56	<0.50	<0.50	<0.50	<0.50
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW12-0711	7/28/2011	<0.50	<0.50	<0.50	<0.50	<5.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
SWPAGW12d-0711	7/28/2011	<0.50	<0.50	<0.50	<0.50	<5.00	<0.50	<0.50	0.87	<0.50	<0.50	<0.50	<0.50
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
March 2012													
5× QL		10.0	10.0	10.0	10.0	15.0	5.00	5.00	5.00	5.00	10.0	5.00	10.0
SWPAGW08-0312	3/24/2012	<2.00	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00
SWPAGW08d-0312	3/24/2012	<2.00	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated.

Table A20. Semi-Volatile Organic Compounds Duplicates (cont.).

Sample ID	Date Collected	2,4,5 trichlorophenol (95 95 4)	2,4,6 trichlorophenol (88 06 2)	2,4 dichlorophenol (120 83 2)	2,4 dimethylphenol (105 67 9)	2,4 dinitrophenol (51 28 5)	2,4dinitrotoluene (121 14 2)	2,6 dinitrotoluene (606 20 2)	2 butoxyethanol (111 76 2)	2 chloronaphthalene (91 58 7)	2 chlorophenol (95 57 8)	2 methylnaphthalene (91 57 6)	2 methylphenol (95 48 7)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
March 2012													
5× QL		10.0	10.0	10.0	10.0	15.0	5.00	5.00	5.00	5.00	10.0	5.00	10.0
SWPAGW13-0312	3/24/2012	<2.00	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00
SWPAGW13d-0312	3/24/2012	<2.00	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
May 2013													
5× QL		10.0	10.0	10. 0	10.0	15.0	5.00	5.00	5.00	5.00	10.0	5.00	10.0
SWPAGW02-0513	5/18/2013	<2.00	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00
SWPAGW02d-0513	5/18/2013	<2.00	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW07-0513	5/19/2013	<2.00	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00
SWPAGW07d-0513	5/19/2013	<2.00	<2.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated.

Table A20. Semi-Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	2 nitroaniline (88 74 4)	2 nitrophenol (88 75 5)	3&4 methylphenol (108 39 4 & 106 44 5)	3,3' dichlorobenzidine (91 94 1)	3 nitroaniline (99 09 2)	4,6 dinitro 2 methylphenol (534 52 1)	4 bromophenyl phenyl ether (101 55 3)	4 chloro 3 methylphenol (59 50 7)	4 chloroaniline (106 47 8)	4 chlorophenyl phenyl ether (7005 72 3)	4 nitroaniline (100 01 6)	4 nitrophenol (100 02 7)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011													
5× QL		2.50	2.50	2.50	5.00	2.50	2.50	2.50	2.50	5.00	2.50	2.50	12.50
SWPAGW05-0711	7/26/2011	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<2.50
SWPAGW05d-0711	7/26/2011	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<2.50
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW12-0711	7/28/2011	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<2.50
SWPAGW12d-0711	7/28/2011	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<2.50
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
March 2012													
5× QL		5.00	10.0	25	5.00	15.0	10.0	5.00	10.0	15.0	5.00	15.0	15.0
SWPAGW08-0312	3/24/2012	<1.00	<2.00	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00
SWPAGW08d-0312	3/24/2012	<1.00	<2.00	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated.

Table A20. Semi-Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	2 nitroaniline (88 74 4)	2 nitrophenol (88 75 5)	3&4 methylphenol (108 39 4 & 106 44 5)	3,3' dichlorobenzidine (91 94 1)	3 nitroaniline (99 09 2)	4,6 dinitro 2 methylphenol (534 52 1)	4 bromophenyl phenyl ether (101 55 3)	4 chloro 3 methylphenol (59 50 7)	4 chloroaniline (106 47 8)	4 chlorophenyl phenyl ether (7005 72 3)	4 nitroaniline (100 01 6)	4 nitrophenol (100 02 7)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
March 2012													
5× QL		5.00	10.0	25	5.00	15.0	10.0	5.00	10.0	15.0	5.00	15.0	15.0
SWPAGW13-0312	3/24/2012	<1.00	<2.00	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00
SWPAGW13d-0312	3/24/2012	<1.00	<2.00	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
May 2013													
5× QL		5.00	10.0	25	5.00	15.0	10.0	5.00	10.0	15.0	5.00	15.0	15.0
SWPAGW02-0513	5/18/2013	<1.00	<2.00	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00
SWPAGW02d-0513	5/18/2013	<1.00	<2.00	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW07-0513	5/19/2013	<1.00	<2.00	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00
SWPAGW07d-0513	5/19/2013	<1.00	<2.00	<5.00	<1.00	<3.00	<2.00	<1.00	<2.00	<3.00	<1.00	<3.00	<3.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated.

Table A20. Semi-Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	Acenaphthene (83 32 9)	Acenaphthylene (208 96 8)	Adamantane (281 23 2)	Aniline (62 53 3)	Anthracene (120 12 7)	Azobenzene (103 33 3)	Benzo(a)anthracene (56 55 3)	Benzo(a)pyrene (50 32 3)	Benzo(b)fluoranthene (205 99 2)	Benzo(g,h,i)perylene (191 24 2)	Benzo(k)fluoranthene (207 08 9)	Benzoic Acid (65 85 0)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011													
5× QL		2.50	2.50	2.50	5.00	2.50	2.50	2.50	2.50	2.50	2.50	2.50	25.00
SWPAGW05-0711	7/26/2011	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.00
SWPAGW05d-0711	7/26/2011	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW12-0711	7/28/2011	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.00
SWPAGW12d-0711	7/28/2011	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<5.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
March 2012													
5× QL		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	15.0
SWPAGW08-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00
SWPAGW08d-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated.

Table A20. Semi-Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	Acenaphthene (83 32 9)	Acenaphthylene (208 96 8)	Adamantane (281 23 2)	Aniline (62 53 3)	Anthracene (120 12 7)	Azobenzene (103 33 3)	Benzo(a)anthracene (56 55 3)	Benzo(a)pyrene (50 32 3)	Benzo(b)fluoranthene (205 99 2)	Benzo(g,h,i)perylene (191 24 2)	Benzo(k)fluoranthene (207 08 9)	Benzoic Acid (65 85 0)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
March 2012													
5× QL		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	15.0
SWPAGW13-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00
SWPAGW13d-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
May 2013													
5× QL		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	15.0
SWPAGW02-0513	5/18/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00
SWPAGW02d-0513	5/18/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW07-0513	5/19/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00
SWPAGW07d-0513	5/19/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<3.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated.

Table A20. Semi-Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	Benzyl alcohol (100 51 6)	Bis (2 chloroethoxy)methane (111 91 1)	Bis (2 chloroethyl)ether (111 44 4)	Bis (2 chloroisopropyl)ether (108 60 1)	Bis (2 ethylhexyl) adipate (103 23 1)	Bis (2 ethylhexyl) phthalate (117 81 7)	Butyl benzyl phthalate (85 68 7)	Carbazole (86 74 8)	Chrysene (218 01 9)	Dibenz(a,h)anthracene (53 70 3)	Dibenzofuran (132 64 9)	Diethyl phthalate (84 66 2)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011													
5× QL		2.50	2.50	2.50	2.50	5.00	5.00	2.50	2.50	2.50	2.50	2.50	2.50
SWPAGW05-0711	7/26/2011	<0.50	<0.50	<0.50	<0.50	<1.00	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
SWPAGW05d-0711	7/26/2011	<0.50	<0.50	<0.50	<0.50	<1.00	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW12-0711	7/28/2011	<0.50	<0.50	<0.50	<0.50	<1.00	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
SWPAGW12d-0711	7/28/2011	<0.50	<0.50	<0.50	<0.50	<1.00	<1.00	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
March 2012													
5× QL		5.00	5.00	5.00	5.00	5.00	10.0	10.0	15.0	5.00	5.00	5.00	5.00
SWPAGW08-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00
SWPAGW08d-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated.

Table A20. Semi-Volatile Organic Compounds Duplicates (cont.).

Sample ID	Date Collected	Benzyl alcohol (100 51 6)	Bis (2 chloroethoxy)methane (111 91 1)	Bis (2 chloroethyl)ether (111 44 4)	Bis (2 chloroisopropyl)ether (108 60 1)	Bis (2 ethylhexyl) adipate (103 23 1)	Bis (2 ethylhexyl) phthalate (117 81 7)	Butyl benzyl phthalate (85 68 7)	Carbazole (86 74 8)	Chrysene (218 01 9)	Dibenz(a,h)anthracene (53 70 3)	Dibenzofuran (132 64 9)	Diethyl phthalate (84 66 2)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
March 2012													
5× QL		5.00	5.00	5.00	5.00	5.00	10.0	10.0	15.0	5.00	5.00	5.00	5.00
SWPAGW13-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00
SWPAGW13d-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<2.00	<3.00	<1.00	<1.00	<1.00	<1.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
May 2013													
5× QL		5.00	5.00	5.00	5.00	5.00	10.0	5.0	15.0	5.00	5.00	5.00	5.00
SWPAGW02-0513	5/18/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
SWPAGW02d-0513	5/18/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW07-0513	5/19/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
SWPAGW07d-0513	5/19/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<3.00	<1.00	<1.00	<1.00	<1.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated.

Table A20. Semi-Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	Dimethyl phthalate (131 11 3)	Di n butyl phthalate (84 74 2)	Di n octyl phthalate (117 84 0)	Diphenylamine (122 39 4)	Fluoranthene (206 44 0)	Fluorene (86 73 7)	Hexachlorobenzene (118 74 1)	Hexachlorobutadiene (87 68 3)	Hexachlorocyclopentadiene (77 47 4)	Hexachloroethane (67 72 1)	Indeno(1,2,3 cd)pyrene (193 39 5)	Isophorone (78 59 1)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011													
5× QL		2.50	2.50	2.50	2.50	2.50	2.50	2.50	5.00	2.50	5.00	2.50	2.50
SWPAGW05-0711	7/26/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<1.00	<0.50	<0.50
SWPAGW05d-0711	7/26/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<1.00	<0.50	<0.50
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW12-0711	7/28/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<1.00	<0.50	<0.50
SWPAGW12d-0711	7/28/2011	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<1.00	<0.50	<0.50
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
March 2012													
5× QL		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
SWPAGW08-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPAGW08d-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated.

Table A20. Semi-Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	Dimethyl phthalate (131 11 3)	Di n butyl phthalate (84 74 2)	Di n octyl phthalate (117 84 0)	Diphenylamine (122 39 4)	Fluoranthene (206 44 0)	Fluorene (86 73 7)	Hexachlorobenzene (118 74 1)	Hexachlorobutadiene (87 68 3)	Hexachlorocyclopentadiene (77 47 4)	Hexachloroethane (67 72 1)	Indeno(1,2,3 cd)pyrene (193 39 5)	Isophorone (78 59 1)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
March 2012													
5× QL		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
SWPAGW13-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPAGW13d-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
May 2013													
5× QL		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
SWPAGW02-0513	5/18/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPAGW02d-0513	5/18/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW07-0513	5/19/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
SWPAGW07d-0513	5/19/2013	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated.

Table A20. Semi-Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	Naphthalene (91 20 3)	Nitrobenzene (98 95 3)	N nitrosodimethylamine (62 75 9)	N nitrosodi n propylamine (621 64 7)	Pentachlorophenol (87 86 5)	Phenanthrene (85 01 8)	Phenol (108 95 2)	Pyrene (129 00 0)	Pyridine (110 86 1)	Squalene (111 02 4)	Terpiniol (98 55 5)	tri (2 butoxyethyl) phosphate (78 51 3)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
July 2011													
5× QL		2.50	2.50	2.50	2.50	5.00	2.50	2.50	2.50	2.50	5.00	2.50	5.00
SWPAGW05-0711	7/26/2011	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<1.00
SWPAGW05d-0711	7/26/2011	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<1.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW12-0711	7/28/2011	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<1.00
SWPAGW12d-0711	7/28/2011	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50	<0.50	<1.00	<0.50	<1.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
March 2012													
5× QL		5.00	5.00	5.00	5.00	5.00	5.00	10.0	5.00	5.00	10.0	5.00	5.00
SWPAGW08-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
SWPAGW08d-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated.

Table A20. Semi-Volatile Organic Compound Duplicates (cont.).

Sample ID	Date Collected	Naphthalene (91 20 3)	Nitrobenzene (98 95 3)	N nitrosodimethylamine (62 75 9)	N nitrosodi n propylamine (621 64 7)	Pentachlorophenol (87 86 5)	Phenanthrene (85 01 8)	Phenol (108 95 2)	Pyrene (129 00 0)	Pyridine (110 86 1)	Squalene (111 02 4)	Terpiniol (98 55 5)	tri (2 butoxyethyl) phosphate (78 51 3)
Units		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
March 2012													
5× QL		5.00	5.00	5.00	5.00	5.00	5.00	10.0	5.00	5.00	10.0	5.00	5.00
SWPAGW13-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
SWPAGW13d-0312	3/24/2012	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
May 2013													
5× QL		5.00	5.00	5.00	5.00	10.0	5.00	10.0	5.00	5.00	10.0	5.00	5.00
SWPAGW02-0513	5/18/2013	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
SWPAGW02d-0513	5/18/2013	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
SWPAGW07-0513	5/19/2013	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
SWPAGW07d-0513	5/19/2013	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<2.00	<1.00	<1.00	<2.00	<1.00	<1.00
RPD (%)		NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC, not calculated.

Table A21. DRO/GRO Duplicates.

Sample ID	Date Collected	GRO/TPH	DRO
Units		µg/L	µg/L
QL		20.0	20.0
July 2011			
5× QL		100	100
SWPAGW05-0711	7/26/2011	<20.0	<21.5
SWPAGW05d-0711	7/26/2011	<20.0	32.3
RPD (%)		NC	NC
SWPAGW12-0711	7/28/2011	<20.0	27.1
SWPAGW12d-0711	7/28/2011	<20.0	<20.0
RPD (%)		NC	NC
March 2012			
5× QL		100	100
SWPAGW08-0312	3/24/2012	<20	74.7
SWPAGW08d-0312	3/24/2012	<20	71.1
RPD (%)		NC	NC
SWPAGW13-0312	3/24/2012	<20	<20.0
SWPAGW13d-0312	3/24/2012	<20	<20.0
RPD (%)		NC	NC
May 2013			
5xQL		100	100
SWPAGW02-0513	5/18/2013	<20.0	<20.0
SWPAGW02d-0513	5/18/2013	<20.0	<20.0
RPD (%)		NC	NC
SWPAGW07-0513	5/19/2013	<20.0	<20.0
SWPAGW07d-0513	5/19/2013	<20.0	<20.0
RPD (%)		NC	NC

NC, not calculated.

Table A22. O and H Stable Isotopes of Water Duplicates.

Sample ID	Date Collected	δ^2H	$\delta^{18}O$
Units		‰	‰
July 2011			
SWPAGW05-0711	7/26/2011	-54.60	-8.10
SWPAGW05d-0711	7/26/2011	-54.22	-8.03
RPD (%)		0.70	0.87
SWPAGW12-0711	7/28/2011	-53.91	-8.39
SWPAGW12d-0711	7/28/2011	-54.04	-8.42
RPD (%)		0.24	0.36
March 2012			
SWPAGW08-0312	3/24/2012	-53.14	-8.40
SWPAGW08d-0312	3/24/2012	-53.10	-8.42
RPD (%)		0.08	0.24
SWPAGW13-0312	3/24/2012	-53.18	-8.38
SWPAGW13d-0312	3/24/2012	-53.08	-8.47
RPD (%)		0.19	1.1
May 2013			
SWPAGW02-0513	5/18/2013	-56.02	-8.66
SWPAGW02d-0513	5/18/2013	-56.00	-8.73
RPD (%)		0.04	0.81
SWPAGW07-0513	5/19/2013	-55.97	-8.72
SWPAGW07d-0513	5/19/2013	-55.91	-8.79
RPD (%)		0.11	0.80

Table A23. Carbon and Hydrogen Isotopes of DIC and Methane Duplicates.

Sample ID	Date Collected	$\delta^{13}C$ DIC	$\delta^{13}C$ CH_4	δD CH_4
Units		‰	‰	‰
July 2011				
SWPAGW05-0711	7/26/2011	-13.04	NR	NR
SWPAGW05d-0711	7/26/2011	-12.92	NR	NR
RPD (%)		0.92	NC	NC
SWPAGW12-0711	7/28/2011	-16.34	NR	NR
SWPAGW12d-0711	7/28/2011	-16.19	NR	NR
RPD (%)		0.92	NC	NC
March 2012				
SWPAGW08-0312	3/24/2012	-14.55	NR	NR
SWPAGW08d-0312	3/24/2012	-14.48	NR	NR
RPD (%)		0.48	NC	NC
SWPAGW13-0312	3/24/2012	-15.07	NR	NR
SWPAGW13d-0312	3/24/2012	-14.75	NR	NR
RPD (%)		2.2	NC	NC
May 2013				
SWPAGW02-0513	5/18/2013	-14.6	NR	NR
SWPAGW02d-0513	5/18/2013	-14.6	NR	NR
RPD (%)		0.0	NC	NC
SWPAGW07-0513	5/19/2013	-17.6	NR	NR
SWPAGW07d-0513	5/19/2013	-17.7	NR	NR
RPD (%)		0.57	NC	NC

NR, not reported by laboratory, no methane detected. NC, not calculated.

Table A24. Strontium Isotope Duplicates.

Sample ID	Date Collected	Sr	$^{87}Sr/^{86}Sr$	1/Sr	Rb/Sr
Units		µg/L	Atom Ratio	L/µg	Weight Ratio
July 2011					
SWPAGW05-0711	7/26/2011	1550	0.711733	0.0006	0.000645
SWPAGW05d-0711	7/26/2011	1540	0.711762	0.0006	0.000649
RPD (%)		0.65	0.004	0.00	0.65
SWPAGW12-0711	7/28/2011	294	0.712413	0.0034	0.002041
SWPAGW12d-0711	7/28/2011	305	0.712409	0.0033	0.001967
RPD (%)		3.67	0.0006	2.99	3.67
March 2012					
SWPAGW08-0312	3/24/2012	200	0.711536	0.00500	0.009500
SWPAGW08d-0312	3/24/2012	204	0.711535	0.00490	0.009314
RPD (%)		1.98	0.0001	1.98	1.98
SWPAGW13-0312	3/24/2012	699	0.711940	0.00143	0.001187
SWPAGW13d-0312	3/24/2012	705	0.711937	0.00142	0.001163
RPD (%)		0.85	0.0004	0.85	2.07
May 2013					
SWPAGW02-0513	5/18/2013	443	0.711236	0.00226	NR
SWPAGW02d-0513	5/18/2013	442	0.711247	0.00226	NR
RPD (%)		0.23	0.00155	0.23	NC
SWPAGW07-0513	5/19/2013	213	0.711852	0.00469	NR
SWPAGW07d-0513	5/19/2013	214	0.711880	0.00467	NR
RPD (%)		0.47	0.00393	0.47	NC

NR, not reported by laboratory. NC, not calculated.

Table A25. Gross Alpha, Gross Beta, and Radium Isotope Duplicates.

Sample ID	Date Collected	Gross Alpha	Gross Beta	Ra 226	Ra 228
Units		pCi/L	pCi/L	pCi/L	pCi/L
July 2011					
5× RL					
SWPAGW05-0711		NA	NA	NA	NA
SWPAGW05d-0711		NA	NA	NA	NA
RPD (%)					
SWPAGW12-0711		NA	NA	NA	NA
SWPAGW12d-0711		NA	NA	NA	NA
RPD (%)					
March 2012					
5× RL		15	20	5	5
SWPAGW08-0312	3/24/2012	<3.0	<4.0	<1.0	<1.0
SWPAGW08d-0312	3/24/2012	<3.0	<4.0	<1.0	<1.0
RPD (%)		NC	NC	NC	NC
SWPAGW13-0312	3/24/2012	<3.0	<4.0	<1.0	<1.0
SWPAGW13d-0312	3/24/2012	<3.0	<4.0	<1.0	<1.0
RPD (%)		NC	NC	NC	NC
May 2013					
5× RL		15	20	5	5
SWPAGW02-0513	5/18/2013	<3.0	<4.0	<1.0	<1.0
SWPAGW02d-0513	5/18/2013	<3.0	<4.0	<1.0	<1.0
RPD (%)		NC	NC	NC	NC
SWPAGW07-0513	5/19/2013	<3.0	<4.0	<1.0	<1.0
SWPAGW07d-0513	5/19/2013	<3.0	<4.0	<1.0	<1.0
RPD (%)		NC	NC	NC	NC

NA, not analyzed. NC, not calculated.

Table A26. Data Usability Summary[1].

Analysis/Lab	Summary of QA/QC Results	Impact on Data/Usability
July 2011		
Field Parameters/EPA on-site	All QA/QC criteria were met. Results for ferrous iron and sulfide are considered screening values as they were measured on site with field kits.	Meets project requirements. All detected results were qualified with “J” as estimated. Data usability is unaffected.
Dissolved gases/ Shaw Environmental	All QA/QC criteria were met.	Meets project requirements.
DOC/ORD/NRMRL- Ada	All QA/QC criteria were met.	Meets project requirements.
DIC/ORD/NRMRL- Ada	All QA/QC criteria were met.	Meets project requirements.
Anions/ Ammonia ORD/NRMRL- Ada	Nitrate + Nitrite: One Equipment Blank was above the QL.	Nitrate + Nitrite: Affected samples were qualified with “B.” The SWPAGW08 concentration was almost 10x the blank value and is considered usable. The remaining qualified samples can be used with caution.
Dissolved Metals/ Shaw Environmental	ICP-MS: All ICP-MS results were rejected and replaced with ICP-OES results. The reasons stated were potential interferences and that interference check standards were not run. ICP-OES: Dissolved Sb and Tl results were rejected due to potential spectral interference. Continuing calibration checks were analyzed at appropriate intervals, however, some metals (B, Ba, K, Na, Ag, Si, S, P, and U) were not always included in the check standards at the required intervals.	ICP-MS: The ICP-MS data were replaced with ICP-OES data. Detection and quantitation limits are higher than desirable. The ICP-OES data should not be compared with the subsequent ICP-MS data for trace metals from the last two sampling events. ICP-OES: Sb and Tl results were rejected as unusable. All samples with detected quantities for these metals were qualified “J” as estimated. Data for B, Ba, K, Na, Ag, Si, S, P, and U are usable as positive identifications with estimated concentrations.

Table A26. Data Usability Summary (cont.).

Analysis/Lab	Summary of QA/QC Results	Impact on Data/Usability
Total Metals/ Shaw Environmental	ICP-MS: All ICP-MS results were rejected and replaced with ICP-OES results. The reasons stated were potential interferences and that interference check standards were not run. ICP-OES: Total Sb and Tl results were rejected due to potential spectral interference. Continuing calibration checks were being analyzed at appropriate intervals, however, some metals (B, Ba, K, Na, Ag, Si, S, P, and U) were not always included in the check standards at the required intervals. Digestion: It was determined that all parameters were not adhered to in EPA Method 3015A.	ICP-MS: The ICP-MS data were replaced with ICP-OES data. Detection and quantitation limits are higher than desirable. The ICP-OES data should not be compared with the subsequent ICP-MS data for trace metals from the last two sampling events. ICP-OES: Sb and Tl results were rejected as unusable. All samples with detected quantities for these metals were qualified “J” as estimated. Data for B, Ba, K, Na, Ag, Si, S, P, and U are usable as positive identifications with estimated concentrations. The “J” qualifier was applied to detections above the QL for digested samples. Data are usable as positive identifications with estimated concentrations.
Charge Balance	The calculated charge balance error ranged from 0.5 to 5.3%, based on the major cations (dissolved Na, K, Ca, and Mg) and anions (Cl, SO_4, and DIC).	Meets project requirements.
Measured versus calculated values of Specific Conductance (SPC)	The error in measured SPC versus calculated SPC ranged from 0.6 to 19.2%.	Samples SWPAGW01, SWPAGW02, SWPAGW03, SWPAGW04, SWPASW01, and SWPASW02 were above the acceptance criterion of 15%; SPC data for these samples are used with caution. In all cases, for samples outside of the acceptance range, the measured SPC value was less than the calculated value; thus, SPC values for these samples could be biased low.
VOC/ Shaw Environmental	The matrix spike results for 1,1-dichloroethene and 1,1,2-trichloroethane were significantly outside of the control limits. These compounds are known to be affected	All data for 1,1-dichloroethene and 1,1,2-trichloroethane were qualified with “R” and rejected as unusable.

Table A26. Data Usability Summary (cont.).

Analysis/Lab	Summary of QA/QC Results	Impact on Data/Usability
	by base hydrolysis. The preservative, trisodium phosphate (TSP), is a base and elevated temperatures (heated headspace sample introduction) will accelerate the hydrolysis of 1,1,2-trichloroethane to 1,1-dichloroethene. Toluene: The Trip Blank and Field Blank 2 had detections of toluene greater than the QL.	 Toluene: Affected samples (SWPAGW04 and SWPASW01) were qualified with "B". SWPAGW04 concentration was similar to the blanks and is usable with caution. SWPASW01 was ~3x the Trip Blank and should be used with caution.
Low Molecular Weight Acids/ Shaw Environmental	All field blanks for acetate were greater than the QL. It was later determined that the TSP preservative was the source of the acetate contamination. Low recovery (0%) was noted for the isobutyrate matrix spike.	For acetate, the data were qualified with "R" and rejected as unusable. Samples were qualified with "J-". Negative bias to the data is possible. As there were no sample detections, it is possible the negative bias may be a factor.
Glycols/ EPA Region 3 Laboratory	The method for glycols was under development. One cooler that contained samples SWPAGW11, SWPAGW12, SWPAGW12D, SWPAGW13, and a field blank arrived at the lab at temperature above 6° C at 17° C. The samples collected on July 25th and 26th 2011 exceeded the 14 day holding time for diethylene, triethylene, and tetraethylene glycol by 24-48 hours.	The QAPP stated these data are to be considered screening values until the method was validated. Even though the data are considered as screening level values, these data are usable as on-going QC checks provide confidence that the method can detect glycols. Affected sample results were qualified with "J-" due to the temperature exceedance; the potential negative bias is taken into account for data usability. Sample results were qualified with "H" to indicate potential impact. Holding time exceedance is considered a potential negative bias. However, the holding time exceedance was minor, so an impact on data usability is considered unlikely.

Table A26. Data Usability Summary (cont.).

Analysis/Lab	Summary of QA/QC Results	Impact on Data/Usability
SVOC/ EPA Region 8 Laboratory	The laboratory control spike for a sample batch had low recoveries for limonene, aniline, hexachlorocyclopentadiene, and pyridine. The laboratory control spike for another sample batch had low recoveries for aniline, hexachlorocyclopentadiene, and pyridine.	These analytes and affected samples were qualified with "J-" to indicate a potential negative bias that is taken into account for data usability.
	The matrix spike of sample SWPAGW11 had low recovery for the following analytes: limonene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,3-dimethyl adamantine, 1,4-dichlorobenzene, 2,4-dichlorophenol, 2-butoxyethanol, and hexachloroethane. Also one surrogate in sample SWPAGW11 was at 47% recovery, below the lower limit of 50%. This further supports the potential for a low bias.	These analytes were qualified for sample SWPAGW11 with "J-" to indicate a potential negative bias. The detections for 2-butoxyethanol, butyl benzyl phthalate, and phenol may be biased low.
	A laboratory refrigerator lost coolant and exceeded the 6°C upper limit, reaching a maximum of 10.7° C.	Affected samples (SWPAGW03, SWPAGW08, SWPAGW09, SWPAGW10, SWPAGW11, SWPAGW12, SWPAGW12-DUP, SWPAGW13, SWPASW03, and SWPA Eq Blk-1) were qualified with "J-" due to a potential negative bias that is taken into account for data usability.
	One equipment blank had 2-butoxyethanol detected above the QL.	Samples collected on the same day as the equipment blank (SWPAGW08, SWPAGW10, and SWPASW03) with detected quantities were qualified with "B." Samples collected on another day with detections were not qualified with "B" (SWPAGW05, SWPAGW05d, and SWPAGW11, SWPAGW12d, SWPAGW13, and SWPASW01). Detections in all of these samples are viewed with caution. There are other factors that support this approach. See discussion in report.

Table A26. Data Usability Summary (cont.).

Analysis/Lab	Summary of QA/QC Results	Impact on Data/Usability
DRO/GRO/ EPA Region 8 Laboratory	GRO: Both field blanks and the equipment blank were above the QL. DRO: The MS/MSD for sample SWPAGW11 had a low recovery of 69% and 67.2% (limits 70-130%). A refrigerator lost coolant and exceeded the 6 °C upper limit, reaching a maximum of 10.7 °C. Some samples were received with a pH greater than two.	GRO: SWPASW01 was qualified with "B." The sample concentration was less than the associated field blank and is therefore considered unusable. DRO: Affected samples were qualified with "J-" for a potential negative bias (SWPAGW04, SWPAGW05, SWPAGW05D, SWPAGW06, SWPAGW07, SWPAGW08, SWPAGW09, SWPAGW10, SWPAGW11, SWPAGW12, SWPAGW12D, SWPAGW13, SWPASW03, SWPA Fld Blk 2, and SWPA Eq Blk-1). Data may be biased low. These samples were qualified with "J-" for a potential negative bias (SWPAGW04, SWPAGW05, SWPAGW05d, SWPAGW06, SWPAGW07, SWPAGW08, SWPAGW09, SWPAGW10, SWPAGW11, SWPAGW12, SWPAGW12D, SWPAGW13, SWPASW02, SWPASW03, SWPA Fld Blk 2, and SWPA Eq Blk-1). Data may be biased low. Affected samples were qualified with "J-" for a potential negative bias (SWPAGW04, SWPAGW05, SWPAGW05d, SWPAGW06, SWPAGW08, and SWPASW02). Data may be biased low. For DRO, due to each of the factors listed, all results should be used with caution as biased low.
O, H Stable Isotopes of Water/ Shaw Environmental	All QA/QC criteria were met.	Meets project requirements.
Sr Isotopes/ USGS Laboratory- Denver	All QA/QC criteria were met.	Meets project requirements.
Isotech Gas Isotopes	All QA/QC criteria were met.	Meets project requirements.

Table A26. Data Usability Summary (cont.).

Analysis/Lab	Summary of QA/QC Results	Impact on Data/Usability
March 2012		
Field Parameters/EPA on-site	All QA/QC criteria were met. Results for ferrous iron and sulfide are considered screening values as they were measured on site with field kits.	Meets project requirements. All detected results were qualified with "J" as estimated. Data usability is unaffected.
Dissolved gases/ Shaw Environmental	All QA/QC criteria were met.	Meets project requirements.
DOC/ ORD/NRMRL- Ada	All QA/QC criteria were met.	Meets project requirements.
DIC/ ORD/NRMRL- Ada	All QA/QC criteria were met.	Meets project requirements.
Anions/ Ammonia ORD/NRMRL- Ada	Nitrate+Nitrite: Two field blanks and one equipment blank had detections of above the QL.	Nitrate+Nitrite: Affected samples (SWPAGW03, SWPAGW04, SWPAGW05, SWPAGW06, SWPAGW08, SWPAGW08d, SWPAGW12, SWPAGW13, SWPAGW13d, SWPAGW15, and SWPASW02) were qualified with "B." These data are indicative of low levels of nitrate in the samples and may be used with caution, with the exception of sample SWPAGW06, in which the blank concentration was greater than the sample concentration.
Dissolved Metals/ Shaw Environmental	ICP-MS: All ICP-MS results were rejected due to potential interferences and that interference check standards were not run. Samples were re-analyzed using a CLP lab. ICP-OES: Continuing calibration checks were analyzed at appropriate intervals, however, these metals (B, Ba, K, Na, Ag, Si, S, and P) were not always included in the check standards at the required intervals.	ICP-MS: CLP lab ICP-MS data were used. ICP-OES: All samples with detected quantities for these metals were qualified "J" as estimated. Data for B, Ba, K, Na, Ag, Si, S, P, and U are usable as positive identifications with estimated concentrations.
Total Metals/ Shaw Environmental	ICP-MS: All ICP-MS results were rejected due to potential interferences and that interference check standards were not run. Samples were re-analyzed using a CLP lab.	ICP-MS: CLP ICP-MS data were used.

Table A26. Data Usability Summary (cont.).

Analysis/Lab	Summary of QA/QC Results	Impact on Data/Usability
	Digestion: It was determined that all parameters were not adhered to in EPA Method 3015A. ICP-OES: Continuing calibration checks were analyzed at appropriate intervals, however, these metals (B, Ba, K, Na, Ag, Si, S, and P) were not always included in the check standards at the required intervals.	Digestion: The "J" qualifier was applied to detections above the QL for digested samples. Data are usable as positive identifications with estimated concentrations. ICP-OES: All samples with detected quantities for these metals were qualified "J" as estimated. Data for B, Ba, K, Na, Ag, Si, S, P, and U are usable as positive identifications with estimated concentrations.
Total and Dissolved Metals by ICP-MS/CLP	The ICP-MS metal analytes, as identified in the QAPP, which were analyzed by the CLP lab are total and dissolved: Al, As, Cd, Cr, Cu, Pb, Ni, Sb, Se, Th, Tl, and U. Field blanks SWPAFBlk02 and SWPAFBlk03 both had dissolved Ni concentrations exceeding the QL at 21.2 and 6.0 µg/L, respectively. SWPAFBlank02 also had total concentrations of cadmium (134 µg/L) and nickel (1.3 µg/L) above the CRQL. The only affected sample was SWPAGW11 for dissolved Ni. No samples were reported with detects for Cd, and no samples were >QL for total Ni.	For dissolved Ni, SWPAGW11 was qualified with a "B". The sample concentration was below the blank value and is therefore unusable.
Charge Balance	The calculated charge balance error ranged from 0.1 to 5.4%, based on the major cations (dissolved Na, K, Ca, and Mg) and anions (Cl, SO_4, and DIC). NO_3 was also used for samples SWPAGW10 and SWPAGW16.	Meets project requirements.
Measured versus calculated values of Specific Conductance (SPC)	The error in measured SPC versus calculated SPC ranged from 0.0 to 7.5%.	Meets project requirements.

Table A26. Data Usability Summary (cont.).

Analysis/Lab	Summary of QA/QC Results	Impact on Data/Usability
VOC/ Shaw Environmental	The matrix spike results for 1,1-dichloroethene and 1,1,2-trichloroethane were significantly outside of the control limits. These compounds are known to be affected by base hydrolysis. The preservative, trisodium phosphate (TSP), is a base and elevated temperatures (heated headspace sample introduction) will accelerate the hydrolysis of 1,1,2-trichloroethane to 1,1-dichloroethene. The carbon disulfide matrix spike had a low recovery.	All data for 1,1-dichloroethene and 1,1,2-trichloroethane were qualified with "R" and rejected as unusable. Affected samples (SWPAGW03, SWPAGW04, SWPAGW05, SWPAGW06, SWPAGW08, SWPAGW08d, SWPAGW12, SWPAGW13, SWPASW13d, SWPAGW15, and SWPASW02) were qualified with "J-" as a potential negative bias that is taken into account for data usability.
Low Molecular Weight Acids/ Shaw Environmental	Formate: All field blank samples contained formate above the QL and were greater than or similar to the sample concentrations. It was determined this was due to contamination from the preservative. Propionate was above QL in a field and an equipment blank.	Formate: All results were rejected and qualified with an "R" as unusable. The affected sample (SWPASW03) was qualified with "B." Data are considered usable with caution as the sample concentration is similar to the blank levels.
Glycols/ EPA Region 3 Laboratory	The method for glycols was under development. A blank spike was below recovery limits at 76% for tetraethylene glycol. Lab reported low (34%) recovery for tetraethylene glycol in a low blank spike at 25 µg/L and low (44%) recovery for 2-butoxyethanol in a low blank spike at 5 µg/L.	The QAPP stated these data are to be considered screening values until the method was validated. The data are usable as on-going QC checks provide confidence that the method can detect glycols. All samples were qualified with "J-" for these two analytes for a potential negative bias that is taken into account for data usability.

Table A26. Data Usability Summary (cont.).

Analysis/Lab	Summary of QA/QC Results	Impact on Data/Usability
SVOC/ EPA Region 8 Laboratory	Method Blank Spike 1, Batch 1200101, had low recoveries for limonene, adamantane, and 1,3-dimethyl adamantane. Method Blank Spike 1, Batch 1200102, had a low recovery for limonene, adamantane, and 1,3-dimethyl adamantane. Matrix spike MS1, Batch 1200101, had low recoveries for limonene and 1,3-dimethyl adamantane. The duplicate for this spike (MSD1) had a low recovery for adamantane.	Affected samples (SWPAGW03, SWPAGW04, SWPAGW05, SWPAGW08, SWPAGW08d, SWPAGW12, SWPAGW13, SWPAGW13d, SWPAGW15 and SWPASW02) were qualified with "J-" for a potential negative bias that is taken into account for data usability. Affected samples (SWPAGW06-0312, SWPAGW10-0312, SWPAGW11-0312, SWPAGW14-0312, SWPAGW16-0312, SWPAGW17-0312 and SWPASW03-0312) were qualified with "J-" for a potential negative bias that is taken into account for data usability. The affected sample (SWPAGW05) was already qualified with "J-" (see above). As a result of the spike recoveries noted above, all samples were qualified for limonene, adamantane, and 1,3-dimethyl adamantane with "J-" for a potential negative bias that is taken into account for data usability.
DRO/GRO/ EPA Region 8 Laboratory	DRO: Diesel range organics were detected in an equipment blank SWPA Eq Blank01 at the RL (20.0 µg/L). GRO: There were detections in one field blank and both equipment blanks; concentrations ranged from 20.0 to 27.4 µg/L. Because TPH as gasoline was not detected in any samples, no qualifications were necessary.	DRO: Affected samples (SWPAGW05 and SWPASW02) were qualified with "B." The result for SWPAGW05 was at the blank concentration and is unusable. The DRO concentration in SWPASW02 was greater than the blank; data for this sample are therefore considered to be usable with caution. GRO: No impact to data usability.
O, H Stable Isotopes of Water/ Shaw Environmental	All QA/QC criteria were met.	Meets project requirements.
Sr Isotopes/ USGS Laboratory- Denver	All QA/QC criteria were met.	Meets project requirements.

Table A26. Data Usability Summary (cont.).

Analysis/Lab	Summary of QA/QC Results	Impact on Data/Usability
Isotech Gas Isotopes	All QA/QC criteria were met.	Meets project requirements.
ALS Radionuclides	All QA/QC criteria were met.	Meets project requirements.
May 2013		
Field Parameters/EPA on-site	All QA/QC criteria were met. Results for ferrous iron and sulfide are considered screening values as they were measured on-site with field kits.	Meets project requirements. All detected results were qualified with "J" as estimated. Data usability is unaffected.
Dissolved gases/ CB&I	All QA/QC criteria were met.	Meets project requirements.
DOC/ORD/NRMRL- Ada	Two equipment blanks with detections above QL.	Affected samples (SWPAGW01, SWPAGW03, SWPAGW05, SWPAGW09, SWPAGW13, and SWPAGW14) were qualified with "B." Sample concentrations for SWPAGW03 and SWPAGW13 were less than the equipment blank concentrations and are unusable, but indicative of low level DOC concentrations. Sample concentrations for SWPAGW01, SWPAGW05, SWPAGW09, and SWPAGW14 were greater than the blank concentrations and are usable with caution.
DIC/ORD/NRMRL-Ada	All QA/QC criteria were met.	Meets project requirements.
Anions/ Ammonia ORD/NRMRL-Ada	TKN: One equipment blank with detection above QL.	TKN: Affected samples (SWPAGW05 and SWPAGW09) were qualified with "B." SWPAGW05 concentration was less than the equipment blank and is therefore unusable. SWPAGW09 was similar to the blank value and is therefore usable with caution.

Table A26. Data Usability Summary (cont.).

Analysis/Lab	Summary of QA/QC Results	Impact on Data/Usability
Dissolved Metals/ Southwest Research Institute	ICP-MS Dissolved Metals, field and equipment blank detections were >QL as listed below: Al: Equipment Blank 2 Cu: Equipment Blank 4 and Field Blank 4 Pb: Equipment Blank 4 ICP-OES: All QA/QC criteria were met. Cold vapor AA for Hg: All QA/QC criteria were met.	ICP-MS: Affected samples were qualified as follows: Al: SWPASW02 was qualified with a "B." The sample concentration was greater than the equipment blank concentration and is therefore usable with caution. Cu: SWPAGW03, SWPAGW13, and SWPAGW14 were qualified with a "B." SWPAGW03 was ~4x the concentration of Field Blank 4 and should be used with caution. SWPAGW13 and SWPAGW14 concentrations were less than Field Blank 4 and are therefore unusable. Pb: SWPAGW03 was qualified with a "B." The sample concentration was greater than the blank and is therefore usable with caution. ICP-OES: Meets project requirements. Cold vapor AA for Hg: Meets project requirements.
Total Metals/ Southwest Research Institute	ICP-OES: Fe: Samples SWPAGW02 and SWPAGW02d were field duplicates. The requirement for field duplicates was a RPD <30% for results >5xQL. The results for samples SWPAGW02 and SWPAGW02d were 902 and 653 µg/L, respectively. These results were both greater than 5xQL and the RPD for these field duplicates was 32%. Mn: Samples SWPAGW02 and SWPAGW02d were field duplicates. The requirement for field duplicates was an RPD <30% for results >5xQL.	ICP-OES: Affected samples were qualified as follows: Fe: Samples SWPAGW02 and SWPAGW02d as well as SWPAGW04 were qualified with an "*" for total Fe results. Precision of these sample results exceeded the project requirement by just 2%, but this variation is considered when using the data. Mn: Samples SWPAGW02 and SWPAGW02d as well as SWPAGW04 were qualified with an "*" for total Mn results. Precision of these sample results exceeded

Table A26. Data Usability Summary (cont.).

Analysis/Lab	Summary of QA/QC Results	Impact on Data/Usability
	The results for samples SWPAGW02 and SWPAGW02d were 508 and 366 µg/L, respectively. These results were both greater than 5xQL and the RPD for these field duplicates was 32.5%. ICP-OES Total Metals, field and equipment blank had detections >QL as listed below: Zn : EB1, EB2, EB3, EB4; the associated samples with concentrations <10x blank: GW03, GW04, GW05, GW07, GW07d, GW08, GW09 GW01, required a “B” qualifier. ICP-MS: V: V was detected in the preparation blank for Sample Delivery Group (SDG) 524043 at 0.22 µg/L. This affected samples: GW01, GW02, GW02d, GW03, GW04, GW05, GW06, GW07d, GW08, SW01, SW02, FB1, FB2, FB3, EB1, EB2, EB3, and EB4. V was also detected in the preparation blank for SDG 524061 at 0.23 µg/L. This affected samples GW07, GW14, GW18, and GW19. ICP-MS Total Metals, field and equipment blank detections >QL listed below:	project requirements by just 2.5% but this variation is considered when using the data. Zn: Samples SWPAGW03, SWPAGW04, SWPAGW05, SWPAGW07, SWPAGW07d, SWPAGW08, and SWPAGW09 were qualified with “B”. The SWPAGW09 concentration was almost 10x the blank and is usable. The remaining samples had similar to up to 3x the blank concentration and are considered to be usable with caution. ICP-MS: Affected samples were qualified as follows: V: Samples SWPAGW01,SWPAGW02, SWPAGW02d, SWPAGW03, SWPAGW04, SWPAGW05, SWPAGW06, SWPAGW07, SWPAGW07d, SWPAGW08, SWPAGW14, SWPAGW18, SWPAGW19, SWPASW01, SWPASW02, FB1, FB2, FB3, EB1, EB2, EB3, and EB4 were qualified with a “B.” Most sample concentrations were ~2-4x the laboratory preparation blanks. Due to the detection of vanadium in preparation blanks and the similarity of the sample concentrations, the blank detections appear to be a laboratory contamination issue or possibly an interference problem with the instrument; the data should be considered unusable.

Table A26. Data Usability Summary (cont.).

Analysis/Lab	Summary of QA/QC Results	Impact on Data/Usability
	As: EB1, EB2, EB3, EB4, FB4; the associated samples with concentrations <10x blank – GW01, GW02, GW02d, GW03, GW05, GW06, GW07, GW07d, GW08, GW13, GW14, GW18, GW19, SW01, and SW02 .	As: Samples SWPAGW01, SWPAGW02, SWPAGW02d, SWPAGW03, SWPAGW05, SWPAGW06, SWPAGW07, SWPAGW07d, SWPAGW08, SWPAGW13, SWPAGW14, SWPAGW18, SWPAGW19, SWPASW01, and SWPASW02 were qualified with "B". Samples were ~2-5x the blank concentrations; the data should be used with caution.
	Cu: EB2, EB3, FB4; the associated samples with concentrations <10x blank – GW02, GW02d, GW03, GW04, GW06,GW08, GW13, GW14, GW18, GW19, SW01, and SW02.	Cu: Samples SWPAGW02, SWPAGW02d, SWPAGW03, SWPAGW04, SWPAGW06, SWPAGW08, SWPAGW13, SWPAGW14, SWPAGW18, SWPAGW19, SWPASW01, and SWPASW02 were qualified with "B". SWPAGW02, SWPAGW02d, SWPAGW03, SWPAGW13, SWPAGW14, SWPAGW18, SWPAGW19, and SWPASW01 concentrations were all below the blank concentrations and are therefore unusable. SWPASW02 had a concentration similar to the blank and should be considered usable with caution. SWPAGW03, SWPAGW04, SWPAGW06, and SWPAGW08 were up to ~6x the blank value and can be used with caution.
	Pb : EB2; the associated samples with concentrations <10x blank – GW04, SW01, and SW02.	Pb: Samples SWPAGW04, SWPASW01, and SWPASW02 were qualified with "B". The SWPAGW04 concentration was less than the blank and is therefore unusable. The other two samples are less than 2x the blank; therefore, these data should be used with caution.
	V: EB1, EB2, EB3, EB4, FB1, FB2, FB3, FB4; the associated samples with concentrations <10x blank – GW01, GW02, GW02d, GW03, GW04, GW05, GW06, GW07, GW07d, GW08, GW14, GW18, GW19, SW01, and SW02.	V: Samples SWPAGW01,SWPAGW02, SWPAGW02d, SWPAGW03, SWPAGW04, SWPAGW05, SWPAGW06, SWPAGW07, SWPAGW07d, SWPAGW08, SWPAGW14, SWPAGW18, SWPAGW19, SWPASW01, SWPASW02 qualified with "B". Most sample concentrations were similar to the blanks. This is related to the issue discussed

Table A26. Data Usability Summary (cont.).

Analysis/Lab	Summary of QA/QC Results	Impact on Data/Usability
	Cold vapor AA for Hg: All QA/QC criteria were met.	above with V. These data should be considered unusable. Cold vapor AA for Hg: Meets project requirements.
Charge Balance	The calculated charge balance error ranged from 2.9 to 9.0%, based on the major cations (dissolved Na, K, Ca, and Mg) and anions (Cl, SO_4, NO_3, and DIC). Alkalinity was used for samples SWPAGW18 and SWPAGW19.	Meets project requirements.
Measured versus calculated values of Specific Conductance (SPC)	The error in measured SPC versus calculated SPC ranged from 0.1 to 5.9%.	Meets project requirements.
VOC/ Southwest Research Institute	All QA/QC criteria were met.	Meets project requirements.
Low Molecular Weight Acids/ Shaw Environmental	Low recovery (0%) for isobutyrate matrix spike.	All samples were qualified with "J-" with potential negative bias to the data. As there were no sample detections, it is possible the negative bias may be a factor (note the 0% recovery for the matrix spike).
Glycols/EPA Region 3	The method for glycols was under development.	The QAPP stated these data are to be considered screening values until the method was validated. The data are usable as on-going QC checks provide confidence that the method can detect glycols.
SVOC/ EPA Region 8 Laboratory	The following samples had low surrogate recoveries: SWPAGW07d: p-terphenyl = low; SWPAGW03: nitrobenzene d5 = low, 2-flourobiphenyl = low.	Analytes that were associated with these surrogates for samples SWPAGW03 and SWPAGW07d were qualified with "J-" for a potential negative bias that is taken into account for data usability. See Appendix B for samples qualified.
DRO/GRO/ EPA Region 8 Laboratory	GRO: All QA/QC criteria were met. DRO: SWPA Eq Blank04 (collected 5/20/13) was above the RL (20 µg/L) at 24.6 µg/L. This affected samples SWPAGW03, SWPAGW13, SWPAGW14 and SWPA F Blank04; all samples were non-detect so no B qualifiers are necessary.	GRO: Meets project requirements. DRO: No impact to data usability.

Table A26. Data Usability Summary (cont.).

Analysis/Lab	Summary of QA/QC Results	Impact on Data/Usability
O, H Stable Isotopes of Water/ Shaw Environmental	All QA/QC criteria were met.	Meets project requirements.
Sr Isotopes/ USGS Laboratory- Denver	All QA/QC criteria were met.	Meets project requirements.
Isotech Gas Isotopes	All QA/QC criteria were met.	Meets project requirements.
ALS Radionuclides	All QA/QC criteria were met.	Meets project requirements.

[1] QA/QC criteria and project requirements were met with exceptions as listed.

Table A27. Field QC Data for YSI Electrode Measurements.

Parameter	Electrode Reading	Acceptance Range	Performance Evaluation
July 2011			
July 25, 2011 initial/ mid-day			
Specific Conductance	1385	1272-1554	Acceptable
ORP	208	204-234	Acceptable
pH	7.01	6.80-7.20	Acceptable
Zero-DO	0.02	<0.25	Acceptable
July 25, 2011 end-of-day			
Specific Conductance	1350	1272-1554	Acceptable
ORP	208	204-234	Acceptable
pH	7.03	6.8-7.2	Acceptable
Zero-DO	0.05	<0.25	Acceptable
July 26, 2011 initial			
Specific Conductance	1413	1272-1554	Acceptable
ORP	205	204-234	Acceptable
pH	7.00	6.8-7.2	Acceptable
Zero-DO	0.01	<0.25	Acceptable
July 26, 2011 mid-day			
Specific Conductance	1401	1272-1554	Acceptable
ORP	208	204-234	Acceptable
pH	7.02	6.8-7.2	Acceptable
July 26, 2011 end-of-day			
Specific Conductance	1309	1272-1554	Acceptable
ORP	210	204-234	Acceptable
pH	7.04	6.8-7.2	Acceptable
Zero-DO	0.01	<0.25	Acceptable
July 27, 2011 mid-day/end-of-day			
Specific Conductance	1396	1272-1554	Acceptable
ORP	NR	NR	Not evaluated
pH	7.04	6.8-7.2	Acceptable
Zero-DO	NR	NR	Not evaluated
July 28, 2011 mid-day/ end-of-day			
Specific Conductance	1400	1272-1554	Acceptable
ORP	209	204-234	Acceptable
pH	6.98	6.8-7.2	Acceptable
Zero-DO	0.00	<0.25	Acceptable
March 2012			
March 23, 2012 initial			
Specific Conductance	1412	1272-1554	Acceptable
ORP	214	204-234	Acceptable
pH	7.00	6.8-7.2	Acceptable

Table A27. Field QC Data for YSI Electrode Measurements (cont.).

Parameter	Electrode Reading	Acceptance Range	Performance Evaluation
March 23, 2012 mid-day			
pH	7.03	6.8-7.2	Acceptable
March 23, 2012 end-of-day			
Specific Conductance	1380	1272-1554	Acceptable
ORP	215	204-234	Acceptable
pH	7.02	6.8-7.2	Acceptable
Zero-DO	0.01	<0.25	Acceptable
March 24, 2012 initial			
Specific Conductance	1410	1272-1554	Acceptable
ORP	216	204-234	Acceptable
pH	7.00	6.8-7.2	Acceptable
Zero-DO	0.02	<0.25	Acceptable
March 24, 2012 mid-day/end-of-day			
Specific Conductance	1398	1272-1554	Acceptable
ORP	215	204-234	Acceptable
pH	7.05	6.8-7.2	Acceptable
Zero-DO	0.03	<0.25	Acceptable
March 25, 2012 initial			
Specific Conductance	1412	1272-1554	Acceptable
ORP	215	204-234	Acceptable
pH	7.00	6.8-7.2	Acceptable
Zero-DO	0.06	<0.25	Acceptable
March 25, 2012 mid-day			
Specific Conductance	7732	7690-8080	Acceptable
ORP	230	204-234	Acceptable
pH	6.88	6.8-7.2	Acceptable
March 25, 2012 end-of-day			
Specific Conductance	NR	NR	Not evaluated
ORP	NR	NR	Not evaluated
pH	7.01	6.8-7.2	Acceptable
Zero-DO	NR	NR	Not evaluated
March 26, 2012 initial			
Specific Conductance	1411	1272-1554	Acceptable
ORP	216	204-234	Acceptable
pH	6.99	6.8-7.2	Acceptable
Zero-DO	0.04	<0.25	Acceptable
March 26, 2012 mid-day/end-of-day			
Specific Conductance	1350	1272-1554	Acceptable
ORP	226	204-234	Acceptable
pH	6.97	6.8-7.2	Acceptable
Turbidity	6.87	0-10	Acceptable
March 27, 2012 initial			
Specific Conductance	1413	1272-1554	Acceptable
ORP	216	204-234	Acceptable
pH	7.00	6.8-7.2	Acceptable
Zero-DO	0.05	<0.25	Acceptable
Alkalinity	100	106	Acceptable

Table A27. Field QC Data for YSI Electrode Measurements (cont.).

Parameter	Electrode Reading	Acceptance Range	Performance Evaluation
March 27, 2012 mid-day/end-of-day			
pH	7.02	6.8-7.2	Acceptable
May 2013			
May 17, 2013 initial			
Specific Conductance	1420	1272-1554	Acceptable
ORP	214	204-234	Acceptable
pH	7.00	6.8-7.2	Acceptable
Zero-DO	0.07	<0.25	Acceptable
May 17, 2013 mid-day			
Specific Conductance	1398	1272-1554	Acceptable
ORP	214	204-234	Acceptable
pH	7.05	6.8-7.2	Acceptable
Zero-DO	0.05	<0.25	Acceptable
May 17, 2013 end-of-day			
Specific Conductance	1398	1272-1554	Acceptable
ORP	216	204-234	Acceptable
pH	7.05	6.8-7.2	Acceptable
Zero-DO	0.11	<0.25	Acceptable
Turbidity	6.70	0-10	Acceptable
May 18, 2013 initial			
Specific Conductance	1413	1272-1554	Acceptable
ORP	216	204-234	Acceptable
pH	7.00	6.8-7.2	Acceptable
Zero-DO	0.11	<0.25	Acceptable
May 18, 2013 mid-day/end-of-day			
Specific Conductance	1379	1272-1554	Acceptable
ORP	214	204-234	Acceptable
pH	6.98	6.8-7.2	Acceptable
Zero-DO	0.06	<0.25	Acceptable
May 19, 2013 initial			
Specific Conductance	1413	1272-1554	Acceptable
ORP	215	204-234	Acceptable
pH	7.01	6.8-7.2	Acceptable
Zero-DO	0.07	<0.25	Acceptable
May 19, 2013 mid-day/end-of-day			
Specific Conductance	1389	1272-1554	Acceptable
ORP	217	204-234	Acceptable
pH	7.06	6.8-7.2	Acceptable
Zero-DO	0.22	<0.25	Acceptable
May 20, 2013 initial			
Specific Conductance	1413	1272-1554	Acceptable
ORP	215	204-234	Acceptable
pH	7.00	6.8-7.2	Acceptable
Zero-DO	0.21	<0.25	Acceptable

Table A27. Field QC Data for YSI Electrode Measurements (cont.).

Parameter	Electrode Reading	Acceptance Range	Performance Evaluation
May 20, 2013 mid-day/end-of-day			
Specific Conductance	1490	1272-1554	Acceptable
ORP	216	204-234	Acceptable
pH	7.12	6.8-7.2	Acceptable
Zero-DO	0.12	<0.25	Acceptable

Table A28. Data Qualifiers and Data Descriptors.

Qualifier	Definition
U	The analyte was analyzed for, but was not detected above the reported quantitation limit (QL).
J	The analyte was positively identified. The associated numerical value is the approximate concentration of the analyte in the sample (due either to the quality of the data generated because certain quality control criteria were not met, or the concentration of the analyte was below the QL).
J+	The result is an estimated quantity, but the result may be biased high.
J-	For both detected and non-detected results, there may be a low bias due to low spike recoveries or sample preservation issues.
B	The analyte is found in a blank sample above the QL and the concentration found in the sample is less than 10 times the concentration found in the blank.
H	The sample was prepared or analyzed beyond the specified holding time. Sample results may be biased low.
*	Relative percent difference of a field or lab duplicate is outside acceptance criteria.
R	The data are unusable. The sample results are rejected due to serious deficiencies in the ability to analyze the sample and/or meet quality control criteria. Sample results are not reported. The analyte may or may not be present in the sample.

Data Descriptors

Descriptor	Definition
NA	Not Applicable (See QAPP)
NR	Not Reported by Laboratory or Field Sampling Team
ND	Not Detected
NS	Not Sampled

Table A29. Tentatively Identified Compounds (TICs) for SVOCs.

Sample	Compound (CAS Number)	Estimated concentration (µg/L)
July 2011 Sampling Event		
SWPASW01-0711	Toluene (108-88-3)	0.57
	3-Hexen-2-one (763-93-9)	0.29
	2-Cyclohexen-1-one, 2-methyl-5	0.32
	Caprolactum (105-60-2)	0.53
	Octacosane (630-02-4)	0.28
SWPAGW04-0711	Toluene (108-88-3)	0.34
	Caprolactum (105-60-2)	0.56
SWPASW02-0711	Toluene (108-88-3)	0.52
SWPAGW05-0711	Caprolactum (105-60-2)	0.39
SWPAGW05d-0711	Caprolactum (105-60-2)	0.39
SWPAGW06-0711	Cyclic octaatomic sulfur (010544-50-0)	5.51
SWPAGW10-0711	1-methyl-2-pyrrolidone (872-50-4)	0.47
SWPASW03-0711	1-methyl-2-pyrrolidone (872-50-4)	0.42
	Caprolactum (105-60-2)	0.37
SWPA EQ BLK-01	1-methyl-2-pyrrolidone (872-50-4)	0.67
	Caprolactum (105-60-2)	0.44
	2-methyl-propanoic acid (79-31-2)	0.37
	3,5-bis(1…)-benzenepropanoic acid (70331-94-1)	0.34
SWPAGW13-0711	1-methyl-2-pyrrolidone (872-50-4)	1.23
	2-(2-butoxyethoxy)ethanol (112-34-5)	0.78
	Caprolactum (105-60-2)	0.39
	1,2-benzenedicarboxylic acid (88-99-3)	0.32
	2-hydroxy-1-(…)-octdecanoic acid	0.37
SWPAGW12-0711	1-methyl-2-pyrrolidone (872-50-4)	0.35
	2,6-dimethylbenzoquinone (527-61-7)	0.44
SWPAGW12d-0711	2,6-dimethylbenzoquinone (527-61-7)	0.54
SWPAGW11-0711	Caprolactam (105-60-2)	0.42
	2-ethyl-1-hexanol (104-76-7)	0.74
March 2012 Sampling Event		
SWPA EQ Blank	2-undecanone (112-12-9)	1.12
SWPAGW06-0312	Cyclic octaatomic sulfur (010544-50-0)	2.02
SWPA F Blank03	2-undecanone (112-12-9)	1.20
SWPA Eq Blank02	2-undecanone (112-12-9)	0.89
SWPAGW11-0312	Cyclic octaatomic sulfur (010544-50-0)	1.48

Table A29. Tentatively Identified Compounds (TICs) for SVOCs (cont.).

Sample	Compound (CAS Number)	Estimated concentration (µg/L)
May 2013		
SWPA F Blank01	2-undecanone (112-12-9)	1.21
SWPA Eq Blank01	2-undecanone (112-12-9)	1.19
SWPAGW05-0513	1-propene, 1,2,3-trichloro (013116-57-9)	1.05
	Propylene glycol (57-55-6)	7.46
SWPAGW09-0513	Cyclic octaatomic sulfur (010544-50-0)	3.40
SWPA F Blank02	2-undecanone (112-12-9)	1.32
	3,5-di-tert-butyl-4-hydroxy (001620-98-0)	0.64
SWPA Eq Blank02	2-undecanone (112-12-9)	1.09
	3,5-di-tert-butyl-4-hydroxy (1620-98-0)	0.53
	Phenol, 2,4-bis(1,1-dimethyl) (96-76-4)	0.66
SWPA F Blank03	2-undecanone (112-12-9)	1.25
	Thiophene, 2-(1,1-dimethyl) (1689-78-7)	0.55
	3,5-di-tert-butyl-4-hydroxy (001620-98-0)	0.79
SWPA Eq Blank03	2-undecanone (112-12-9)	1.01
	3,5-di-tert-butyl-4-hydroxy (001620-98-0)	0.61
	Phenol, 2,4-bis(1,1-dimethyl) (96-76-4)	0.57
SWPAGW08-0513	Cyclic octaatomic sulfur (010544-50-0)	29.5
SWPA Eq Blank04	3,5-di-tert-butyl-4-hydroxy (001620-98-0)	0.64
	2-undecanone (112-12-9)	2.13

Appendix B
Sample Results
Retrospective Case Study in Southwestern Pennsylvania

U.S. Environmental Protection Agency
Office of Research and Development
Washington, DC

May 2015
EPA/600/R-14/084

Table of Contents

Tables

Appendix B. Sample Results_ Legend (Washington County, Pennsylvania)

Data Qualifiers

<	The analyte concentration is less than the quantitation limit (QL).
U	The analyte was analyzed for, but was not detected above the reported QL.
J	The analyte was positively identified. The associated numerical value is the approximate concentration of the analyte in the sample (due either to the quality of the data generated because certain quality control criteria were not met, or the concentration of the analyte was below the QL).
J+	The result is an estimated quantity, but the result may be biased high.
J-	For both detected and non-detected results, the result is estimated but may be biased low.
B	The analyte is found in a blank sample above the QL and the concentration found in the sample is less than 10 times the concentration found in the blank.
H	The sample was prepared or analyzed beyond the specified holding time. Sample results may be biased low.
*	Relative percent difference of a field or lab duplicate is outside acceptance criteria.
R	The data are unusable. The sample results are rejected due to serious deficiencies in the ability to analyze the sample and/or meet quality control criteria. Sample results are not reported. The analyte may or may not be present in the sample.

Notes

Table B-1	Total Dissolved Solids (TDS) is estimated based on Specific Conductance (SPC): TDS(mg/L) = SPC(mS/cm) * 650.
	Field-determined concentrations of ferrous iron and hydrogen sulfide are screening values.
Table B-3	R. Data rejected. Potential spectral (mass or emission) interference.
Table B-4	R. Data rejected. 1,1,2-trichloroethane is subject to alkaline hydrolysis to 1,1-dichloroethene. This reaction could be supported by the sample preservative (trisodium phosphate).
Table B-5	R. Data rejected. Acetate contamination in samples and blanks is due to the sample preservative (trisodium phosphate).
	The method used for glycol analysis is under development.

Appendix B. Sample Results - Legend (Washington County, Pennsylvania)

Acronyms

CAS	Chemical Abstracts Service
DIC	Dissolved Inorganic Carbon
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DRO	Diesel Range Organics
GRO	Gasoline Range Organics
NA	Not Applicable (See QAPP)
ND	Not Detected
NR	Not Reported by Laboratory or Field Sampling Team
NS	Not Sampled
ORP	Oxidation reduction potential
SPC	Specific Conductance
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TPH	Total Petroleum Hydrocarbons
Gross Alpha	Gross alpha particle activity
Gross Beta	Gross beta particle activity

Units

BTU	British thermal unit
^{o}C	Degrees Celsius
µg/L	Micrograms per liter
mg/L	Milligrams per liter
mS/cm	Millisiemens per centimeter at 25^{o}C
pCi/L	Picocuries per liter

Key

GW	Ground water sample
SW	Surface water sample
04	Sampling location
d	Field Duplicate

Appendix B. Sample Results. Legend (Washington County, Pennsylvania)

Metals and Isotopes

Ag	Silver	Hg	Mercury	Sb	Antimony	$\delta^{2}H$	[($^{2}H/H$) Sample/($^{2}H/H$) Standard] * 1000
Al	Aluminum	K	Potassium	Se	Selenium	$\delta^{18}O$	[($^{18}O/^{16}O$) Sample/($^{18}O/^{16}O$) Standard] * 1000
As	Arsenic	Li	Lithium	Si	Silicon	$\delta^{13}C$	[($^{13}C/^{12}C$) Sample/($^{13}C/^{12}C$) Standard] * 1000
B	Boron	Mg	Magnesium	Sr	Strontium		
Ba	Barium	Mn	Manganese	Th	Thorium	Ra-226	Radium-226
Be	Beryllium	Mo	Molybdenum	Ti	Titanium	Ra-228	Radium-228
Ca	Calcium	Na	Sodium	Tl	Thallium		
Cd	Cadmium	Ni	Nickel	U	Uranium		
Co	Cobalt	P	Phosphorus	V	Vanadium		
Cr	Chromium	Pb	Lead	Zn	Zinc		
Cu	Copper	Rb	Rubidium				
Fe	Iron	S	Sulfur				

Table B-1 Sample Results - Field Parameters (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW01 7/25/11 Round 1	GW01 5/17/13 Round 3	GW02 7/25/11 Round 1	GW02 5/18/13 Round 3	GW03 7/25/11 Round 1	GW03 3/23/12 Round 2	GW03 5/20/13 Round 3
Temperature	^{o}C	17.2	14.1	12.6	12.3	16.0	11.9	12.3
SPC	mS/cm	0.379	0.537	0.343	0.537	0.581	0.752	0.798
TDS	mg/L	247	349	223	349	378	489	519
DO	mg/L	0.01	0.15	0.00	0.09	4.47	7.64	8.52
pH		7.12	6.87	7.56	6.90	7.52	7.06	6.85
ORP	mV	17	78	-132	-25	23	99	235
Turbidity	NTU	2.0	0.6	8.2	27.7	5.2	10.6	2.5
Alkalinity	mg $CaCO_3$/L	350	281	300	240	262	252	187
Ferrous Iron	mg Fe^{2+}/L	<0.03 U	<0.03 U	0.03 J	0.03 J	<0.03 U	<0.03 U	<0.03 U
Hydrogen Sulfide	mg S/L	<0.01 U	0.01 J	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U

Table B-1 Sample Results - Field Parameters (Washington County, Pennsylvania)

	Sample	GW04	GW04	GW04	GW05	GW05	GW05	GW06	GW06	GW06
	Sample Date	7/25/11	3/23/12	5/18/13	7/26/11	3/23/12	5/17/13	7/26/11	3/24/12	5/19/13
Parameter	Unit	Round 1	Round 2	Round 3	Round 1	Round 2	Round 3	Round 1	Round 2	Round 3
Temperature	^{o}C	14.8	14.2	13.4	13.4	12.3	12.7	16.3	11.7	12.0
SPC	mS/cm	0.398	0.587	0.597	0.874	1.352	1.472	0.645	0.642	0.694
TDS	mg/L	258	382	388	568	879	957	420	417	452
DO	mg/L	0.03	0.06	0.14	2.86	7.42	4.49	0.47	0.23	0.12
pH		7.29	7.20	7.06	7.14	6.84	6.77	8.60	6.99	7.14
ORP	mV	-29	-49	-31	127	82	130	-157	-98	-130
Turbidity	NTU	17	5.7	15.2	16	4.4	0.9	19	0.8	7.1
Alkalinity	mg $CaCO_3$/L	244	232	274	340	320	365	428	205	278
Ferrous Iron	mg Fe^{2+}/L	1.65 J	<0.03 U	0.55 J	<0.03 U	<0.03 U	<0.03 U	0.15 J	0.83 J	0.78 J
Hydrogen Sulfide	mg S/L	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	0.05 J	0.26 J

Table B-1 Sample Results - Field Parameters (Washington County, Pennsylvania)

	Sample	GW07	GW07	GW08	GW08	GW08	GW09	GW09	GW10	GW10
	Sample Date	7/26/11	5/19/13	7/27/11	3/24/12	5/19/13	7/27/11	5/17/13	7/27/11	3/26/12
Parameter	Unit	Round 1	Round 3	Round 1	Round 2	Round 3	Round 1	Round 3	Round 1	Round 2
Temperature	^{o}C	13.2	13.0	20.1	10.8	12.3	13.0	12.3	13.4	11.5
SPC	mS/cm	0.442	0.592	0.481	0.525	0.527	0.583	0.754	0.816	0.894
TDS	mg/L	287	385	312	341	343	379	490	531	581
DO	mg/L	3.97	4.94	5.41	6.12	6.49	8.24	7.22	3.89	7.28
pH		6.88	6.20	7.52	7.35	7.18	7.17	6.92	7.13	6.98
ORP	mV	115	134	75	14	178	98	153	99	41
Turbidity	NTU	9.0	3.0	7.6	1.6	2.2	5.0	25.2	4.3	3.5
Alkalinity	mg $CaCO_3$/L	94	115	208	202	210	216	252	396	290
Ferrous Iron	mg Fe^{2+}/L	<0.03 U	<0.03 U	<0.03 U	<0.03 U	<0.03 U	<0.03 U	<0.03 U	<0.03 U	<0.03 U
Hydrogen Sulfide	mg S/L	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U

Table B-1 Sample Results - Field Parameters (Washington County, Pennsylvania)

	Sample	GW11	GW11	GW12	GW12	GW13	GW13	GW13	GW14	GW14
	Sample Date	7/28/11	3/26/12	7/28/11	3/25/12	7/28/11	3/24/12	5/20/13	3/27/12	5/20/13
Parameter	Unit	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 3	Round 2	Round 3
Temperature	^oC	16.6	13.6	19.1	14.7	16.9	10.7	12.4	9.0	11.6
SPC	mS/cm	0.608	0.710	0.568	0.413	2.005	1.869	1.530	1.120	1.002
TDS	mg/L	395	462	369	268	1303	1215	994	728	651
DO	mg/L	0.19	0.25	2.86	6.35	1.85	9.68	6.21	6.36	4.64
pH		7.11	6.98	6.97	6.82	7.02	6.95	7.05	7.10	6.74
ORP	mV	68	23	90	105	103	63	257	120	187
Turbidity	NTU	4.5	2.3	7.0	2.2	13	2.0	2.9	3.7	12.0
Alkalinity	mg $CaCO_3$/L	264	290	272	210	198	192	225	194	224
Ferrous Iron	mg Fe^{2+}/L	<0.03 U	0.05 J	<0.03 U	<0.03 U	<0.03 U	<0.03 U	<0.03 U	<0.03 U	<0.03 U
Hydrogen Sulfide	mg S/L	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U

Table B-1 Sample Results - Field Parameters (Washington County, Pennsylvania)

	Sample	GW15	GW16	GW17	GW18	GW19
	Sample Date	3/25/12	3/27/12	3/27/12	5/20/13	5/20/13
Parameter	Unit	Round 2	Round 2	Round 2	Round 3	Round 3
Temperature	^oC	11.1	12.2	12.6	17.5	16.1
SPC	mS/cm	0.503	0.617	1.024	0.531	0.840
TDS	mg/L	327	401	666	345	546
DO	mg/L	6.86	6.30	0.06	3.25	1.82
pH		7.00	6.63	8.93	7.82	7.70
ORP	mV	79	224	123	193	124
Turbidity	NTU	0.8	2.4	1.0	4.7	5.4
Alkalinity	mg $CaCO_3$/L	216	200	540	294	407
Ferrous Iron	mg Fe^{2+}/L	<0.03 U	<0.03 U	<0.03 U	<0.03 U	<0.03 U
Hydrogen Sulfide	mg S/L	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U

Table B-1 Sample Results - Field Parameters (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	SW01 7/25/11 Round 1	SW01 5/18/13 Round 3	SW02 7/25/11 Round 1	SW02 3/23/12 Round 2	SW02 5/18/13 Round 3	SW03 7/27/11 Round 1	SW03 3/26/12 Round 2
Temperature	^{o}C	16.1	11.8	22.1	16.7	18.9	19.1	10.2
SPC	mS/cm	0.370	0.538	0.457	0.610	0.593	0.566	0.551
TDS	mg/L	241	349	297	397	386	368	358
DO	mg/L	4.87	8.45	6.06	11.17	9.81	4.55	6.94
pH		7.45	7.33	8.13	8.27	7.89	7.14	6.90
ORP	mV	-10	219	-1	84	148	-23	64
Turbidity	NTU	5.4	18.3	47	27.0	19.8	3.0	0.7
Alkalinity	mg $CaCO_3$/L	326	293	292	198	205	252	218
Ferrous Iron	mg Fe^{2+}/L	<0.03 U	<0.03 U	0.03 J	<0.03 U	<0.03 U	<0.03 U	<0.03 U
Hydrogen Sulfide	mg S/L	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U

Table B-2 Sample Results - Anions and Ammonia (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW01 7/25/11 Round 1	GW01 5/17/13 Round 3	GW02 7/25/11 Round 1	GW02 5/18/13 Round 3	GW03 7/25/11 Round 1	GW03 3/23/12 Round 2	GW03 5/20/13 Round 3
Anion-Cation Balance	%	1.8	8.4	5.3	7.2	3.0	3.3	6.9
DOC	mg/L	<0.50 U	0.46 B	0.64	0.69	<0.50 U	0.60	0.52 B
DIC	mg/L	75.3	72.8	65.1	60.7	68.5	72.0	70.2
Nitrate + Nitrite	mg N/L	0.55	0.18	0.21	0.05 J	0.73	2.50 B	1.20
Ammonia	mg N/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
TKN	mg N/L	NA	<0.10 U	NA	<0.10 U	NA	NA	0.05 J
Bromide	mg/L	1.24	1.70	1.41	1.54	<2.00 U	1.88	<1.00 U
Chloride	mg/L	5.17	4.85	5.04	14.8	92.7	50.9	73.4
Sulfate	mg/L	43.2	37.1	38.9	38.4	57.3	41.3	52.2
Fluoride	mg/L	0.13 J	0.17 J	0.18 J	0.17 J	0.16 J	0.10 J	0.06 J

Table B-2 Sample Results - Anions and Ammonia (Washington County, Pennsylvania)

	Sample	GW04	GW04	GW04	GW05	GW05	GW05	GW06	GW06	GW06
	Sample Date	7/25/11	3/23/12	5/18/13	7/26/11	3/23/12	5/17/13	7/26/11	3/24/12	5/19/13
Parameter	Unit	Round 1	Round 2	Round 3	Round 1	Round 2	Round 3	Round 1	Round 2	Round 3
Anion-Cation Balance	%	3.5	1.2	5.0	3.5	2.1	4.3	0.8	2.2	6.3
DOC	mg/L	1.02	0.98	0.92	0.80	1.19	1.10 B	0.54	<0.50 U	0.45
DIC	mg/L	68.8	62.9	63.3	103	97.4	98.3	75.9	54.2	71.7
Nitrate + Nitrite	mg N/L	0.19	0.57 B	0.02 J	0.49	1.51 B	0.38	<0.10 U	0.41 B	<0.10 U
Ammonia	mg N/L	0.18	0.14	0.09 J	<0.10 U	<0.10 U	<0.10 U	0.27	0.27	0.17
TKN	mg N/L	NA	NA	0.25	NA	NA	0.16 B	NA	NA	0.36
Bromide	mg/L	1.75	1.17	1.60	1.00 J	<1.00 U	<1.00 U	<1.00 U	0.66 J	<1.00 U
Chloride	mg/L	27.0	27.9	29.5	75.7	210	249	46.1	58.1	51.3
Sulfate	mg/L	28.1	26.0	23.6	53.9	37.0	44.7	14.4	47.1	14.6
Fluoride	mg/L	0.17 J	0.09 J	0.13 J	0.11 J	0.05 J	0.06 J	1.24	0.22	1.15

Table B-2 Sample Results - Anions and Ammonia (Washington County, Pennsylvania)

	Sample	GW07	GW07	GW08	GW08	GW08	GW09	GW09	GW10	GW10
	Sample Date	7/26/11	5/19/13	7/27/11	3/24/12	5/19/13	7/27/11	5/17/13	7/27/11	3/26/12
Parameter	Unit	Round 1	Round 3	Round 1	Round 2	Round 3	Round 1	Round 3	Round 1	Round 2
Anion-Cation Balance	%	4.8	7.3	1.6	2.2	7.6	1.8	9.0	5.2	1.0
DOC	mg/L	0.56	0.62	0.61	0.55	0.39	0.58	0.60 B	1.06	1.07
DIC	mg/L	33.2	24.2	56.3	55.6	54.1	62.1	72.8	80.5	79.2
Nitrate + Nitrite	mg N/L	2.55	1.09	1.93 B	2.26 B	1.46	0.84 B	0.28	17.7	23
Ammonia	mg N/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	0.29	<0.10 U	<0.10 U
TKN	mg N/L	NA	0.09 J	NA	NA	<0.10 U	NA	0.51 B	NA	NA
Bromide	mg/L	<1.00 U	<1.00 U	1.53	0.72 J	1.06	1.57	<1.00 U	2.05	3.03
Chloride	mg/L	73.2	111	16.7	12.7	11.9	46.7	68.0	40.4	43.2
Sulfate	mg/L	37.7	35.1	40.4	36.0	37.8	42.4	52.4	69.8	70.9
Fluoride	mg/L	0.10 J	<0.20 U	0.13 J	0.09 J	0.09 J	0.06 J	0.09 J	0.06 J	0.07 J

Table B-2 Sample Results - Anions and Ammonia (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW11 7/28/11 Round 1	GW11 3/26/12 Round 2	GW12 7/28/11 Round 1	GW12 3/25/12 Round 2	GW13 7/28/11 Round 1	GW13 3/24/12 Round 2	GW13 5/20/13 Round 3	GW14 3/27/12 Round 2	GW14 5/20/13 Round 3
Anion-Cation Balance	%	2.3	1.9	1.4	5.4	2.3	1.3	2.9	0.7	5.7
DOC	mg/L	0.65	0.73	0.83	0.55	0.55	0.52	0.54 B	0.67	0.61 B
DIC	mg/L	80.1	80.0	70.2	55.1	52.6	55.6	53.6	54.6	57.2
Nitrate + Nitrite	mg N/L	0.38 B	0.73	4.54	0.84 B	0.32 B	1.21 B	0.32	0.71	0.31
Ammonia	mg N/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
TKN	mg N/L	NA	NA	NA	NA	NA	NA	0.14	NA	0.12
Bromide	mg/L	2.40	1.98	1.99	0.44 J	<6.00 U	<1.00 U	2.23	0.54 J	0.64 J
Chloride	mg/L	16.7	16.6	28.7	1.91	631	462	390	228	179
Sulfate	mg/L	98.9	91.6	56.2	26.8	25.7	27.3	31.3	25.8	31.3
Fluoride	mg/L	0.10 J	0.08 J	0.09 J	0.11 J	<0.20 U	0.05 J	<0.20 U	<0.20 U	0.07 J

Table B-2 Sample Results - Anions and Ammonia (Washington County, Pennsylvania)

	Sample	GW15	GW16	GW17	GW18	GW19
	Sample Date	3/25/12	3/27/12	3/27/12	5/20/13	5/20/13
Parameter	Unit	Round 2	Round 2	Round 2	Round 3	Round 3
Anion-Cation Balance	%	4.2	3.9	2.4	0.6	2.8
DOC	mg/L	0.62	1.33	1.99	NS	NS
DIC	mg/L	60.0	66.0	119	NS	NS
Nitrate + Nitrite	mg N/L	1.68 B	3.88	0.38	0.32	<0.10 U
Ammonia	mg N/L	<0.10 U	<0.10 U	0.27	0.13	0.08 J
TKN	mg N/L	NA	NA	NA	0.26	0.24
Bromide	mg/L	0.72 J	1.39	<1.00 U	0.20 J	<1.00 U
Chloride	mg/L	7.76	34.5	41.2	2.23	33.9
Sulfate	mg/L	30.9	56.6	4.51	22.7	24.6
Fluoride	mg/L	0.08 J	0.06 J	2.03	0.3	0.96

Table B-2 Sample Results - Anions and Ammonia (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	SW01 7/25/11 Round 1	SW01 5/18/13 Round 3	SW02 7/25/11 Round 1	SW02 3/23/12 Round 2	SW02 5/18/13 Round 3	SW03 7/27/11 Round 1	SW03 3/26/12 Round 2
Anion-Cation Balance	%	2.7	6.3	0.5	0.9	3.1	2.9	3.74
DOC	mg/L	1.17	0.94	1.80	1.24	1.85	0.90	0.72
DIC	mg/L	69.0	61.4	51.9	49.2	46.2	80.8	66.7
Nitrate + Nitrite	mg N/L	0.57	0.38	0.42	1.29 B	0.32	0.71 B	2.42
Ammonia	mg N/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
TKN	mg N/L	NA	0.05 J	NA	NA	0.17	NA	NA
Bromide	mg/L	1.15	1.17	0.48 J	0.66 J	0.70 J	1.15	0.99 J
Chloride	mg/L	1.86	1.93	60.4	41.9	40.1	8.59	13.2
Sulfate	mg/L	38.3	38.7	43.6	40.5	49.3	48.8	45.5
Fluoride	mg/L	0.17 J	0.17 J	0.14 J	0.13 J	0.16 J	0.10 J	0.03 J

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

	Sample	GW01	GW01	GW02	GW02	GW03	GW03	GW03
	Sample Date	7/25/11	5/17/13	7/25/11	5/18/13	7/25/11	3/23/12	5/20/13
Parameter	Unit	Round 1	Round 3	Round 1	Round 3	Round 1	Round 2	Round 3
Dissolved Ag	µg/L	<14 U	<10 U	<14 U	<10 U	<14 U	<16 U	<10 U
Total Ag	µg/L	<16 U	<10 U	<16 U	<10 U	<16 U	<16 U, J-	<10 U
Dissolved Al	µg/L	<494 U	<20 U	<494 U	<20 U	<494 U	<20.0 U	<20 U
Total Al	µg/L	<548 U	<20 U	<548 U	<20 U	<548 U	<20.0 U	<20 U
Dissolved As	µg/L	<20 U	<0.20 U	<20 U	0.17 J	<20 U	0.53 J	0.14 J
Total As	µg/L	<22 U	0.31 B	<22 U	1.3 B	<22 U	0.54 J	0.57 B
Dissolved B	µg/L	<333 U	<40 U	<333 U	11 J	<333 U	<333 U	11 J
Total B	µg/L	<370 U	16 J	<370 U	24	<370 U	<370 U	21
Dissolved Ba	µg/L	163 J	166	89 J	97	96 J	109 J	101
Total Ba	µg/L	161 J	162	93 J	102	97 J	109 J	100
Dissolved Be	µg/L	<10 U	<5.0 U	<10 U	<5.0 U	<10 U	<10 U	<5.0 U
Total Be	µg/L	<11 U	<2.5 U	<11 U	<2.5 U	<11 U	<11 U	<2.5 U
Dissolved Ca	mg/L	74.6	78.8	69.9	75.8	127	121	135
Total Ca	mg/L	74.7 J	75.4	71.1 J	73.3	130 J	125 J	135
Dissolved Cd	µg/L	<4 U	<0.20 U	<4 U	<0.20 U	<4 U	<1.0 U	<0.20 U
Total Cd	µg/L	<4 U	<0.20 U	<4 U	<0.20 U	<4 U	<1.0 U	<0.20 U
Dissolved Co	µg/L	<4 U	<5.0 U	<4 U	<5.0 U	<4 U	<4 U	<5.0 U
Total Co	µg/L	<4 U	<2.5 U	<4 U	<2.5 U	<4 U	<4 U	0.54 J
Dissolved Cr	µg/L	<7 U	0.46 J	<7 U	0.32 J	<7 U	<2.0 U	<2.0 U
Total Cr	µg/L	<8 U	<2.0 U	<8 U	<2.0 U	<8 U	<2.0 U	<2.0 U
Dissolved Cu	µg/L	12 J	9.4	<20 U	0.57	<20 U	6.4	5.8 B
Total Cu	µg/L	<22 U	9.4	<22 U	0.80 B	38 J	6.1	6.2 B
Dissolved Fe	µg/L	<67 U	100	67	122	<67 U	<67 U	106
Total Fe	µg/L	<74 U	94	297 J	902 *	<74 U	<74 U	139
Dissolved Hg	µg/L	NA	<0.20 U	NA	<0.20 U	NA	NA	<0.20 U
Total Hg	µg/L	NA	<0.20 U	NA	<0.20 U	NA	NA	<0.20 U
Dissolved K	mg/L	0.76 J	0.95	0.96 J	1.18	1.23 J	1.13 J	1.27
Total K	mg/L	0.78 J	0.90	1.03 J	1.18	1.30 J	1.14 J	1.25
Dissolved Li	µg/L	NA	6.5 J	NA	3.9 J	NA	NA	8.6 J
Total Li	µg/L	NA	6.7	NA	4.2 J	NA	NA	8.2
Dissolved Mg	mg/L	27.5	29.7	21.4	22.7	15.6	12.7	15.1

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW04 7/25/11 Round 1	GW04 3/23/12 Round 2	GW04 5/18/13 Round 3	GW05 7/26/11 Round 1	GW05 3/23/12 Round 2	GW05 5/17/13 Round 3	GW06 7/26/11 Round 1	GW06 3/24/12 Round 2	GW06 5/19/13 Round 3
Dissolved Ag	µg/L	<14 U	<16 U	<10 U	4 J	<16 U	<10 U	<14 U	<16 U	<10 U
Total Ag	µg/L	<16 U	<16 U, J-	<10 U	<16 U	<16 U, J-	<10 U	<16 U	<16 U, J-	<10 U
Dissolved Al	µg/L	<494 U	<20.0 U	<20 U	<494 U	28.7	<20 U	<494 U	<20.0 U	<20 U
Total Al	µg/L	<548 U	<20.0 U	85	<548 U	21.8	<20 U	<548 U	<20.0 U	<20 U
Dissolved As	µg/L	<20 U	0.77 J	0.55	<20 U	0.83 J	0.11 J	<20 U	1.3	0.19 J
Total As	µg/L	<22 U	2.3	4.1	<22 U	0.96 J	0.46 B	<22 U	1.4	0.67 B
Dissolved B	µg/L	<333 U	<333 U	30 J	<333 U	<333 U	29 J	256 J	109 J	236
Total B	µg/L	<370 U	<370 U	36	<370 U	<370 U	39	247 J	<370 U	230
Dissolved Ba	µg/L	465 J	438 J	407	175 J	280 J	265	231 J	410 J	293
Total Ba	µg/L	493 J	446 J	460	178 J	274 J	264	239 J	394 J	301
Dissolved Be	µg/L	<10 U	<10 U	<5.0 U	<10 U	<10 U	<5.0 U	<10 U	<10 U	<5.0 U
Total Be	µg/L	<11 U	<11 U	<2.5 U	<11 U	<11 U	<2.5 U	<11 U	<11 U	<2.5 U
Dissolved Ca	mg/L	92.0	91.8	93.7	125	164	176	12.4	52.6	17.4
Total Ca	mg/L	94.2 J	93.8 J	91.9	127 J	167 J	181	12.9 J	53.9 J	19.0
Dissolved Cd	µg/L	<4 U	<1.0 U	<0.20 U	<4 U	<1.0 U	<0.20 U	<4 U	<1.0 U	<0.20 U
Total Cd	µg/L	<4 U	<1.0 U	<0.20 U	<4 U	<1.0 U	<0.20 U	<4 U	<1.0 U	<0.20 U
Dissolved Co	µg/L	<4 U	<4 U	1.7 J	<4 U	<4 U	<5.0 U	<4 U	<4 U	<5.0 U
Total Co	µg/L	<4 U	<4 U	0.62 J	<4 U	<4 U	<2.5 U	<4 U	<4 U	<2.5 U
Dissolved Cr	µg/L	<7 U	<2.0 U	<2.0 U	<7 U	<2.0 U	0.86 J	<7 U	<2.0 U	<2.0 U
Total Cr	µg/L	<8 U	<2.0 U	<2.0 U	<8 U	<2.0 U	<2.0 U	<8 U	<2.0 U	<2.0 U
Dissolved Cu	µg/L	<20 U	<2.0 U	0.44 J	11 J	<2.0 U	1.1	<20 U	<2.0 U	0.24 J
Total Cu	µg/L	<22 U	<2.0 U	3.5 B	<22 U	<2.0 U	1.4	<22 U	12.2	1.5 B
Dissolved Fe	µg/L	1060	773	348	<67 U	265	77 J	201	2750	888
Total Fe	µg/L	3040 J	1950 J	5450 *	<74 U	44 J	89	800 J	3080 J	1480
Dissolved Hg	µg/L	NA	NA	<0.20 U	NA	NA	<0.20 U	NA	NA	<0.20 U
Total Hg	µg/L	NA	NA	<0.20 U	NA	NA	<0.20 U	NA	NA	<0.20 U
Dissolved K	mg/L	1.35 J	1.20 J	1.33	1.57 J	1.82 J	2.08	0.83 J	1.32 J	0.97
Total K	mg/L	1.36 J	1.25 J	1.30	1.61 J	1.93 J	2.04	0.88 J	1.34 J	0.96
Dissolved Li	µg/L	NA	NA	8.4 J	NA	NA	8.4 J	NA	NA	19
Total Li	µg/L	NA	NA	7.8	NA	NA	8.2	NA	NA	18
Dissolved Mg	mg/L	11.7	12.1	13.5	19.6	21.0	22.3	3.85	13.6	5.42

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW07 7/26/11 Round 1	GW07 5/19/13 Round 3	GW08 7/27/11 Round 1	GW08 3/24/12 Round 2	GW08 5/19/13 Round 3	GW09 7/27/11 Round 1	GW09 5/17/13 Round 3	GW10 7/27/11 Round 1	GW10 3/26/12 Round 2
Dissolved Ag	µg/L	<14 U	<10 U	<14 U	<16 U	<10 U	<14 U	<10 U	<14 U	<16 U
Total Ag	µg/L	<16 U	<10 U	<16 U	<16 U, J-	<10 U	<16 U	<10 U	<16 U	<16 U, J-
Dissolved Al	µg/L	<494 U	<20 U	<494 U	28.1	<20 U	<494 U	136	<494 U	<20.0 U
Total Al	µg/L	<548 U	<20 U	<548 U	54.8	33	<548 U	2380	<548 U	69.7
Dissolved As	µg/L	<20 U	0.12 J	<20 U	0.69 J	<0.20 U	<20 U	0.46	<20 U	0.59 J
Total As	µg/L	<22 U	0.23 B	<22 U	0.50 J	0.38 B	<22 U	5.9	<22 U	1.2
Dissolved B	µg/L	<333 U	17 J	<333 U	<333 U	<40 U	<333 U	52	<333 U	<333 U
Total B	µg/L	<370 U	23	<370 U	<370 U	<20 U	<370 U	35	<370 U	<370 U
Dissolved Ba	µg/L	74 J	85	125 J	129 J	121	264 J	179	104 J	90 J
Total Ba	µg/L	77 J	81	127 J	129 J	120	273 J	675	107 J	91 J
Dissolved Be	µg/L	<10 U	<5.0 U	<10 U	<10 U	<5.0 U	<10 U	<5.0 U	<10 U	<10 U
Total Be	µg/L	<11 U	<2.5 U	<11 U	<11 U	<2.5 U	<11 U	0.21 J	<11 U	<11 U
Dissolved Ca	mg/L	53.7	59.1	89.4	91.3	98.5	98.5	56	129	134
Total Ca	mg/L	54.4 J	56.1	90.8 J	93.5 J	93.5	100 J	109	131 J	141 J
Dissolved Cd	µg/L	<4 U	<0.20 U	<4 U	<1.0 U	<0.20 U	<4 U	<0.20 U	<4 U	0.31 J
Total Cd	µg/L	<4 U	<0.20 U	<4 U	<1.0 U	<0.20 U	<4 U	<0.20 U	<4 U	<1.0 U
Dissolved Co	µg/L	<4 U	<5.0 U	<4 U	<4 U	<5.0 U	<4 U	2.0 J	<4 U	<4 U
Total Co	µg/L	<4 U	<2.5 U	<4 U	<4 U	<2.5 U	<4 U	10.8	<4 U	<4 U
Dissolved Cr	µg/L	<7 U	<2.0 U	<7 U	<2.0 U	<2.0 U	<7 U	1.3 J	<7 U	<2.0 U
Total Cr	µg/L	<8 U	<2.0 U	<8 U	<2.0 U	<2.0 U	4 J	15.8	<8 U	<2.0 U
Dissolved Cu	µg/L	60	78	8 J	3.6	1.5	<20 U	2.9	<20 U	<2.0 U
Total Cu	µg/L	70 J	72	27 J	4.1	1.9 B	<22 U	36.1	<22 U	1.3 J
Dissolved Fe	µg/L	<67 U	<100 U	<67 U	<67 U	<100 U	<67 U	832	<67 U	<67 U
Total Fe	µg/L	25 J	<50 U	<74 U	41 J	46 J	150 J	10200	<74 U	58 J
Dissolved Hg	µg/L	NA	<0.20 U	NA	NA	<0.20 U	NA	<0.20 U	NA	NA
Total Hg	µg/L	NA	<0.20 U	NA	NA	0.01 J	NA	0.02 J	NA	NA
Dissolved K	mg/L	1.26 J	1.34	1.30 J	1.24 J	1.09	0.90 J	2.12	1.63 J	1.82 J
Total K	mg/L	1.29 J	1.28	1.31 J	1.24 J	1.08	1.00 J	2.40	1.66 J	1.87 J
Dissolved Li	µg/L	NA	3.7 J	NA	NA	4.6 J	NA	18	NA	NA
Total Li	µg/L	NA	3.9 J	NA	NA	4.6 J	NA	14	NA	NA
Dissolved Mg	mg/L	10.0	10.4	8.83	8.75	9.28	13.0	9.74	21.5	21.3

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW11 7/28/11 Round 1	GW11 3/26/12 Round 2	GW12 7/28/11 Round 1	GW12 3/25/12 Round 2	GW13 7/28/11 Round 1	GW13 3/24/12 Round 2	GW13 5/20/13 Round 3	GW14 3/27/12 Round 2	GW14 5/20/13 Round 3
Dissolved Ag	µg/L	<14 U	<16 U	<14 U	<16 U	4 J	<16 U	<10 U	<16 U	<10 U
Total Ag	µg/L	<16 U	<16 U, J-	<16 U	<16 U, J-	<16 U	<16 U, J-	<10 U	<16 U, J-	<10 U
Dissolved Al	µg/L	<494 U	<20.0 U	<494 U	<20.0 U	<494 U	<20.0 U	<20 U	<20.0 U	<20 U
Total Al	µg/L	<548 U	<20.0 U	986 J	<20.0 U	182 J	<20.0 U	<20 U	66.0	26
Dissolved As	µg/L	<20 U	0.63 J	<20 U	0.56 J	<20 U	1.0	0.08 J	1.1	0.31
Total As	µg/L	<22 U	0.78 J	<22 U	0.71 J	<22 U	0.87 J	0.23 B	1.1	0.56 B
Dissolved B	µg/L	<333 U	<333 U	<333 U	<333 U	<333 U	<333 U	<40 U	<333 U	<40 U
Total B	µg/L	<370 U	<370 U	<370 U	<370 U	<370 U	<370 U	3.1 J	<370 U	8.2 J
Dissolved Ba	µg/L	34 J	33 J	37 J	43 J	291 J	223 J	172	142 J	122
Total Ba	µg/L	35 J	33 J	76 J	44 J	298 J	222 J	163	142 J	115
Dissolved Be	µg/L	<10 U	<10 U	<10 U	<10 U	<10 U	<10 U	<5.0 U	<10 U	<5.0 U
Total Be	µg/L	<11 U	<11 U	<11 U	<11 U	<11 U	<11 U	<2.5 U	<11 U	<2.5 U
Dissolved Ca	mg/L	102	104	103	70.8	351	295	288	190	175
Total Ca	mg/L	103 J	104 J	104 J	72.1 J	352 J	309 J	274	194 J	175
Dissolved Cd	µg/L	<4 U	<1.0 U	<4 U	<1.0 U	<4 U	<1.0 U	<0.20 U	<1.0 U	<0.20 U
Total Cd	µg/L	<4 U	<1.0 U	2 J	<1.0 U	<4 U	<1.0 U	<0.20 U	<1.0 U	<0.20 U
Dissolved Co	µg/L	1 J	<4 U	<4 U	<4 U	<4 U	<4 U	<5.0 U	<4 U	<5.0 U
Total Co	µg/L	<4 U	<4 U	<4 U	<4 U	<4 U	<4 U	<2.5 U	<4 U	<2.5 U
Dissolved Cr	µg/L	<7 U	<2.0 U	<7 U	<2.0 U	<7 U	<2.0 U	<2.0 U	<2.0 U	<2.0 U
Total Cr	µg/L	<8 U	<2.0 U	7 J	<2.0 U	<8 U	<2.0 U	<2.0 U	<2.0 U	<2.0 U
Dissolved Cu	µg/L	9 J	2.9	21	5.7	<20 U	<2.0 U	0.84 B	<2.0 U	1.0 B
Total Cu	µg/L	<22 U	24.9	47 J	6.5	<22 U	<2.0 U	0.71 B	0.63 J	0.68 B
Dissolved Fe	µg/L	23 J	75	<67 U	<67 U	<67 U	<67 U	27 J	26 J	93 J
Total Fe	µg/L	48 J	383 J	835 J	<74 U	27 J	<74 U	61	210 J	135
Dissolved Hg	µg/L	NA	NA	NA	NA	NA	NA	<0.20 U	NA	<0.20 U
Total Hg	µg/L	NA	NA	NA	NA	NA	NA	<0.20 U	NA	<0.20 U
Dissolved K	mg/L	1.54 J	1.59 J	1.04 J	1.09 J	1.39 J	1.21 J	1.36	1.10 J	1.11
Total K	mg/L	1.63 J	1.69 J	1.28 J	1.15 J	1.44 J	1.23 J	1.29	1.22 J	1.06
Dissolved Li	µg/L	NA	NA	NA	NA	NA	NA	6.9 J	NA	5.4 J
Total Li	µg/L	NA	NA	NA	NA	NA	NA	6.9	NA	5.4
Dissolved Mg	mg/L	27.5	29.4	15.0	9.09	16.1	14.1	13.0	12.2	12.1

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW15 3/25/12 Round 2	GW16 3/27/12 Round 2	GW17 3/27/12 Round 2	GW18 5/20/13 Round 3	GW19 5/20/13 Round 3
Dissolved Ag	µg/L	<16 U	<16 U	<16 U	2.2 J	<10 U
Total Ag	µg/L	<16 U, J-	<16 U, J-	<16 U, J-	<10 U	0.8 J
Dissolved Al	µg/L	<20.0 U	<20.0 U	<20.0 U	<20 U	<20 U
Total Al	µg/L	<20.0 U	<20.0 U	<20.0 U	<20 U	46
Dissolved As	µg/L	0.51 J	0.78 J	0.64 J	0.19 J	0.84
Total As	µg/L	0.44 J	0.75 J	1.0	0.31 B	0.94 B
Dissolved B	µg/L	<333 U	<333 U	246 J	132	97
Total B	µg/L	<370 U	<370 U	246 J	138	105
Dissolved Ba	µg/L	49 J	44 J	60 J	131	137
Total Ba	µg/L	50 J	46 J	60 J	127	127
Dissolved Be	µg/L	<10 U	<10 U	<10 U	<5.0 U	<5.0 U
Total Be	µg/L	<11 U	<11 U	<11 U	<2.5 U	<2.5 U
Dissolved Ca	mg/L	94.9	96.5	6.21	38.7	27.7
Total Ca	mg/L	98.5 J	99 J	6.46 J	40.1	25.5
Dissolved Cd	µg/L	<1.0 U	<1.0 U	<1.0 U	<0.20 U	<0.20 U
Total Cd	µg/L	<1.0 U	<1.0 U	<1.0 U	<0.20 U	<0.20 U
Dissolved Co	µg/L	<4 U	<4 U	<4 U	<5.0 U	<5.0 U
Total Co	µg/L	<4 U	<4 U	<4 U	<2.5 U	<2.5 U
Dissolved Cr	µg/L	<2.0 U	<2.0 U	<2.0 U	<2.0 U	<2.0 U
Total Cr	µg/L	<2.0 U	<2.0 U	<2.0 U	<2.0 U	<2.0 U
Dissolved Cu	µg/L	<2.0 U	11.0	<2.0 U	<0.50 U	<0.50 U
Total Cu	µg/L	<2.0 U	10.2	0.90 J	0.59 B	0.60 B
Dissolved Fe	µg/L	<67 U	<67 U	<67 U	29 J	27 J
Total Fe	µg/L	<74 U	63 J	<74 U	94	71
Dissolved Hg	µg/L	NA	NA	NA	<0.20 U	<0.20 U
Total Hg	µg/L	NA	NA	NA	<0.20 U	<0.20 U
Dissolved K	mg/L	0.92 J	1.65 J	0.89 J	1.58	1.26
Total K	mg/L	1.05 J	1.71 J	0.93 J	1.58	1.18
Dissolved Li	µg/L	NA	NA	NA	12	12
Total Li	µg/L	NA	NA	NA	12	12
Dissolved Mg	mg/L	5.94	14.3	4.43	10.8	6.02

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	SW01 7/25/11 Round 1	SW01 5/18/13 Round 3	SW02 7/25/11 Round 1	SW02 3/23/12 Round 2	SW02 5/18/13 Round 3	SW03 7/27/11 Round 1	SW03 3/26/12 Round 2
Dissolved Ag	µg/L	5 J	<10 U	<14 U	<16 U	<10 U	<14 U	<16 U
Total Ag	µg/L	<16 U	<10 U	<16 U	<16 U, J-	2.9 J	<16 U	<16 U, J-
Dissolved Al	µg/L	<494 U	<20 U	<494 U	15.7 J	22 B	<494 U	<20.0 U
Total Al	µg/L	364 J	339	1030 J	469	359	<548 U	<20.0 U
Dissolved As	µg/L	<20 U	0.16 J	<20 U	0.79 J	0.61	<20 U	<1.0 U
Total As	µg/L	<22 U	0.61 B	<22 U	0.91 J	1.0 B	<22 U	0.53 J
Dissolved B	µg/L	<333 U	11 J	<333 U	<333 U	13 J	<333 U	<333 U
Total B	µg/L	<370 U	21	<370 U	<370 U	23	<370 U	<370 U
Dissolved Ba	µg/L	105 J	105	144 J	130 J	118	45 J	40 J
Total Ba	µg/L	110 J	107	155 J	140 J	118	46 J	41 J
Dissolved Be	µg/L	<10 U	<5.0 U	<10 U	<10 U	<5.0 U	<10 U	<10 U
Total Be	µg/L	<11 U	<2.5 U	<11 U	<11 U	<2.5 U	<11 U	<11 U
Dissolved Ca	mg/L	67.5	73.5	101	94.7	93.1	96.2	87.0
Total Ca	mg/L	69 J	71.3	103 J	99.2 J	90.7	97.9 J	88.9 J
Dissolved Cd	µg/L	<4 U	<0.20 U	<4 U	<1.0 U	<0.20 U	<4 U	<1.0 U
Total Cd	µg/L	<4 U	<0.20 U	<4 U	<1.0 U	<0.20 U	<4 U	<1.0 U
Dissolved Co	µg/L	<4 U	<5.0 U	<4 U	<4 U	1.8 J	<4 U	<4 U
Total Co	µg/L	<4 U	<2.5 U	<4 U	<4 U	<2.5 U	<4 U	<4 U
Dissolved Cr	µg/L	<7 U	0.34 J	<7 U	<2.0 U	<2.0 U	<7 U	<2.0 U
Total Cr	µg/L	<8 U	<2.0 U	<8 U	0.73 J	<2.0 U	<8 U	<2.0 U
Dissolved Cu	µg/L	<20 U	0.58	<20 U	<2.0 U	4.5	7 J	<2.0 U
Total Cu	µg/L	<22 U	0.93 B	<22 U	<2.0 U	1.3 B	38 J	0.74 J
Dissolved Fe	µg/L	<67 U	105	<67 U	<67 U	38 J	<67 U	<67 U
Total Fe	µg/L	196 J	502	699 J	679 J	481	<74 U	<74 U
Dissolved Hg	µg/L	NA	<0.20 U	NA	NA	<0.20 U	NA	NA
Total Hg	µg/L	NA	<0.20 U	NA	NA	<0.20 U	NA	NA
Dissolved K	mg/L	1.22 J	1.22	1.55 J	1.22 J	1.45	0.86 J	1.24 J
Total K	mg/L	1.34 J	1.24	1.80 J	1.44 J	1.40	0.91 J	1.32 J
Dissolved Li	µg/L	NA	4.6 J	NA	NA	5.5 J	NA	NA
Total Li	µg/L	NA	5.4	NA	NA	5.2	NA	NA
Dissolved Mg	mg/L	25.8	27.5	10.2	8.82	9.80	18.1	17.3

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW01 7/25/11 Round 1	GW01 5/17/13 Round 3	GW02 7/25/11 Round 1	GW02 5/18/13 Round 3	GW03 7/25/11 Round 1	GW03 3/23/12 Round 2	GW03 5/20/13 Round 3
Total Mg	mg/L	27.9 J	28.2	21.8 J	22.0	16.0 J	12.7 J	14.5
Dissolved Mn	µg/L	<14 U	5.4	113	78	<14 U	<14 U	18
Total Mn	µg/L	<16 U	8.5	223 J	508 *	<16 U	<16 U	18
Dissolved Mo	µg/L	<17 U	<0.50 U	<17 U	0.52	<17 U	<17 U	<0.50 U
Total Mo	µg/L	<19 U	<0.50 U	<19 U	0.66	<19 U	<19 U	<0.50 U
Dissolved Na	mg/L	4.76 J	5.48	4.44 J	7.32	22.7 J	16.9 J	19.8
Total Na	mg/L	4.97 J	5.30	4.75 J	7.46	22.5 J	17.1 J	19.3
Dissolved Ni	µg/L	<84 U	4.3	<84 U	3.1	<84 U	<1.0 U	6.0
Total Ni	µg/L	<93 U	2.9	<93 U	3.7	<93 U	<1.0 U	4.4
Dissolved P	mg/L	<0.06 U	<0.05 U	<0.06 U	<0.05 U	<0.06 U	<0.06 U	<0.05 U
Total P	mg/L	<0.07 U	<0.03 U	<0.07 U	<0.03 U	<0.07 U	<0.07 U	<0.03 U
Dissolved Pb	µg/L	<17 U	1.20	<17 U	<0.20 U	<17 U	<1.0 U	0.29 B
Total Pb	µg/L	<19 U	1.3	<19 U	<0.20 U	<19 U	0.21 J	0.31
Dissolved S	mg/L	13.7 J	NA	12.7 J	NA	18.6 J	14.6 J	NA
Total S	mg/L	12.7 J	NA	11.6 J	NA	17.4 J	13.0 J	NA
Dissolved Sb	µg/L	R	<0.20 U	R	<0.20 U	R	<2.0 U	<0.20 U
Total Sb	µg/L	R	<0.20 U	R	<0.20 U	R	<2.0 U	<0.20 U
Dissolved Se	µg/L	<30 U	<2.0 U	<30 U	<2.0 U	<30 U	<5.0 U	<2.0 U
Total Se	µg/L	<33 U	<2.0 U	<33 U	0.46 J	<33 U	<5.0 U	<2.0 U
Dissolved Si	mg/L	5.44 J	5.01	4.58 J	4.05	5.72 J	6.13 J	5.31
Total Si	mg/L	5.31 J	4.84	4.42 J	3.99	5.63 J	5.83 J	5.13
Dissolved Sr	µg/L	520	494	450	455	690	524	566
Total Sr	µg/L	521 J	528	451 J	475	716 J	520 J	604
Dissolved Th	µg/L	NA	<0.20 U	NA	<0.20 U	NA	<1.0 U	<0.20 U
Total Th	µg/L	NA	<0.20 U	NA	<0.20 U	NA	<1.0 U	<0.20 U
Dissolved Ti	µg/L	<7 U	<5.0 U	<7 U	0.61 J	<7 U	<7 U	1.20 J
Total Ti	µg/L	<8 U	<2.5 U	<8 U	0.50 J	<8 U	<8 U	1.7 J
Dissolved Tl	µg/L	R	<0.20 U	R	<0.20 U	R	<1.0 U	<0.20 U
Total Tl	µg/L	R	<0.20 U	R	<0.20 U	R	<1.0 U	<0.20 U
Dissolved U	µg/L	NA	0.32	NA	0.63	NA	0.48 J	0.57
Total U	µg/L	NA	0.34	NA	0.66	NA	0.46 J	0.60

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

	Sample	GW04	GW04	GW04	GW05	GW05	GW05	GW06	GW06	GW06
	Sample Date	7/25/11	3/23/12	5/18/13	7/26/11	3/23/12	5/17/13	7/26/11	3/24/12	5/19/13
Parameter	Unit	Round 1	Round 2	Round 3	Round 1	Round 2	Round 3	Round 1	Round 2	Round 3
Total Mg	mg/L	11.9 J	12.0 J	12.6	20.1 J	20.9 J	21.8	4.03 J	13.8 J	5.99
Dissolved Mn	µg/L	929	1060	750	<14 U	77	2.6 J	143	690	233
Total Mn	µg/L	1060 J	1090 J	857 *	<16 U	16 J	34	188 J	745 J	273
Dissolved Mo	µg/L	<17 U	<17 U	0.78	<17 U	<17 U	<0.50 U	<17 U	<17 U	<0.50 U
Total Mo	µg/L	<19 U	<19 U	0.97	<19 U	<19 U	<0.50 U	<19 U	<19 U	<0.50 U
Dissolved Na	mg/L	11.1 J	10.9 J	12.6	47.8 J	80.8 J	106	160 J	64.4 J	149
Total Na	mg/L	11.3 J	11.2 J	12.2	48.0 J	80.5 J	106	157 J	57.4 J	138
Dissolved Ni	µg/L	<84 U	<1.0 U	4.0	<84 U	3.0	7.8	<84 U	<1.0 U	0.7
Total Ni	µg/L	<93 U	0.70 J	3.3	<93 U	0.68 J	6.6	<93 U	<1.0 U	1.1
Dissolved P	mg/L	<0.06 U	<0.06 U	<0.05 U	<0.06 U	<0.06 U	<0.05 U	<0.06 U	0.02 J	0.06
Total P	mg/L	0.03 J	<0.07 U	0.09	<0.07 U	<0.07 U	<0.03 U	0.03 J	0.04 J	0.04
Dissolved Pb	µg/L	<17 U	<1.0 U	<0.20 U	<17 U	0.23 J	<0.20 U	<17 U	<1.0 U	<0.20 U
Total Pb	µg/L	<19 U	<1.0 U	0.21 B	<19 U	<1.0 U	0.10 J	<19 U	<1.0 U	0.06 J
Dissolved S	mg/L	9.01 J	8.88 J	NA	17.3 J	12.5 J	NA	5.66 J	16.9 J	NA
Total S	mg/L	8.22 J	8.07 J	NA	16.1 J	11.9 J	NA	4.78 J	14.9 J	NA
Dissolved Sb	µg/L	R	<2.0 U	<0.20 U	R	<2.0 U	<0.20 U	R	<2.0 U	<0.20 U
Total Sb	µg/L	R	<2.0 U	<0.20 U	R	<2.0 U	<0.20 U	R	<2.0 U	<0.20 U
Dissolved Se	µg/L	<30 U	<5.0 U	<2.0 U	<30 U	<5.0 U	<2.0 U	<30 U	<5.0 U	<2.0 U
Total Se	µg/L	<33 U	<5.0 U	<2.0 U	<33 U	<5.0 U	<2.0 U	<33 U	<5.0 U	<2.0 U
Dissolved Si	mg/L	11.2 J	9.70 J	9.02	6.01 J	6.38 J	5.29	6.01 J	9.64 J	6.26
Total Si	mg/L	11.0 J	9.23 J	9.46	5.85 J	6.01 J	5.22	5.87 J	8.97 J	6.38
Dissolved Sr	µg/L	790	794	871	1530	1050	1220	200	622	215
Total Sr	µg/L	824 J	780 J	874	1560 J	1030 J	1310	208 J	573 J	239
Dissolved Th	µg/L	NA	<1.0 U	<0.20 U	NA	<1.0 U	<0.20 U	NA	<1.0 U	<0.20 U
Total Th	µg/L	NA	<1.0 U	<0.20 U	NA	<1.0 U	<0.20 U	NA	<1.0 U	<0.20 U
Dissolved Ti	µg/L	<7 U	<7 U	1.20 J	<7 U	<7 U	<5.0 U	<7 U	<7 U	0.29 J
Total Ti	µg/L	<8 U	2 J	2.2 J	<8 U	3 J	<2.5 U	<8 U	<8 U	<2.5 U
Dissolved Tl	µg/L	R	<1.0 U	<0.20 U	R	<1.0 U	<0.20 U	R	<1.0 U	<0.20 U
Total Tl	µg/L	R	<1.0 U	<0.20 U	R	<1.0 U	<0.20 U	R	<1.0 U	<0.20 U
Dissolved U	µg/L	NA	<1.0 U	0.08 J	NA	0.46 J	0.52	NA	<1.0 U	<0.20 U
Total U	µg/L	NA	<1.0 U	0.10 J	NA	0.47 J	0.56	NA	<1.0 U	<0.20 U

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

Parameter	Sample / Sample Date / Unit	GW07 7/26/11 Round 1	GW07 5/19/13 Round 3	GW08 7/27/11 Round 1	GW08 3/24/12 Round 2	GW08 5/19/13 Round 3	GW09 7/27/11 Round 1	GW09 5/17/13 Round 3	GW10 7/27/11 Round 1	GW10 3/26/12 Round 2
Total Mg	mg/L	10.1 J	9.68	8.88 J	8.63 J	8.89	13.3 J	16.3	21.9 J	21.3 J
Dissolved Mn	µg/L	<14 U	0.42 J	<14 U	20	1.8 J	<14 U	172	20	<14 U
Total Mn	µg/L	<16 U	0.48 J	<16 U	33 J	3.0	<16 U	425	34 J	21 J
Dissolved Mo	µg/L	<17 U	<0.50 U	<17 U	<17 U	<0.50 U	<17 U	<0.50 U	<17 U	<17 U
Total Mo	µg/L	<19 U	0.21 J	<19 U	<19 U	<0.50 U	<19 U	1.2	<19 U	<19 U
Dissolved Na	mg/L	23.0 J	39.0	7.32 J	6.14 J	7.23	10.8 J	132	24.1 J	24.3 J
Total Na	mg/L	23.0 J	37.4	7.50 J	6.27 J	7.20	11.3 J	47.6	24.1 J	24.6 J
Dissolved Ni	µg/L	<84 U	2.6	<84 U	<1.0 U	4.2	<84 U	4.4	<84 U	<1.0 U
Total Ni	µg/L	<93 U	2.6	<93 U	<1.0 U	2.9	<93 U	17.5	<93 U	0.40 J
Dissolved P	mg/L	<0.06 U	<0.05 U	<0.06 U	<0.06 U	<0.05 U	<0.06 U	0.06	<0.06 U	<0.06 U
Total P	mg/L	<0.07 U	0.01 J	<0.07 U	<0.07 U	<0.03 U	<0.07 U	0.22	<0.07 U	<0.07 U
Dissolved Pb	µg/L	<17 U	0.84	<17 U	<1.0 U	0.56	<17 U	1.40	<17 U	<1.0 U
Total Pb	µg/L	<19 U	0.82	<19 U	<1.0 U	0.60	<19 U	25.6	<19 U	0.23 J
Dissolved S	mg/L	12.9 J	NA	13.0 J	13.0 J	NA	13.8 J	NA	23.2 J	24.4 J
Total S	mg/L	11.8 J	NA	11.7 J	11.2 J	NA	12.6 J	NA	21.4 J	21.9 J
Dissolved Sb	µg/L	R	<0.20 U	R	<2.0 U	<0.20 U	R	0.10 J	R	<2.0 U
Total Sb	µg/L	R	<0.20 U	R	<2.0 U	<0.20 U	R	0.20	R	<2.0 U
Dissolved Se	µg/L	<30 U	<2.0 U	<30 U	<5.0 U	<2.0 U	<30 U	<2.0 U	<30 U	<5.0 U
Total Se	µg/L	<33 U	<2.0 U	<33 U	<5.0 U	0.90 J	<33 U	<2.0 U	<33 U	<5.0 U
Dissolved Si	mg/L	6.09 J	5.42	5.11 J	5.33 J	4.82	5.95 J	3.76	7.27 J	7.18 J
Total Si	mg/L	5.96 J	5.19	4.98 J	5.02 J	4.70	5.89 J	9.13	7.17 J	6.89 J
Dissolved Sr	µg/L	200	229	230	201	216	380	603	690	577
Total Sr	µg/L	206 J	228	237 J	197 J	227	398 J	690	686 J	584 J
Dissolved Th	µg/L	NA	<0.20 U	NA	<1.0 U	<0.20 U	NA	0.16 J	NA	<1.0 U
Total Th	µg/L	NA	0.18 J	NA	<1.0 U	<0.20 U	NA	1.20	NA	<1.0 U
Dissolved Ti	µg/L	<7 U	0.81 J	<7 U	<7 U	0.68 J	<7 U	<5.0 U	<7 U	<7 U
Total Ti	µg/L	<8 U	0.72 J	<8 U	3 J	1.1 J	<8 U	43.3	<8 U	3 J
Dissolved Tl	µg/L	R	<0.20 U	R	<1.0 U	<0.20 U	R	<0.20 U	R	<1.0 U
Total Tl	µg/L	R	<0.20 U	R	<1.0 U	<0.20 U	R	<0.20 U	R	<1.0 U
Dissolved U	µg/L	NA	0.14 J	NA	0.55 J	0.46	NA	0.24	NA	1.6
Total U	µg/L	NA	0.06 J	NA	0.51 J	0.50	NA	0.45	NA	2.0

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW11 7/28/11 Round 1	GW11 3/26/12 Round 2	GW12 7/28/11 Round 1	GW12 3/25/12 Round 2	GW13 7/28/11 Round 1	GW13 3/24/12 Round 2	GW13 5/20/13 Round 3	GW14 3/27/12 Round 2	GW14 5/20/13 Round 3
Total Mg	mg/L	28.1 J	29.9 J	15.2 J	8.95 J	16.3 J	14.2 J	12.1	12.2 J	11.4
Dissolved Mn	µg/L	299	821	18	<14 U	<14 U	<14 U	1.7 J	38	57
Total Mn	µg/L	330 J	2200 J	1580 J	<16 U	<16 U	<16 U	2.0 J	46 J	58
Dissolved Mo	µg/L	<17 U	<17 U	<17 U	<17 U	<17 U	<17 U	<0.50 U	<17 U	<0.50 U
Total Mo	µg/L	<19 U	<19 U	<19 U	<19 U	<19 U	<19 U	0.36 J	<19 U	0.32 J
Dissolved Na	mg/L	11.3 J	11.0 J	12.0 J	4.52 J	43.4 J	23.3 J	20.6	11.8 J	11.8
Total Na	mg/L	11.7 J	11.9 J	12.4 J	4.69 J	43.7 J	23.6 J	19.5	11.9 J	11.2
Dissolved Ni	µg/L	<84 U	3.0 B	<84 U	<1.0 U	<84 U	<1.0 U	10.2	<1.0 U	6.4
Total Ni	µg/L	<93 U	0.33 J	<93 U	<1.0 U	<93 U	<1.0 U	8.0	<1.0 U	5.3
Dissolved P	mg/L	<0.06 U	<0.06 U	<0.06 U	<0.06 U	<0.06 U	<0.06 U	<0.05 U	<0.06 U	0.01 J
Total P	mg/L	<0.07 U	<0.07 U	<0.07 U	<0.07 U	<0.07 U	<0.07 U	0.003 J	<0.07 U	0.01 J
Dissolved Pb	µg/L	<17 U	0.46 J	<17 U	0.40 J	<17 U	<1.0 U	<0.20 U	<1.0 U	<0.20 U
Total Pb	µg/L	<19 U	4.3	17 J	<1.0 U	<19 U	<1.0 U	<0.20 U	0.22 J	<0.20 U
Dissolved S	mg/L	31.4 J	32.0 J	18.0 J	9.19 J	8.39 J	11.1 J	NA	9.94 J	NA
Total S	mg/L	28.8 J	27.9 J	16.3 J	7.94 J	7.27 J	9.73 J	NA	8.78 J	NA
Dissolved Sb	µg/L	R	<2.0 U	R	<2.0 U	R	<2.0 U	<0.20 U	<2.0 U	<0.20 U
Total Sb	µg/L	R	<2.0 U	R	<2.0 U	R	<2.0 U	<0.20 U	<2.0 U	<0.20 U
Dissolved Se	µg/L	<30 U	<5.0 U	<30 U	<5.0 U	<30 U	3.2 J	<2.0 U	1.8 J	<2.0 U
Total Se	µg/L	<33 U	<5.0 U	<33 U	<5.0 U	<33 U	3.0 J	<2.0 U	<5.0 U	<2.0 U
Dissolved Si	mg/L	6.69 J	6.66 J	6.10 J	5.21 J	5.79 J	5.60 J	4.91	5.38 J	4.97
Total Si	mg/L	6.46 J	6.20 J	7.17 J	4.93 J	5.83 J	5.31 J	4.72	5.53 J	4.74
Dissolved Sr	µg/L	310	309	310	168	830	690	595	514	499
Total Sr	µg/L	319 J	307 J	325 J	165 J	849 J	683 J	602	500 J	493
Dissolved Th	µg/L	NA	<1.0 U	NA	<1.0 U	NA	<1.0 U	<0.20 U	<1.0 U	<0.20 U
Total Th	µg/L	NA	<1.0 U	NA	<1.0 U	NA	<1.0 U	<0.20 U	<1.0 U	<0.20 U
Dissolved Ti	µg/L	<7 U	<7 U	<7 U	<7 U	<7 U	<7 U	2.70 J	<7 U	1.40 J
Total Ti	µg/L	<8 U	<8 U	13 J	<8 U	<8 U	3 J	2.0 J	10 J	2.3 J
Dissolved Tl	µg/L	R	<1.0 U	R	<1.0 U	R	<1.0 U	<0.20 U	<1.0 U	<0.20 U
Total Tl	µg/L	R	<1.0 U	R	<1.0 U	R	<1.0 U	<0.20 U	<1.0 U	<0.20 U
Dissolved U	µg/L	NA	0.90 J	NA	0.57 J	NA	0.88 J	0.93	0.73 J	0.77
Total U	µg/L	NA	0.92 J	NA	0.70 J	NA	0.93 J	0.92	0.69 J	0.71

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW15 3/25/12 Round 2	GW16 3/27/12 Round 2	GW17 3/27/12 Round 2	GW18 5/20/13 Round 3	GW19 5/20/13 Round 3
Total Mg	mg/L	6.06 J	14.2 J	4.4 J	11.0	5.55
Dissolved Mn	µg/L	<14 U	<14 U	<14 U	13	9.0
Total Mn	µg/L	<16 U	<16 U	<16 U	15	9.2
Dissolved Mo	µg/L	<17 U	<17 U	<17 U	0.62	0.67
Total Mo	µg/L	<19 U	<19 U	<19 U	0.62	0.58
Dissolved Na	mg/L	3.33 J	12.0 J	265 J	76.8	182
Total Na	mg/L	3.60 J	12.2 J	265 J	67.0	175
Dissolved Ni	µg/L	<1.0 U	1.0	0.63 J	1.6	1.1
Total Ni	µg/L	<1.0 U	0.43 J	0.77 J	1.7	1.5
Dissolved P	mg/L	<0.06 U	<0.06 U	0.06 J	0.01 J	0.05 J
Total P	mg/L	<0.07 U	<0.07 U	0.08 J	0.01 J	0.05
Dissolved Pb	µg/L	<1.0 U	0.26 J	<1.0 U	<0.20 U	<0.20 U
Total Pb	µg/L	<1.0 U	0.41 J	<1.0 U	<0.20 U	<0.20 U
Dissolved S	mg/L	11.1 J	19.3 J	1.53 J	NA	NA
Total S	mg/L	9.85 J	17.1 J	1.39 J	NA	NA
Dissolved Sb	µg/L	<2.0 U	<2.0 U	<2.0 U	0.12 J	0.20
Total Sb	µg/L	<2.0 U	<2.0 U	<2.0 U	0.14 J	0.17 J
Dissolved Se	µg/L	<5.0 U	<5.0 U	<5.0 U	<2.0 U	<2.0 U
Total Se	µg/L	<5.0 U	<5.0 U	<5.0 U	<2.0 U	<2.0 U
Dissolved Si	mg/L	6.04 J	7.08 J	4.55 J	8.06	6.63
Total Si	mg/L	5.67 J	6.70 J	4.26 J	8.06	6.22
Dissolved Sr	µg/L	219	250	86	1080	424
Total Sr	µg/L	216 J	249 J	84 J	1160	419
Dissolved Th	µg/L	<1.0 U	<1.0 U	<1.0 U	<0.20 U	<0.20 U
Total Th	µg/L	<1.0 U	<1.0 U	<1.0 U	<0.20 U	<0.20 U
Dissolved Ti	µg/L	<7 U	<7 U	<7 U	0.31 J	0.25 J
Total Ti	µg/L	3 J	<8 U	<8 U	0.68 J	1.8 J
Dissolved Tl	µg/L	<1.0 U	<1.0 U	<1.0 U	<0.20 U	<0.20 U
Total Tl	µg/L	<1.0 U	<1.0 U	<1.0 U	<0.20 U	<0.20 U
Dissolved U	µg/L	0.80 J	0.83 J	0.70 J	0.12 J	0.09 J
Total U	µg/L	0.77 J	0.76 J	0.68 J	0.12 J	0.09 J

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	SW01 7/25/11 Round 1	SW01 5/18/13 Round 3	SW02 7/25/11 Round 1	SW02 3/23/12 Round 2	SW02 5/18/13 Round 3	SW03 7/27/11 Round 1	SW03 3/26/12 Round 2
Total Mg	mg/L	26.5 J	26.5	10.4 J	8.94 J	9.34	18.6 J	17.3 J
Dissolved Mn	µg/L	<14 U	2.8 J	78	29	50	<14 U	<14 U
Total Mn	µg/L	<16 U	16	100 J	70 J	68	<16 U	<16 U
Dissolved Mo	µg/L	<17 U	0.96	<17 U	<17 U	6.3	<17 U	<17 U
Total Mo	µg/L	<19 U	1.0	<19 U	<19 U	6.1	<19 U	<19 U
Dissolved Na	mg/L	7.94 J	7.09	21.1 J	17.3 J	19.1	8.51 J	7.37 J
Total Na	mg/L	8.19 J	6.66	21.1 J	17.3 J	18.0	8.71 J	7.76 J
Dissolved Ni	µg/L	<84 U	3.2	<84 U	<1.0 U	4.2	<84 U	<1.0 U
Total Ni	µg/L	<93 U	2.5	<93 U	0.80 J	3.4	<93 U	<1.0 U
Dissolved P	mg/L	<0.06 U	<0.05 U	<0.06 U	<0.06 U	<0.05 U	<0.06 U	<0.06 U
Total P	mg/L	<0.07 U	<0.03 U	0.04 J	0.05 J	0.04	<0.07 U	<0.07 U
Dissolved Pb	µg/L	<17 U	<0.20 U	<17 U	<1.0 U	0.16 J	<17 U	<1.0 U
Total Pb	µg/L	<19 U	0.42 B	<19 U	0.91 J	0.48 B	<19 U	<1.0 U
Dissolved S	mg/L	12.5 J	NA	14.4 J	14.4 J	NA	15.9 J	15.7 J
Total S	mg/L	11.6 J	NA	13.2 J	13.0 J	NA	14.7 J	13.7 J
Dissolved Sb	µg/L	R	<0.20 U	R	<2.0 U	<0.20 U	R	<2.0 U
Total Sb	µg/L	R	<0.20 U	R	<2.0 U	<0.20 U	R	<2.0 U
Dissolved Se	µg/L	<30 U	<2.0 U	<30 U	<5.0 U	<2.0 U	<30 U	<5.0 U
Total Se	µg/L	<33 U	0.97 J	<33 U	<5.0 U	1.00 J	<33 U	<5.0 U
Dissolved Si	mg/L	4.97 J	4.11	6.01 J	5.24 J	4.73	4.86 J	5.67 J
Total Si	mg/L	5.54 J	4.60	7.77 J	6.56 J	5.05	4.79 J	5.38 J
Dissolved Sr	µg/L	730	630	400	606	324	370	345
Total Sr	µg/L	750 J	666	402 J	599 J	320	381 J	338 J
Dissolved Th	µg/L	NA	<0.20 U	NA	<1.0 U	<0.20 U	NA	<1.0 U
Total Th	µg/L	NA	<0.20 U	NA	<1.0 U	<0.20 U	NA	<1.0 U
Dissolved Ti	µg/L	<7 U	0.52 J	<7 U	<7 U	1.2 J	<7 U	<7 U
Total Ti	µg/L	7 J	6.1	28 J	30 J	9.0	<8 U	26 J
Dissolved Tl	µg/L	R	<0.20 U	R	<1.0 U	<0.20 U	R	<1.0 U
Total Tl	µg/L	R	<0.20 U	R	<1.0 U	<0.20 U	R	<1.0 U
Dissolved U	µg/L	NA	0.48	NA	0.65 J	0.64	NA	1.2
Total U	µg/L	NA	0.52	NA	0.66 J	0.68	NA	1.2

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW01 7/25/11 Round 1	GW01 5/17/13 Round 3	GW02 7/25/11 Round 1	GW02 5/18/13 Round 3	GW03 7/25/11 Round 1	GW03 3/23/12 Round 2	GW03 5/20/13 Round 3
Dissolved V	µg/L	<10 U	<0.20 U	<10 U	<0.20 U	<10 U	<10 U	0.04 J
Total V	µg/L	<11 U	0.51 B	4 J	0.53 B	<11 U	<11 U	0.59 B
Dissolved Zn	µg/L	24 J	15	<50 U	<5.0 U	25 J	<50 U	<5.0 U
Total Zn	µg/L	21 J	13.7 B	<56 U	<2.5 U	25 J	<56 U	5.1 B

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

	Sample	GW04	GW04	GW04	GW05	GW05	GW05	GW06	GW06	GW06
	Sample Date	7/25/11	3/23/12	5/18/13	7/26/11	3/23/12	5/17/13	7/26/11	3/24/12	5/19/13
Parameter	Unit	Round 1	Round 2	Round 3	Round 1	Round 2	Round 3	Round 1	Round 2	Round 3
Dissolved V	µg/L	<10 U	<10 U	<0.20 U	<10 U	<10 U	0.05 J	<10 U	<10 U	<0.20 U
Total V	µg/L	<11 U	<11 U	0.81 B	<11 U	<11 U	0.49 B	<11 U	<11 U	0.49 B
Dissolved Zn	µg/L	19 J	<50 U	<5.0 U	29 J	<50 U	3.9 J	<50 U	<50 U	<5.0 U
Total Zn	µg/L	20 J	<56 U	5.1 B	23 J	<56 U	4.4 B	<56 U	<56 U	<2.5 U

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

	Sample	GW07	GW07	GW08	GW08	GW08	GW09	GW09	GW10	GW10
	Sample Date	7/26/11	5/19/13	7/27/11	3/24/12	5/19/13	7/27/11	5/17/13	7/27/11	3/26/12
Parameter	Unit	Round 1	Round 3	Round 1	Round 2	Round 3	Round 1	Round 3	Round 1	Round 2
Dissolved V	µg/L	<10 U	0.05 J	<10 U	<10 U	<0.20 U	<10 U	0.28	4 J	<10 U
Total V	µg/L	<11 U	0.28 B	<11 U	<11 U	0.54 B	<11 U	6.1	4 J	<11 U
Dissolved Zn	µg/L	<50 U	17	24 J	<50 U	<5.0 U	19 J	5.0	25 J	<50 U
Total Zn	µg/L	<56 U	10.3 B	22 J	<56 U	4.4 B	19 J	39.8 B	25 J	<56 U

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW11 7/28/11 Round 1	GW11 3/26/12 Round 2	GW12 7/28/11 Round 1	GW12 3/25/12 Round 2	GW13 7/28/11 Round 1	GW13 3/24/12 Round 2	GW13 5/20/13 Round 3	GW14 3/27/12 Round 2	GW14 5/20/13 Round 3
Dissolved V	µg/L	<10 U	<10 U	<10 U	<10 U	5 J	<10 U	0.07 J	<10 U	0.07 J
Total V	µg/L	<11 U	<11 U	4 J	<11 U	<11 U	<11 U	<0.20 U	<11 U	0.36 B
Dissolved Zn	µg/L	34 J	<50 U	245	<50 U	48 J	<50 U	<5.0 U	<50 U	<5.0 U
Total Zn	µg/L	34 J	35 J	641 J	<56 U	40 J	<56 U	<2.5 U	<56 U	<2.5 U

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

	Sample	GW15	GW16	GW17	GW18	GW19
	Sample Date	3/25/12	3/27/12	3/27/12	5/20/13	5/20/13
Parameter	Unit	Round 2	Round 2	Round 2	Round 3	Round 3
Dissolved V	µg/L	<10 U	<10 U	<10 U	0.04 J	0.04 J
Total V	µg/L	<11 U	<11 U	<11 U	0.22 B	0.34 B
Dissolved Zn	µg/L	<50 U	<50 U	<50 U	<5.0 U	<5.0 U
Total Zn	µg/L	<56 U	<56 U	<56 U	<2.5 U	<2.5 U

Table B-3 Sample Results - Dissolved and Total Metals (Washington County, Pennsylvania)

	Sample	SW01	SW01	SW02	SW02	SW02	SW03	SW03
	Sample Date	7/25/11	5/18/13	7/25/11	3/23/12	5/18/13	7/27/11	3/26/12
Parameter	Unit	Round 1	Round 3	Round 1	Round 2	Round 3	Round 1	Round 2
Dissolved V	µg/L	<10 U	0.18 J	<10 U	<10 U	0.50	3 J	<10 U
Total V	µg/L	<11 U	1.2 B	4 J	<11 U	1.7 B	5 J	<11 U
Dissolved Zn	µg/L	18 J	<5.0 U	21 J	<50 U	<5.0 U	17 J	<50 U
Total Zn	µg/L	18 J	<2.5 U	20 J	<56 U	<2.5 U	18 J	<56 U

Table B-4 Sample Results - Volatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW01 7/25/11 Round 1	GW01 5/17/13 Round 3	GW02 7/25/11 Round 1	GW02 5/18/13 Round 3	GW03 7/25/11 Round 1	GW03 3/23/12 Round 2	GW03 5/20/13 Round 3
ethanol (64-17-5)	µg/L	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U
isopropanol (67-63-0)	µg/L	<25 U	<10 U	<25 U	<10 U	<25 U	<25 U	<10 U
acrylonitrile (107-13-1)	µg/L	<25 U	<1.0 U	<25 U	<1.0 U	<25 U	<25 U	<1.0 U
styrene (100-42-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
acetone (67-64-1)	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	0.87 J
tert-butyl alcohol (75-65-0)	µg/L	<5.0 U	<10 U	<5.0 U	<10 U	<5.0 U	<5.0 U	<10 U
methyl tert-butyl ether (1634-04-4)	µg/L	<1.0 U	<0.5 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U
diisopropyl ether (108-20-3)	µg/L	<1.0 U	<0.5 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U
ethyl tert-butyl ether (637-92-3)	µg/L	<1.0 U	<0.5 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U
tert-amyl methyl ether (994-05-8)	µg/L	<1.0 U	<0.5 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U
vinyl chloride (75-01-4)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1-dichloroethene (75-35-4)	µg/L	R	<0.5 U	R	<0.5 U	R	R	<0.5 U
carbon disulfide (75-15-0)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U, J-	<0.5 U
methylene chloride (75-09-2)	µg/L	<1.0 U	<0.5 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U
trans-1,2-dichloroethene (156-60-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1-dichloroethane (75-34-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
cis-1,2-dichloroethene (156-59-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
chloroform (67-66-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,1-trichloroethane (71-55-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
carbon tetrachloride (56-23-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
benzene (71-43-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-dichloroethane (107-06-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
trichloroethene (79-01-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
toluene (108-88-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,2-trichloroethane (79-00-5)	µg/L	R	<0.5 U	R	<0.5 U	R	R	<0.5 U
tetrachloroethene (127-18-4)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
chlorobenzene (108-90-7)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
ethylbenzene (100-41-4)	µg/L	<1.0 U	<0.5 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U
m+p xylene (108-38-3, 106-42-3)	µg/L	<2.0 U	<1.0 U	<2.0 U	<1.0 U	<2.0 U	<2.0 U	<1.0 U
o-xylene (95-47-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
isopropylbenzene (98-82-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3,5-trimethylbenzene (108-67-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

Table B-4 Sample Results - Volatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW04 7/25/11 Round 1	GW04 3/23/12 Round 2	GW04 5/18/13 Round 3	GW05 7/26/11 Round 1	GW05 3/23/12 Round 2	GW05 5/17/13 Round 3
ethanol (64-17-5)	µg/L	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U
isopropanol (67-63-0)	µg/L	<25 U	<25 U	<10 U	<25 U	<25 U	<10 U
acrylonitrile (107-13-1)	µg/L	<25 U	<25 U	<1.0 U	<25 U	<25 U	<1.0 U
styrene (100-42-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
acetone (67-64-1)	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U
tert-butyl alcohol (75-65-0)	µg/L	<5.0 U	<5.0 U	<10 U	<5.0 U	<5.0 U	<10 U
methyl tert-butyl ether (1634-04-4)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U
diisopropyl ether (108-20-3)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U
ethyl tert-butyl ether (637-92-3)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U
tert-amyl methyl ether (994-05-8)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U
vinyl chloride (75-01-4)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1-dichloroethene (75-35-4)	µg/L	R	R	<0.5 U	R	R	<0.5 U
carbon disulfide (75-15-0)	µg/L	<0.5 U	<0.5 U, J-	<0.5 U	<0.5 U	<0.5 U, J-	<0.5 U
methylene chloride (75-09-2)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U
trans-1,2-dichloroethene (156-60-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1-dichloroethane (75-34-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
cis-1,2-dichloroethene (156-59-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
chloroform (67-66-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,1-trichloroethane (71-55-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
carbon tetrachloride (56-23-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
benzene (71-43-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-dichloroethane (107-06-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
trichloroethene (79-01-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
toluene (108-88-3)	µg/L	0.80 B	<0.5 U	0.37 J	<0.5 U	<0.5 U	<0.5 U
1,1,2-trichloroethane (79-00-5)	µg/L	R	R	<0.5 U	R	R	<0.5 U
tetrachloroethene (127-18-4)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
chlorobenzene (108-90-7)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
ethylbenzene (100-41-4)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U
m+p xylene (108-38-3, 106-42-3)	µg/L	<2.0 U	<2.0 U	<1.0 U	<2.0 U	<2.0 U	<1.0 U
o-xylene (95-47-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
isopropylbenzene (98-82-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3,5-trimethylbenzene (108-67-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

Table B-4 Sample Results - Volatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW06 7/26/11 Round 1	GW06 3/24/12 Round 2	GW06 5/19/13 Round 3	GW07 7/26/11 Round 1	GW07 5/19/13 Round 3
ethanol (64-17-5)	µg/L	<100 U	<100 U	<100 U	<100 U	<100 U
isopropanol (67-63-0)	µg/L	<25 U	<25 U	<10 U	<25 U	<10 U
acrylonitrile (107-13-1)	µg/L	<25 U	<25 U	<1.0 U	<25 U	<1.0 U
styrene (100-42-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
acetone (67-64-1)	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U
tert-butyl alcohol (75-65-0)	µg/L	<5.0 U	<5.0 U	<10 U	<5.0 U	<10 U
methyl tert-butyl ether (1634-04-4)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<0.5 U
diisopropyl ether (108-20-3)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<0.5 U
ethyl tert-butyl ether (637-92-3)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<0.5 U
tert-amyl methyl ether (994-05-8)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<0.5 U
vinyl chloride (75-01-4)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1-dichloroethene (75-35-4)	µg/L	R	R	<0.5 U	R	<0.5 U
carbon disulfide (75-15-0)	µg/L	<0.5 U	<0.5 U, J-	<0.5 U	<0.5 U	<0.5 U
methylene chloride (75-09-2)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<0.5 U
trans-1,2-dichloroethene (156-60-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1-dichloroethane (75-34-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
cis-1,2-dichloroethene (156-59-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
chloroform (67-66-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,1-trichloroethane (71-55-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
carbon tetrachloride (56-23-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
benzene (71-43-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-dichloroethane (107-06-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
trichloroethene (79-01-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
toluene (108-88-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,2-trichloroethane (79-00-5)	µg/L	R	R	<0.5 U	R	<0.5 U
tetrachloroethene (127-18-4)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
chlorobenzene (108-90-7)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
ethylbenzene (100-41-4)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<0.5 U
m+p xylene (108-38-3, 106-42-3)	µg/L	<2.0 U	<2.0 U	<1.0 U	<2.0 U	<1.0 U
o-xylene (95-47-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
isopropylbenzene (98-82-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3,5-trimethylbenzene (108-67-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

Table B-4 Sample Results - Volatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW08 7/27/11 Round 1	GW08 3/24/12 Round 2	GW08 5/19/13 Round 3	GW09 7/27/11 Round 1	GW09 5/17/13 Round 3	GW10 7/27/11 Round 1	GW10 3/26/12 Round 2
ethanol (64-17-5)	µg/L	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U
isopropanol (67-63-0)	µg/L	<25 U	<25 U	<10 U	<25 U	<10 U	<25 U	<25 U
acrylonitrile (107-13-1)	µg/L	<25 U	<25 U	<1.0 U	<25 U	<1.0 U	<25 U	<25 U
styrene (100-42-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
acetone (67-64-1)	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	0.48 J	<1.0 U	<1.0 U
tert-butyl alcohol (75-65-0)	µg/L	<5.0 U	<5.0 U	<10 U	<5.0 U	<10 U	<5.0 U	<5.0 U
methyl tert-butyl ether (1634-04-4)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U
diisopropyl ether (108-20-3)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U
ethyl tert-butyl ether (637-92-3)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U
tert-amyl methyl ether (994-05-8)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U
vinyl chloride (75-01-4)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1-dichloroethene (75-35-4)	µg/L	R	R	<0.5 U	R	<0.5 U	R	R
carbon disulfide (75-15-0)	µg/L	<0.5 U	<0.5 U, J-	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
methylene chloride (75-09-2)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U
trans-1,2-dichloroethene (156-60-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1-dichloroethane (75-34-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
cis-1,2-dichloroethene (156-59-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
chloroform (67-66-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,1-trichloroethane (71-55-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
carbon tetrachloride (56-23-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
benzene (71-43-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-dichloroethane (107-06-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
trichloroethene (79-01-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
toluene (108-88-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,2-trichloroethane (79-00-5)	µg/L	R	R	<0.5 U	R	<0.5 U	R	R
tetrachloroethene (127-18-4)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
chlorobenzene (108-90-7)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
ethylbenzene (100-41-4)	µg/L	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U
m+p xylene (108-38-3, 106-42-3)	µg/L	<2.0 U	<2.0 U	<1.0 U	<2.0 U	<1.0 U	<2.0 U	<2.0 U
o-xylene (95-47-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
isopropylbenzene (98-82-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3,5-trimethylbenzene (108-67-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

Table B-4 Sample Results - Volatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample / Sample Date / Unit	GW11 7/28/11 Round 1	GW11 3/26/12 Round 2	GW12 7/28/11 Round 1	GW12 3/25/12 Round 2	GW13 7/28/11 Round 1	GW13 3/24/12 Round 2	GW13 5/20/13 Round 3
ethanol (64-17-5)	µg/L	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U
isopropanol (67-63-0)	µg/L	<25 U	<25 U	<25 U	<25 U	<25 U	<25 U	<10 U
acrylonitrile (107-13-1)	µg/L	<25 U	<25 U	<25 U	<25 U	<25 U	<25 U	<1.0 U
styrene (100-42-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
acetone (67-64-1)	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U
tert-butyl alcohol (75-65-0)	µg/L	<5.0 U	<5.0 U	<5.0 U	<5.0 U	<5.0 U	<5.0 U	<10 U
methyl tert-butyl ether (1634-04-4)	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<0.5 U
diisopropyl ether (108-20-3)	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<0.5 U
ethyl tert-butyl ether (637-92-3)	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<0.5 U
tert-amyl methyl ether (994-05-8)	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<0.5 U
vinyl chloride (75-01-4)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1-dichloroethene (75-35-4)	µg/L	R	R	R	R	R	R	<0.5 U
carbon disulfide (75-15-0)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U, J-	<0.5 U	<0.5 U, J-	<0.5 U
methylene chloride (75-09-2)	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<0.5 U
trans-1,2-dichloroethene (156-60-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1-dichloroethane (75-34-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
cis-1,2-dichloroethene (156-59-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
chloroform (67-66-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,1-trichloroethane (71-55-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
carbon tetrachloride (56-23-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
benzene (71-43-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-dichloroethane (107-06-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
trichloroethene (79-01-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
toluene (108-88-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,2-trichloroethane (79-00-5)	µg/L	R	R	R	R	R	R	<0.5 U
tetrachloroethene (127-18-4)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
chlorobenzene (108-90-7)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
ethylbenzene (100-41-4)	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<0.5 U
m+p xylene (108-38-3, 106-42-3)	µg/L	<2.0 U	<2.0 U	<2.0 U	<2.0 U	<2.0 U	<2.0 U	<1.0 U
o-xylene (95-47-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
isopropylbenzene (98-82-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3,5-trimethylbenzene (108-67-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

Table B-4 Sample Results - Volatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW14 3/27/12 Round 2	GW14 5/20/13 Round 3	GW15 3/25/12 Round 2	GW16 3/27/12 Round 2	GW17 3/27/12 Round 2	GW18 5/20/13 Round 3	GW19 5/20/13 Round 3
ethanol (64-17-5)	µg/L	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U
isopropanol (67-63-0)	µg/L	<25 U	<10 U	<25 U	<25 U	<25 U	<10 U	<10 U
acrylonitrile (107-13-1)	µg/L	<25 U	<1.0 U	<25 U	<25 U	<25 U	<1.0 U	<1.0 U
styrene (100-42-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
acetone (67-64-1)	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	1.3
tert-butyl alcohol (75-65-0)	µg/L	<5.0 U	<10 U	<5.0 U	<5.0 U	<5.0 U	<10 U	<10 U
methyl tert-butyl ether (1634-04-4)	µg/L	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<1.0 U	<0.5 U	<0.5 U
diisopropyl ether (108-20-3)	µg/L	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<1.0 U	<0.5 U	<0.5 U
ethyl tert-butyl ether (637-92-3)	µg/L	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<1.0 U	<0.5 U	<0.5 U
tert-amyl methyl ether (994-05-8)	µg/L	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<1.0 U	<0.5 U	<0.5 U
vinyl chloride (75-01-4)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1-dichloroethene (75-35-4)	µg/L	R	<0.5 U	R	R	R	<0.5 U	<0.5 U
carbon disulfide (75-15-0)	µg/L	<0.5 U	<0.5 U	<0.5 U, J-	<0.5 U	<0.5 U	<0.5 U	<0.5 U
methylene chloride (75-09-2)	µg/L	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<1.0 U	<0.5 U	<0.5 U
trans-1,2-dichloroethene (156-60-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1-dichloroethane (75-34-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
cis-1,2-dichloroethene (156-59-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
chloroform (67-66-3)	µg/L	<0.5 U	0.15 J	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,1-trichloroethane (71-55-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
carbon tetrachloride (56-23-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
benzene (71-43-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.07 J
1,2-dichloroethane (107-06-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
trichloroethene (79-01-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
toluene (108-88-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.11 J	2.2
1,1,2-trichloroethane (79-00-5)	µg/L	R	<0.5 U	R	R	R	<0.5 U	<0.5 U
tetrachloroethene (127-18-4)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
chlorobenzene (108-90-7)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
ethylbenzene (100-41-4)	µg/L	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<1.0 U	<0.5 U	<0.5 U
m+p xylene (108-38-3, 106-42-3)	µg/L	<2.0 U	<1.0 U	<2.0 U	<2.0 U	<2.0 U	<1.0 U	<1.0 U
o-xylene (95-47-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
isopropylbenzene (98-82-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3,5-trimethylbenzene (108-67-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

Table B-4 Sample Results - Volatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	SW01 7/25/11 Round 1	SW01 5/18/13 Round 3	SW02 7/25/11 Round 1	SW02 3/23/12 Round 2	SW02 5/18/13 Round 3	SW03 7/27/11 Round 1	SW03 3/26/12 Round 2
ethanol (64-17-5)	µg/L	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U	<100 U
isopropanol (67-63-0)	µg/L	<25 U	<10 U	<25 U	<25 U	<10 U	<25 U	<25 U
acrylonitrile (107-13-1)	µg/L	<25 U	<1.0 U	<25 U	<25 U	<1.0 U	<25 U	<25 U
styrene (100-42-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
acetone (67-64-1)	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U
tert-butyl alcohol (75-65-0)	µg/L	<5.0 U	<10 U	<5.0 U	<5.0 U	<10 U	<5.0 U	<5.0 U
methyl tert-butyl ether (1634-04-4)	µg/L	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U
diisopropyl ether (108-20-3)	µg/L	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U
ethyl tert-butyl ether (637-92-3)	µg/L	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U
tert-amyl methyl ether (994-05-8)	µg/L	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U
vinyl chloride (75-01-4)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1-dichloroethene (75-35-4)	µg/L	R	<0.5 U	R	R	<0.5 U	R	R
carbon disulfide (75-15-0)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U, J-	<0.5 U	<0.5 U	<0.5 U
methylene chloride (75-09-2)	µg/L	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U
trans-1,2-dichloroethene (156-60-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1-dichloroethane (75-34-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
cis-1,2-dichloroethene (156-59-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
chloroform (67-66-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.28 J	<0.5 U	<0.5 U
1,1,1-trichloroethane (71-55-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
carbon tetrachloride (56-23-5)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
benzene (71-43-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-dichloroethane (107-06-2)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
trichloroethene (79-01-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
toluene (108-88-3)	µg/L	2.18 B	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,2-trichloroethane (79-00-5)	µg/L	R	<0.5 U	R	R	<0.5 U	R	R
tetrachloroethene (127-18-4)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
chlorobenzene (108-90-7)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
ethylbenzene (100-41-4)	µg/L	<1.0 U	<0.5 U	<1.0 U	<1.0 U	<0.5 U	<1.0 U	<1.0 U
m+p xylene (108-38-3, 106-42-3)	µg/L	<2.0 U	<1.0 U	<2.0 U	<2.0 U	<1.0 U	<2.0 U	<2.0 U
o-xylene (95-47-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
isopropylbenzene (98-82-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3,5-trimethylbenzene (108-67-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

Table B-4 Sample Results - Volatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW01 7/25/11 Round 1	GW01 5/17/13 Round 3	GW02 7/25/11 Round 1	GW02 5/18/13 Round 3	GW03 7/25/11 Round 1	GW03 3/23/12 Round 2	GW03 5/20/13 Round 3
1,2,4-trimethylbenzene (95-63-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3-dichlorobenzene (541-73-1)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,4-dichlorobenzene (106-46-7)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2,3-trimethylbenzene (526-73-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-dichlorobenzene (95-50-1)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
naphthalene (91-20-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

Table B-4 Sample Results - Volatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW04 7/25/11 Round 1	GW04 3/23/12 Round 2	GW04 5/18/13 Round 3	GW05 7/26/11 Round 1	GW05 3/23/12 Round 2	GW05 5/17/13 Round 3
1,2,4-trimethylbenzene (95-63-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3-dichlorobenzene (541-73-1)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,4-dichlorobenzene (106-46-7)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2,3-trimethylbenzene (526-73-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-dichlorobenzene (95-50-1)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
naphthalene (91-20-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

Table B-4 Sample Results - Volatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW06 7/26/11 Round 1	GW06 3/24/12 Round 2	GW06 5/19/13 Round 3	GW07 7/26/11 Round 1	GW07 5/19/13 Round 3
1,2,4-trimethylbenzene (95-63-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3-dichlorobenzene (541-73-1)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,4-dichlorobenzene (106-46-7)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2,3-trimethylbenzene (526-73-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-dichlorobenzene (95-50-1)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
naphthalene (91-20-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

Table B-4 Sample Results - Volatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW08 7/27/11 Round 1	GW08 3/24/12 Round 2	GW08 5/19/13 Round 3	GW09 7/27/11 Round 1	GW09 5/17/13 Round 3	GW10 7/27/11 Round 1	GW10 3/26/12 Round 2
1,2,4-trimethylbenzene (95-63-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3-dichlorobenzene (541-73-1)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,4-dichlorobenzene (106-46-7)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2,3-trimethylbenzene (526-73-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-dichlorobenzene (95-50-1)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
naphthalene (91-20-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

Table B-4 Sample Results - Volatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample / Sample Date / Unit	GW11 7/28/11 Round 1	GW11 3/26/12 Round 2	GW12 7/28/11 Round 1	GW12 3/25/12 Round 2	GW13 7/28/11 Round 1	GW13 3/24/12 Round 2	GW13 5/20/13 Round 3
1,2,4-trimethylbenzene (95-63-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3-dichlorobenzene (541-73-1)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,4-dichlorobenzene (106-46-7)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2,3-trimethylbenzene (526-73-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-dichlorobenzene (95-50-1)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
naphthalene (91-20-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

Table B-4 Sample Results - Volatile Organic Compounds (Washington County, Pennsylvania)

	Sample	GW14	GW14	GW15	GW16	GW17	GW18	GW19
	Sample Date	3/27/12	5/20/13	3/25/12	3/27/12	3/27/12	5/20/13	5/20/13
Parameter (CAS Number)	Unit	Round 2	Round 3	Round 2	Round 2	Round 2	Round 3	Round 3
1,2,4-trimethylbenzene (95-63-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3-dichlorobenzene (541-73-1)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,4-dichlorobenzene (106-46-7)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2,3-trimethylbenzene (526-73-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-dichlorobenzene (95-50-1)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
naphthalene (91-20-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

Table B-4 Sample Results - Volatile Organic Compounds (Washington County, Pennsylvania)

	Sample	SW01	SW01	SW02	SW02	SW02	SW03	SW03
	Sample Date	7/25/11	5/18/13	7/25/11	3/23/12	5/18/13	7/27/11	3/26/12
Parameter (CAS Number)	Unit	Round 1	Round 3	Round 1	Round 2	Round 3	Round 1	Round 2
1,2,4-trimethylbenzene (95-63-6)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3-dichlorobenzene (541-73-1)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,4-dichlorobenzene (106-46-7)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2,3-trimethylbenzene (526-73-8)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-dichlorobenzene (95-50-1)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
naphthalene (91-20-3)	µg/L	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

Table B-5 Sample Results - Dissolved Gases, Diesel and Gasoline Range Organics, Glycols, and Low Molecular Weight Acids (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW01 7/25/11 Round 1	GW01 5/17/13 Round 3	GW02 7/25/11 Round 1	GW02 5/18/13 Round 3	GW03 7/25/11 Round 1	GW03 3/23/12 Round 2	GW03 5/20/13 Round 3
Dissolved Gases								
Methane (74-82-8)	mg/L	<0.0015 U	<0.0013 U	<0.0015 U	<0.0013 U	<0.0015 U	<0.0014 U	<0.0013 U
Ethane (74-84-0)	mg/L	<0.0029 U	<0.0027 U	<0.0029 U	<0.0027 U	<0.0029 U	<0.0027 U	<0.0027 U
Propane (74-98-6)	mg/L	<0.0041 U	<0.0037 U	<0.0041 U	<0.0037 U	<0.0041 U	<0.0038 U	<0.0037 U
Butane (106-97-8)	mg/L	<0.0055 U	<0.0047 U	<0.0055 U	<0.0047 U	<0.0055 U	<0.0048 U	<0.0047 U
Diesel and Gas Range Organics								
GRO/TPH	µg/L	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U
DRO	µg/L	<21.3 U	<20.0 U	<20.0 U	<20.0 U	<21.1 U	<20.0 U	<20.0 U
Glycols								
2-butoxyethanol (111-76-2)	µg/L	<5 U	<10 U	<5 U	<10 U	<5 U	<10 U, J-	<10 U
Diethylene glycol (111-46-6)	µg/L	<50 H, U	<10 U	<50 H, U	<10 U	<50 H, U	<25 U	<10 U
Triethylene glycol (112-27-6)	µg/L	<5 H, U	<10 U	<5 H, U	<10 U	<5 H, U	<25 U	<10 U
Tetraethylene glycol (112-60-7)	µg/L	<25 H, U	<10 U	<25 H, U	<10 U	<25 H, U	<50 U, J-	<10 U
Low Molecular Weight Acids								
Lactate (50-21-5)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Formate (64-18-6)	mg/L	<0.10 U	NA	0.11	NA	<0.10 U	R	NA
Acetate (64-19-7)	mg/L	R	<0.10 U	R	<0.10 U	R	<0.10 U	<0.10 U
Propionate (79-09-4)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Butyrate (107-92-6)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Isobutyrate (79-31-2)	mg/L	<0.10 U, J-	<0.10 U, J-	<0.10 U, J-	<0.10 U, J-	<0.10 U, J-	<0.10 U	<0.10 U, J-

Table B-5 Sample Results - Dissolved Gases, Diesel and Gasoline Range Organics, Glycols, and Low Molecular Weight Acids (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW04 7/25/11 Round 1	GW04 3/23/12 Round 2	GW04 5/18/13 Round 3	GW05 7/26/11 Round 1	GW05 3/23/12 Round 2	GW05 5/17/13 Round 3
Dissolved Gases							
Methane (74-82-8)	mg/L	0.0276	0.0304	<0.0013 U	<0.0015 U	<0.0014 U	<0.0013 U
Ethane (74-84-0)	mg/L	<0.0029 U	<0.0027 U	<0.0027 U	<0.0029 U	<0.0027 U	<0.0027 U
Propane (74-98-6)	mg/L	<0.0041 U	<0.0038 U	<0.0037 U	<0.0041 U	<0.0038 U	<0.0037 U
Butane (106-97-8)	mg/L	<0.0055 U	<0.0048 U	<0.0047 U	<0.0055 U	<0.0048 U	<0.0047 U
Diesel and Gas Range Organics							
GRO/TPH	µg/L	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U
DRO	µg/L	34.6 J-	<20.0 U	32.4	<21.5 U, J-	20.1 B	<20.0 U
Glycols							
2-butoxyethanol (111-76-2)	µg/L	<5 U	<10 U, J-	<10 U	<5 U	<10 U, J-	<10 U
Diethylene glycol (111-46-6)	µg/L	<50 H, U	<25 U	<10 U	<50 H, U	<25 U	<10 U
Triethylene glycol (112-27-6)	µg/L	<5 H, U	<25 U	<10 U	<5 H, U	<25 U	<10 U
Tetraethylene glycol (112-60-7)	µg/L	<25 H, U	<50 U, J-	<10 U	<25 H, U	<50 U, J-	<10 U
Low Molecular Weight Acids							
Lactate (50-21-5)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Formate (64-18-6)	mg/L	<0.10 U	R	NA	0.19	R	NA
Acetate (64-19-7)	mg/L	R	<0.10 U	<0.10 U	R	<0.10 U	<0.10 U
Propionate (79-09-4)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Butyrate (107-92-6)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Isobutyrate (79-31-2)	mg/L	<0.10 U, J-	<0.10 U	<0.10 U, J-	<0.10 U, J-	<0.10 U	<0.10 U, J-

Table B-5 Sample Results - Dissolved Gases, Diesel and Gasoline Range Organics, Glycols, and Low Molecular Weight Acids (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample / Sample Date / Unit	GW06 7/26/11 Round 1	GW06 3/24/12 Round 2	GW06 5/19/13 Round 3	GW07 7/26/11 Round 1	GW07 5/19/13 Round 3	GW08 7/27/11 Round 1	GW08 3/24/12 Round 2	GW08 5/19/13 Round 3
Dissolved Gases									
Methane (74-82-8)	mg/L	5.560	0.7810	5.35	0.0447	<0.0013 U	<0.0015 U	0.0016	<0.0013 U
Ethane (74-84-0)	mg/L	0.0043	<0.0027 U	0.0045	<0.0029 U	<0.0027 U	<0.0029 U	<0.0027 U	<0.0027 U
Propane (74-98-6)	mg/L	<0.0041 U	<0.0038 U	<0.0037 U	<0.0041 U	<0.0037 U	<0.0041 U	<0.0038 U	<0.0037 U
Butane (106-97-8)	mg/L	<0.0055 U	<0.0048 U	<0.0047 U	<0.0055 U	<0.0047 U	<0.0055 U	<0.0048 U	<0.0047 U
Diesel and Gas Range Organics									
GRO/TPH	µg/L	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U
DRO	µg/L	31.5 J-	<20.0 U	<20.0 U	<20.0 U, J-	<20.0 U	71.2 J-	74.7	<20.0 U
Glycols									
2-butoxyethanol (111-76-2)	µg/L	<5 U	<10 U, J-	<10 U	<5 U	<10 U	<5 U	<10 U, J-	<10 U
Diethylene glycol (111-46-6)	µg/L	<50 H, U	<25 U	<10 U	<50 H, U	<10 U	<50 U	<25 U	<10 U
Triethylene glycol (112-27-6)	µg/L	<5 H, U	<25 U	<10 U	<5 H, U	<10 U	<5 U	<25 U	<10 U
Tetraethylene glycol (112-60-7)	µg/L	<25 H, U	<50 U, J-	<10 U	<25 H, U	<10 U	<25 U	<50 U, J-	<10 U
Low Molecular Weight Acids									
Lactate (50-21-5)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Formate (64-18-6)	mg/L	0.21	R	NA	0.13	NA	0.37	R	NA
Acetate (64-19-7)	mg/L	R	<0.10 U	<0.10 U	R	<0.10 U	R	<0.10 U	<0.10 U
Propionate (79-09-4)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Butyrate (107-92-6)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Isobutyrate (79-31-2)	mg/L	<0.10 U, J-	<0.10 U	<0.10 U, J-	<0.10 U, J-	<0.10 U, J-	<0.10 U, J-	<0.10 U	<0.10 U, J-

Table B-5 Sample Results - Dissolved Gases, Diesel and Gasoline Range Organics, Glycols, and Low Molecular Weight Acids (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW09 7/27/11 Round 1	GW09 5/17/13 Round 3	GW10 7/27/11 Round 1	GW10 3/26/12 Round 2	GW11 7/28/11 Round 1	GW11 3/26/12 Round 2	GW12 7/28/11 Round 1	GW12 3/25/12 Round 2
Dissolved Gases									
Methane (74-82-8)	mg/L	<0.0015 U	<0.0013 U	<0.0015 U	<0.0014 U	<0.0015 U	<0.0014 U	<0.0015 U	<0.0014 U
Ethane (74-84-0)	mg/L	<0.0029 U	<0.0027 U	<0.0029 U	<0.0027 U	<0.0029 U	<0.0027 U	<0.0029 U	<0.0027 U
Propane (74-98-6)	mg/L	<0.0041 U	<0.0037 U	<0.0041 U	<0.0038 U	<0.0041 U	<0.0038 U	<0.0041 U	<0.0038 U
Butane (106-97-8)	mg/L	<0.0055 U	<0.0047 U	<0.0055 U	<0.0048 U	<0.0055 U	<0.0048 U	<0.0055 U	<0.0048 U
Diesel and Gas Range Organics									
GRO/TPH	µg/L	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U
DRO	µg/L	<21.1 U, J-	<20.0 U	26.9 J-	27.1	73.8 J-	84.4	27.1 J-	<20.0 U
Glycols									
2-butoxyethanol (111-76-2)	µg/L	<5 U	<10 U	<5 U	<10 U, J-	<5 U, J-	<10 U, J-	<5 U, J-	<10 U, J-
Diethylene glycol (111-46-6)	µg/L	<50 U	<10 U	<50 U	<25 U	<50 U, J-	<25 U	<50 U, J-	<25 U
Triethylene glycol (112-27-6)	µg/L	<5 U	<10 U	<5 U	<25 U	<5 U, J-	<25 U	<5 U, J-	<25 U
Tetraethylene glycol (112-60-7)	µg/L	<25 U	<10 U	<25 U	<50 U, J-	<25 U, J-	<50 U, J-	<25 U, J-	<50 U, J-
Low Molecular Weight Acids									
Lactate (50-21-5)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Formate (64-18-6)	mg/L	0.26	NA	0.20	R	0.31	R	0.14	R
Acetate (64-19-7)	mg/L	R	<0.10 U	R	<0.10 U	R	<0.10 U	R	<0.10 U
Propionate (79-09-4)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Butyrate (107-92-6)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Isobutyrate (79-31-2)	mg/L	<0.10 U, J-	<0.10 U, J-	<0.10 U, J-	<0.10 U	<0.10 U, J-	<0.10 U	<0.10 U, J-	<0.10 U

Table B-5 Sample Results - Dissolved Gases, Diesel and Gasoline Range Organics, Glycols, and Low Molecular Weight Acids (Washington County, Pennsylvania)

	Sample	GW13	GW13	GW13	GW14	GW14	GW15	GW16	GW17
	Sample Date	7/28/11	3/24/12	5/20/13	3/27/12	5/20/13	3/25/12	3/27/12	3/27/12
Parameter (CAS Number)	Unit	Round 1	Round 2	Round 3	Round 2	Round 3	Round 2	Round 2	Round 2
Dissolved Gases									
Methane (74-82-8)	mg/L	<0.0015 U	<0.0014 U	<0.0013 U	0.0027	<0.0013 U	<0.0014 U	<0.0014 U	15.50
Ethane (74-84-0)	mg/L	<0.0029 U	<0.0027 U	<0.0027 U	<0.0027 U	<0.0027 U	<0.0027 U	<0.0027 U	0.291
Propane (74-98-6)	mg/L	<0.0041 U	<0.0038 U	<0.0037 U	<0.0038 U	<0.0037 U	<0.0038 U	<0.0038 U	<0.0038 U
Butane (106-97-8)	mg/L	<0.0055 U	<0.0048 U	<0.0047 U	<0.0048 U	<0.0047 U	<0.0048 U	<0.0048 U	<0.0048 U
Diesel and Gas Range Organics									
GRO/TPH	µg/L	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U
DRO	µg/L	<21.3 U, J-	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	24.8	87.9
Glycols									
2-butoxyethanol (111-76-2)	µg/L	<5 U, J-	<10 U, J-	<10 U	<10 U, J-	<10 U	<10 U, J-	<10 U, J-	<10 U, J-
Diethylene glycol (111-46-6)	µg/L	<50 U, J-	<25 U	<10 U	<25 U	<10 U	<25 U	<25 U	<25 U
Triethylene glycol (112-27-6)	µg/L	<5 U, J-	<25 U	<10 U	<25 U	<10 U	<25 U	<25 U	<25 U
Tetraethylene glycol (112-60-7)	µg/L	<25 U, J-	<50 U, J-	<10 U	<50 U, J-	<10 U	<50 U, J-	<50 U, J-	<50 U, J-
Low Molecular Weight Acids									
Lactate (50-21-5)	mg/L	<0.10 U	<0.10 U	<0.10 U	0.06 J	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Formate (64-18-6)	mg/L	0.38	R	NA	R	NA	R	R	R
Acetate (64-19-7)	mg/L	R	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Propionate (79-09-4)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Butyrate (107-92-6)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Isobutyrate (79-31-2)	mg/L	<0.10 U, J-	<0.10 U	<0.10 U, J-	<0.10 U	<0.10 U, J-	<0.10 U	<0.10 U	<0.10 U

Table B-5 Sample Results - Dissolved Gases, Diesel and Gasoline Range Organics, Glycols, and Low Molecular Weight Acids (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample / Sample Date / Unit	GW18 5/20/13 Round 3	GW19 5/20/13 Round 3
Dissolved Gases			
Methane (74-82-8)	mg/L	NS	NS
Ethane (74-84-0)	mg/L	NS	NS
Propane (74-98-6)	mg/L	NS	NS
Butane (106-97-8)	mg/L	NS	NS
Diesel and Gas Range Organics			
GRO/TPH	µg/L	NS	NS
DRO	µg/L	NS	NS
Glycols			
2-butoxyethanol (111-76-2)	µg/L	NS	NS
Diethylene glycol (111-46-6)	µg/L	NS	NS
Triethylene glycol (112-27-6)	µg/L	NS	NS
Tetraethylene glycol (112-60-7)	µg/L	NS	NS
Low Molecular Weight Acids			
Lactate (50-21-5)	mg/L	NS	NS
Formate (64-18-6)	mg/L	NA	NA
Acetate (64-19-7)	mg/L	NS	NS
Propionate (79-09-4)	mg/L	NS	NS
Butyrate (107-92-6)	mg/L	NS	NS
Isobutyrate (79-31-2)	mg/L	NS	NS

Table B-5 Sample Results - Dissolved Gases, Diesel and Gasoline Range Organics, Glycols, and Low Molecular Weight Acids (Washington County, Pennsylvania)

	Sample	SW01	SW01	SW02	SW02	SW02	SW03	SW03
	Sample Date	7/25/11	5/18/13	7/25/11	3/23/12	5/18/13	7/27/11	3/26/12
Parameter (CAS Number)	Unit	Round 1	Round 3	Round 1	Round 2	Round 3	Round 1	Round 2
Dissolved Gases								
Methane (74-82-8)	mg/L	<0.0015 U	<0.0013 U	<0.0015 U	<0.0014 U	<0.0013 U	<0.0015 U	<0.0014 U
Ethane (74-84-0)	mg/L	<0.0029 U	<0.0027 U	<0.0029 U	<0.0027 U	<0.0027 U	<0.0029 U	<0.0027 U
Propane (74-98-6)	mg/L	<0.0041 U	<0.0037 U	<0.0041 U	<0.0038 U	<0.0037 U	<0.0041 U	<0.0038 U
Butane (106-97-8)	mg/L	<0.0055 U	<0.0047 U	<0.0055 U	<0.0048 U	<0.0047 U	<0.0055 U	<0.0048 U
Diesel and Gas Range Organics								
GRO/TPH	µg/L	25.4 B	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U	<20.0 U
DRO	µg/L	34.9 J-	<20.0 U	28.7 J-	29.0 B	51.2	<21.7 U, J-	<20.0 U
Glycols								
2-butoxyethanol (111-76-2)	µg/L	<5 U	<10 U	<5 U	<10 U, J-	<10 U	<5 U	<10 U, J-
Diethylene glycol (111-46-6)	µg/L	<50 H, U	<10 U	<50 H, U	<25 U	<10 U	<50 U	<25 U
Triethylene glycol (112-27-6)	µg/L	<5 H, U	<10 U	<5 H, U	<25 U	<10 U	<5 U	<25 U
Tetraethylene glycol (112-60-7)	µg/L	<25 H, U	<10 U	<25 H, U	<50 U, J-	<10 U	<25 U	<50 U, J-
Low Molecular Weight Acids								
Lactate (50-21-5)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	0.04 J
Formate (64-18-6)	mg/L	0.16	NA	<0.10 U	R	NA	0.22	R
Acetate (64-19-7)	mg/L	R	<0.10 U	R	<0.10 U	<0.10 U	R	<0.10 U
Propionate (79-09-4)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	0.11 B
Butyrate (107-92-6)	mg/L	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U	<0.10 U
Isobutyrate (79-31-2)	mg/L	<0.10 U, J-	<0.10 U, J-	<0.10 U, J-	<0.10 U	<0.10 U, J-	<0.10 U, J-	<0.10 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW01 7/25/11 Round 1	GW01 5/17/13 Round 3	GW02 7/25/11 Round 1	GW02 5/18/13 Round 3	GW03 7/25/11 Round 1	GW03 3/23/12 Round 2	GW03 5/20/13 Round 3
R-(+)-limonene (5989-27-5)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U, J-	<1.00 U
1,2,4-trichlorobenzene (120-82-1)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U, J-
1,2-dichlorobenzene (95-50-1)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
1,2-dinitrobenzene (528-29-0)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
1,3-dichlorobenzene (541-73-1)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
1,3-dimethyladamantane (702-79-4)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U, J-	<1.00 U, J-
1,3 -dinitrobenzene (99-65-0)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
1,4-dichlorobenzene (106-46-7)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
1,4-dinitrobenzene (100-25-4)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
1-methylnaphthalene (90-12-0)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U, J-
2,3,4,6-tetrachlorophenol (58-90-2)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
2,3,5,6-tetrachlorophenol (935-95-5)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
2,4,5-trichlorophenol (95-95-4)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U, J-
2,4,6-trichlorophenol (88-06-2)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U, J-
2,4-dichlorophenol (120-83-2)	µg/L	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U, J-
2,4-dimethylphenol (105-67-9)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U, J-
2,4-dinitrophenol (51-28-5)	µg/L	<5.0 U	<3.00 U	<5.0 U	<3.00 U	<5.0 U, J-	<3.00 U	<3.00 U
2,4-dinitrotoluene (121-14-2)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
2,6-dinitrotoluene (606-20-2)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
2-butoxyethanol (111-76-2)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
2-chloronaphthalene (91-58-7)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
2-chlorophenol (95-57-8)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
2-methylnaphthalene (91-57-6)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U, J-
2-methylphenol (95-48-7)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
2-nitroaniline (88-74-4)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
2-nitrophenol (88-75-5)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U, J-
3&4-methylphenol (108-39-4 & 106-44-5)	µg/L	<0.50 U	<5.00 U	<0.50 U	<5.00 U	<0.50 U, J-	<5.00 U	<5.00 U, J-
3,3'-dichlorobenzidine (91-94-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U
3-nitroaniline (99-09-2)	µg/L	<0.50 U	<3.00 U	<0.50 U	<3.00 U	<0.50 U, J-	<3.00 U	<3.00 U
4,6-dinitro-2-methylphenol (534-52-1)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
4-bromophenyl phenyl ether (101-55-3)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
4-chloro-3-methylphenol (59-50-7)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U, J-

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW04 7/25/11 Round 1	GW04 3/23/12 Round 2	GW04 5/18/13 Round 3	GW05 7/26/11 Round 1	GW05 3/23/12 Round 2	GW05 5/17/13 Round 3
R-(+)-limonene (5989-27-5)	µg/L	<0.50 U, J-	<1.00 U, J-	<1.00 U	<0.50 U, J-	<1.00 U, J-	<1.00 U
1,2,4-trichlorobenzene (120-82-1)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
1,2-dichlorobenzene (95-50-1)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
1,2-dinitrobenzene (528-29-0)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
1,3-dichlorobenzene (541-73-1)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
1,3-dimethyladamantane (702-79-4)	µg/L	<0.50 U, J-	<1.00 U, J-	<1.00 U	<0.50 U, J-	<1.00 U, J-	<1.00 U
1,3 -dinitrobenzene (99-65-0)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
1,4-dichlorobenzene (106-46-7)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
1,4-dinitrobenzene (100-25-4)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
1-methylnaphthalene (90-12-0)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
2,3,4,6-tetrachlorophenol (58-90-2)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U
2,3,5,6-tetrachlorophenol (935-95-5)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U
2,4,5-trichlorophenol (95-95-4)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U
2,4,6-trichlorophenol (88-06-2)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U
2,4-dichlorophenol (120-83-2)	µg/L	<0.50 U, J-	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
2,4-dimethylphenol (105-67-9)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U
2,4-dinitrophenol (51-28-5)	µg/L	<5.0 U	<3.00 U	<3.00 U	<5.0 U	<3.00 U	<3.00 U
2,4-dinitrotoluene (121-14-2)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
2,6-dinitrotoluene (606-20-2)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
2-butoxyethanol (111-76-2)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	1.00 J-	<1.00 U	<1.00 U
2-chloronaphthalene (91-58-7)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
2-chlorophenol (95-57-8)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U
2-methylnaphthalene (91-57-6)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
2-methylphenol (95-48-7)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U
2-nitroaniline (88-74-4)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
2-nitrophenol (88-75-5)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U
3&4-methylphenol (108-39-4 & 106-44-5)	µg/L	<0.50 U	<5.00 U	<5.00 U	<0.50 U	<5.00 U	<5.00 U
3,3'-dichlorobenzidine (91-94-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
3-nitroaniline (99-09-2)	µg/L	<0.50 U	<3.00 U	<3.00 U	<0.50 U	<3.00 U	<3.00 U
4,6-dinitro-2-methylphenol (534-52-1)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U
4-bromophenyl phenyl ether (101-55-3)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
4-chloro-3-methylphenol (59-50-7)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW06 7/26/11 Round 1	GW06 3/24/12 Round 2	GW06 5/19/13 Round 3	GW07 7/26/11 Round 1	GW07 5/19/13 Round 3
R-(+)-limonene (5989-27-5)	µg/L	<0.50 U, J-	<1.00 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
1,2,4-trichlorobenzene (120-82-1)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
1,2-dichlorobenzene (95-50-1)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
1,2-dinitrobenzene (528-29-0)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
1,3-dichlorobenzene (541-73-1)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
1,3-dimethyladamantane (702-79-4)	µg/L	<0.50 U, J-	<1.00 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
1,3 -dinitrobenzene (99-65-0)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
1,4-dichlorobenzene (106-46-7)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
1,4-dinitrobenzene (100-25-4)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
1-methylnaphthalene (90-12-0)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
2,3,4,6-tetrachlorophenol (58-90-2)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U
2,3,5,6-tetrachlorophenol (935-95-5)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U
2,4,5-trichlorophenol (95-95-4)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U
2,4,6-trichlorophenol (88-06-2)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U
2,4-dichlorophenol (120-83-2)	µg/L	<0.50 U, J-	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U
2,4-dimethylphenol (105-67-9)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U
2,4-dinitrophenol (51-28-5)	µg/L	<5.0 U	<3.00 U	<3.00 U	<5.0 U	<3.00 U
2,4-dinitrotoluene (121-14-2)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
2,6-dinitrotoluene (606-20-2)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
2-butoxyethanol (111-76-2)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
2-chloronaphthalene (91-58-7)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
2-chlorophenol (95-57-8)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U
2-methylnaphthalene (91-57-6)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
2-methylphenol (95-48-7)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U
2-nitroaniline (88-74-4)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
2-nitrophenol (88-75-5)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U
3&4-methylphenol (108-39-4 & 106-44-5)	µg/L	<0.50 U	<5.00 U	<5.00 U	<0.50 U	<5.00 U
3,3'-dichlorobenzidine (91-94-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
3-nitroaniline (99-09-2)	µg/L	<0.50 U	<3.00 U	<3.00 U	<0.50 U	<3.00 U
4,6-dinitro-2-methylphenol (534-52-1)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U
4-bromophenyl phenyl ether (101-55-3)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
4-chloro-3-methylphenol (59-50-7)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW08 7/27/11 Round 1	GW08 3/24/12 Round 2	GW08 5/19/13 Round 3	GW09 7/27/11 Round 1	GW09 5/17/13 Round 3	GW10 7/27/11 Round 1	GW10 3/26/12 Round 2
R-(+)-limonene (5989-27-5)	µg/L	<0.50 U, J-	<1.00 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U, J-
1,2,4-trichlorobenzene (120-82-1)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
1,2-dichlorobenzene (95-50-1)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
1,2-dinitrobenzene (528-29-0)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
1,3-dichlorobenzene (541-73-1)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
1,3-dimethyladamantane (702-79-4)	µg/L	<0.50 U, J-	<1.00 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U, J-
1,3 -dinitrobenzene (99-65-0)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
1,4-dichlorobenzene (106-46-7)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
1,4-dinitrobenzene (100-25-4)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
1-methylnaphthalene (90-12-0)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
2,3,4,6-tetrachlorophenol (58-90-2)	µg/L	<0.50 U, J-	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U
2,3,5,6-tetrachlorophenol (935-95-5)	µg/L	<0.50 U, J-	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U
2,4,5-trichlorophenol (95-95-4)	µg/L	<0.50 U, J-	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U
2,4,6-trichlorophenol (88-06-2)	µg/L	<0.50 U, J-	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U
2,4-dichlorophenol (120-83-2)	µg/L	<0.50 U, J-	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U
2,4-dimethylphenol (105-67-9)	µg/L	<0.50 U, J-	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U
2,4-dinitrophenol (51-28-5)	µg/L	<5.0 U, J-	<3.00 U	<3.00 U	<5.0 U, J-	<3.00 U	<5.0 U, J-	<3.00 U
2,4-dinitrotoluene (121-14-2)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
2,6-dinitrotoluene (606-20-2)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
2-butoxyethanol (111-76-2)	µg/L	0.74 J-, B	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	0.69 J-, B	<1.00 U
2-chloronaphthalene (91-58-7)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
2-chlorophenol (95-57-8)	µg/L	<0.50 U, J-	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U
2-methylnaphthalene (91-57-6)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
2-methylphenol (95-48-7)	µg/L	<0.50 U, J-	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U
2-nitroaniline (88-74-4)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
2-nitrophenol (88-75-5)	µg/L	<0.50 U, J-	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U
3&4-methylphenol (108-39-4 & 106-44-5)	µg/L	<0.50 U, J-	<5.00 U	<5.00 U	<0.50 U, J-	<5.00 U	<0.50 U, J-	<5.00 U
3,3'-dichlorobenzidine (91-94-1)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U
3-nitroaniline (99-09-2)	µg/L	<0.50 U, J-	<3.00 U	<3.00 U	<0.50 U, J-	<3.00 U	<0.50 U, J-	<3.00 U
4,6-dinitro-2-methylphenol (534-52-1)	µg/L	<0.50 U, J-	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U
4-bromophenyl phenyl ether (101-55-3)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
4-chloro-3-methylphenol (59-50-7)	µg/L	<0.50 U, J-	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW11 7/28/11 Round 1	GW11 3/26/12 Round 2	GW12 7/28/11 Round 1	GW12 3/25/12 Round 2	GW13 7/28/11 Round 1	GW13 3/24/12 Round 2	GW13 5/20/13 Round 3
R-(+)-limonene (5989-27-5)	µg/L	<0.50 U, J-	<1.00 U, J-	<0.50 U, J-	<1.00 U, J-	<0.50 U, J-	<1.00 U, J-	<1.00 U
1,2,4-trichlorobenzene (120-82-1)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
1,2-dichlorobenzene (95-50-1)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
1,2-dinitrobenzene (528-29-0)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
1,3-dichlorobenzene (541-73-1)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
1,3-dimethyladamantane (702-79-4)	µg/L	<0.50 U, J-	<1.00 U, J-	<0.50 U, J-	<1.00 U, J-	<0.50 U, J-	<1.00 U, J-	<1.00 U
1,3 -dinitrobenzene (99-65-0)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
1,4-dichlorobenzene (106-46-7)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
1,4-dinitrobenzene (100-25-4)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
1-methylnaphthalene (90-12-0)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
2,3,4,6-tetrachlorophenol (58-90-2)	µg/L	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
2,3,5,6-tetrachlorophenol (935-95-5)	µg/L	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
2,4,5-trichlorophenol (95-95-4)	µg/L	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
2,4,6-trichlorophenol (88-06-2)	µg/L	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
2,4-dichlorophenol (120-83-2)	µg/L	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
2,4-dimethylphenol (105-67-9)	µg/L	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
2,4-dinitrophenol (51-28-5)	µg/L	<5.0 U, J-	<3.00 U	<5.0 U, J-	<3.00 U	<5.0 U, J-	<3.00 U	<3.00 U
2,4-dinitrotoluene (121-14-2)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
2,6-dinitrotoluene (606-20-2)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
2-butoxyethanol (111-76-2)	µg/L	1.99 J-	<1.00 U	<0.50 U, J-	<1.00 U	2.92 J-	<1.00 U	<1.00 U
2-chloronaphthalene (91-58-7)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
2-chlorophenol (95-57-8)	µg/L	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
2-methylnaphthalene (91-57-6)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
2-methylphenol (95-48-7)	µg/L	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
2-nitroaniline (88-74-4)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
2-nitrophenol (88-75-5)	µg/L	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
3&4-methylphenol (108-39-4 & 106-44-5)	µg/L	<0.50 U, J-	<5.00 U	<0.50 U, J-	<5.00 U	<0.50 U, J-	<5.00 U	<5.00 U
3,3'-dichlorobenzidine (91-94-1)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U
3-nitroaniline (99-09-2)	µg/L	<0.50 U, J-	<3.00 U	<0.50 U, J-	<3.00 U	<0.50 U, J-	<3.00 U	<3.00 U
4,6-dinitro-2-methylphenol (534-52-1)	µg/L	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
4-bromophenyl phenyl ether (101-55-3)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
4-chloro-3-methylphenol (59-50-7)	µg/L	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW14 3/27/12 Round 2	GW14 5/20/13 Round 3	GW15 3/25/12 Round 2	GW16 3/27/12 Round 2	GW17 3/27/12 Round 2	GW18 5/20/13 Round 3	GW19 5/20/13 Round 3
R-(+)-limonene (5989-27-5)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U, J-	<1.00 U, J-	NS	NS
1,2,4-trichlorobenzene (120-82-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
1,2-dichlorobenzene (95-50-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
1,2-dinitrobenzene (528-29-0)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
1,3-dichlorobenzene (541-73-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
1,3-dimethyladamantane (702-79-4)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U, J-	<1.00 U, J-	NS	NS
1,3 -dinitrobenzene (99-65-0)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
1,4-dichlorobenzene (106-46-7)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
1,4-dinitrobenzene (100-25-4)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
1-methylnaphthalene (90-12-0)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
2,3,4,6-tetrachlorophenol (58-90-2)	µg/L	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	NS	NS
2,3,5,6-tetrachlorophenol (935-95-5)	µg/L	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	NS	NS
2,4,5-trichlorophenol (95-95-4)	µg/L	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	NS	NS
2,4,6-trichlorophenol (88-06-2)	µg/L	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	NS	NS
2,4-dichlorophenol (120-83-2)	µg/L	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	NS	NS
2,4-dimethylphenol (105-67-9)	µg/L	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	NS	NS
2,4-dinitrophenol (51-28-5)	µg/L	<3.00 U	<3.00 U	<3.00 U	<3.00 U	<3.00 U	NS	NS
2,4-dinitrotoluene (121-14-2)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
2,6-dinitrotoluene (606-20-2)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
2-butoxyethanol (111-76-2)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
2-chloronaphthalene (91-58-7)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
2-chlorophenol (95-57-8)	µg/L	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	NS	NS
2-methylnaphthalene (91-57-6)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
2-methylphenol (95-48-7)	µg/L	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	NS	NS
2-nitroaniline (88-74-4)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
2-nitrophenol (88-75-5)	µg/L	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	NS	NS
3&4-methylphenol (108-39-4 & 106-44-5)	µg/L	<5.00 U	<5.00 U	<5.00 U	<5.00 U	<5.00 U	NS	NS
3,3'-dichlorobenzidine (91-94-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
3-nitroaniline (99-09-2)	µg/L	<3.00 U	<3.00 U	<3.00 U	<3.00 U	<3.00 U	NS	NS
4,6-dinitro-2-methylphenol (534-52-1)	µg/L	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	NS	NS
4-bromophenyl phenyl ether (101-55-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
4-chloro-3-methylphenol (59-50-7)	µg/L	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	NS	NS

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	SW01 7/25/11 Round 1	SW01 5/18/13 Round 3	SW02 7/25/11 Round 1	SW02 3/23/12 Round 2	SW02 5/18/13 Round 3	SW03 7/27/11 Round 1	SW03 3/26/12 Round 2
R-(+)-limonene (5989-27-5)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U, J-	<1.00 U	<0.50 U, J-	<1.00 U, J-
1,2,4-trichlorobenzene (120-82-1)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
1,2-dichlorobenzene (95-50-1)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
1,2-dinitrobenzene (528-29-0)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
1,3-dichlorobenzene (541-73-1)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
1,3-dimethyladamantane (702-79-4)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U, J-	<1.00 U	<0.50 U, J-	<1.00 U, J-
1,3 -dinitrobenzene (99-65-0)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
1,4-dichlorobenzene (106-46-7)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
1,4-dinitrobenzene (100-25-4)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
1-methylnaphthalene (90-12-0)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
2,3,4,6-tetrachlorophenol (58-90-2)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U
2,3,5,6-tetrachlorophenol (935-95-5)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U
2,4,5-trichlorophenol (95-95-4)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U
2,4,6-trichlorophenol (88-06-2)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U
2,4-dichlorophenol (120-83-2)	µg/L	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U
2,4-dimethylphenol (105-67-9)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U
2,4-dinitrophenol (51-28-5)	µg/L	<5.0 U	<3.00 U	<5.0 U	<3.00 U	<3.00 U	<5.0 U, J-	<3.00 U
2,4-dinitrotoluene (121-14-2)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
2,6-dinitrotoluene (606-20-2)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
2-butoxyethanol (111-76-2)	µg/L	0.54 J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U	1.65 J-, B	<1.00 U
2-chloronaphthalene (91-58-7)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
2-chlorophenol (95-57-8)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U
2-methylnaphthalene (91-57-6)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
2-methylphenol (95-48-7)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U
2-nitroaniline (88-74-4)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
2-nitrophenol (88-75-5)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U
3&4-methylphenol (108-39-4 & 106-44-5)	µg/L	<0.50 U	<5.00 U	<0.50 U	<5.00 U	<5.00 U	<0.50 U, J-	<5.00 U
3,3'-dichlorobenzidine (91-94-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U
3-nitroaniline (99-09-2)	µg/L	<0.50 U	<3.00 U	<0.50 U	<3.00 U	<3.00 U	<0.50 U, J-	<3.00 U
4,6-dinitro-2-methylphenol (534-52-1)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U
4-bromophenyl phenyl ether (101-55-3)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
4-chloro-3-methylphenol (59-50-7)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW01 7/25/11 Round 1	GW01 5/17/13 Round 3	GW02 7/25/11 Round 1	GW02 5/18/13 Round 3	GW03 7/25/11 Round 1	GW03 3/23/12 Round 2	GW03 5/20/13 Round 3
4-chloroaniline (106-47-8)	µg/L	<1.00 U	<3.00 U	<1.00 U	<3.00 U	<1.00 U, J-	<3.00 U	<3.00 U, J-
4-chlorophenyl phenyl ether (7005-72-3)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
4-nitroaniline (100-01-6)	µg/L	<0.50 U	<3.00 U	<0.50 U	<3.00 U	<0.50 U, J-	<3.00 U	<3.00 U
4-nitrophenol (100-02-7)	µg/L	<2.50 U	<3.00 U	<2.50 U	<3.00 U	<2.50 U, J-	<3.00 U	<3.00 U
Acenaphthene (83-32-9)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Acenaphthylene (208-96-8)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Adamantane (281-23-2)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U, J-	<1.00 U
Aniline (62-53-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U
Anthracene (120-12-7)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Azobenzene (103-33-3)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Benzo(a)anthracene (56-55-3)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Benzo(a)pyrene (50-32-8)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Benzo(b)fluoranthene (205-99-2)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Benzo(g,h,i)perylene (191-24-2)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Benzo(k)fluoranthene (207-08-9)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Benzoic Acid (65-85-0)	µg/L	<5.00 U	<3.00 U	<5.00 U	<3.00 U	<5.00 U, J-	<3.00 U	<3.00 U, J-
Benzyl alcohol (100-51-6)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Bis-(2-chloroethoxy)methane (111-91-1)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U, J-
Bis-(2-chloroethyl)ether (111-44-4)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Bis-(2-chloroisopropyl)ether (108-60-1)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Bis-(2-ethylhexyl) adipate (103-23-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U
Bis-(2-ethylhexyl) phthalate (117-81-7)	µg/L	2.17	<2.00 U	1.51	<2.00 U	<1.00 U, J-	<2.00 U	<2.00 U
Butyl benzyl phthalate (85-68-7)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<2.00 U	<1.00 U
Carbazole (86-74-8)	µg/L	<0.50 U	<3.00 U	<0.50 U	<3.00 U	<0.50 U, J-	<3.00 U	<3.00 U
Chrysene (218-01-9)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Dibenz(a,h)anthracene (53-70-3)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Dibenzofuran (132-64-9)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Diethyl phthalate (84-66-2)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Dimethyl phthalate (131-11-3)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Di-n-butyl phthalate (84-74-2)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Di-n-octyl phthalate (117-84-0)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Diphenylamine (122-39-4)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW04 7/25/11 Round 1	GW04 3/23/12 Round 2	GW04 5/18/13 Round 3	GW05 7/26/11 Round 1	GW05 3/23/12 Round 2	GW05 5/17/13 Round 3
4-chloroaniline (106-47-8)	µg/L	<1.00 U	<3.00 U	<3.00 U	<1.00 U	<3.00 U	<3.00 U
4-chlorophenyl phenyl ether (7005-72-3)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
4-nitroaniline (100-01-6)	µg/L	<0.50 U	<3.00 U	<3.00 U	<0.50 U	<3.00 U	<3.00 U
4-nitrophenol (100-02-7)	µg/L	<2.50 U	<3.00 U	<3.00 U	<2.50 U	<3.00 U	<3.00 U
Acenaphthene (83-32-9)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Acenaphthylene (208-96-8)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Adamantane (281-23-2)	µg/L	<0.50 U, J-	<1.00 U, J-	<1.00 U	<0.50 U, J-	<1.00 U, J-	<1.00 U
Aniline (62-53-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Anthracene (120-12-7)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Azobenzene (103-33-3)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Benzo(a)anthracene (56-55-3)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Benzo(a)pyrene (50-32-8)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Benzo(b)fluoranthene (205-99-2)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Benzo(g,h,i)perylene (191-24-2)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Benzo(k)fluoranthene (207-08-9)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Benzoic Acid (65-85-0)	µg/L	<5.00 U	<3.00 U	<3.00 U	<5.00 U	<3.00 U	<3.00 U
Benzyl alcohol (100-51-6)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Bis-(2-chloroethoxy)methane (111-91-1)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Bis-(2-chloroethyl)ether (111-44-4)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Bis-(2-chloroisopropyl)ether (108-60-1)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Bis-(2-ethylhexyl) adipate (103-23-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Bis-(2-ethylhexyl) phthalate (117-81-7)	µg/L	<1.00 U	<2.00 U	<2.00 U	<1.00 U	<2.00 U	<2.00 U
Butyl benzyl phthalate (85-68-7)	µg/L	<0.50 U	<2.00 U	<1.00 U	<0.50 U	<2.00 U	<1.00 U
Carbazole (86-74-8)	µg/L	<0.50 U	<3.00 U	<3.00 U	<0.50 U	<3.00 U	<3.00 U
Chrysene (218-01-9)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Dibenz(a,h)anthracene (53-70-3)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Dibenzofuran (132-64-9)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Diethyl phthalate (84-66-2)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Dimethyl phthalate (131-11-3)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Di-n-butyl phthalate (84-74-2)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Di-n-octyl phthalate (117-84-0)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	1.13	<1.00 U
Diphenylamine (122-39-4)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW06 7/26/11 Round 1	GW06 3/24/12 Round 2	GW06 5/19/13 Round 3	GW07 7/26/11 Round 1	GW07 5/19/13 Round 3
4-chloroaniline (106-47-8)	µg/L	<1.00 U	<3.00 U	<3.00 U	<1.00 U	<3.00 U
4-chlorophenyl phenyl ether (7005-72-3)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
4-nitroaniline (100-01-6)	µg/L	<0.50 U	<3.00 U	<3.00 U	<0.50 U	<3.00 U
4-nitrophenol (100-02-7)	µg/L	<2.50 U	<3.00 U	<3.00 U	<2.50 U	<3.00 U
Acenaphthene (83-32-9)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Acenaphthylene (208-96-8)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Adamantane (281-23-2)	µg/L	<0.50 U, J-	<1.00 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Aniline (62-53-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Anthracene (120-12-7)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Azobenzene (103-33-3)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Benzo(a)anthracene (56-55-3)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Benzo(a)pyrene (50-32-8)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Benzo(b)fluoranthene (205-99-2)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Benzo(g,h,i)perylene (191-24-2)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Benzo(k)fluoranthene (207-08-9)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Benzoic Acid (65-85-0)	µg/L	<5.00 U	<3.00 U	<3.00 U	<5.00 U	<3.00 U
Benzyl alcohol (100-51-6)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Bis-(2-chloroethoxy)methane (111-91-1)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Bis-(2-chloroethyl)ether (111-44-4)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Bis-(2-chloroisopropyl)ether (108-60-1)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Bis-(2-ethylhexyl) adipate (103-23-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Bis-(2-ethylhexyl) phthalate (117-81-7)	µg/L	<1.00 U	<2.00 U	<2.00 U	1.38	<2.00 U
Butyl benzyl phthalate (85-68-7)	µg/L	1.40	<2.00 U	<1.00 U	<0.50 U	<1.00 U
Carbazole (86-74-8)	µg/L	<0.50 U	<3.00 U	<3.00 U	<0.50 U	<3.00 U
Chrysene (218-01-9)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Dibenz(a,h)anthracene (53-70-3)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Dibenzofuran (132-64-9)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Diethyl phthalate (84-66-2)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Dimethyl phthalate (131-11-3)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Di-n-butyl phthalate (84-74-2)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Di-n-octyl phthalate (117-84-0)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Diphenylamine (122-39-4)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample / Sample Date / Unit	GW08 7/27/11 Round 1	GW08 3/24/12 Round 2	GW08 5/19/13 Round 3	GW09 7/27/11 Round 1	GW09 5/17/13 Round 3	GW10 7/27/11 Round 1	GW10 3/26/12 Round 2
4-chloroaniline (106-47-8)	µg/L	<1.00 U, J-	<3.00 U	<3.00 U	<1.00 U, J-	<3.00 U	<1.00 U, J-	<3.00 U
4-chlorophenyl phenyl ether (7005-72-3)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
4-nitroaniline (100-01-6)	µg/L	<0.50 U, J-	<3.00 U	<3.00 U	<0.50 U, J-	<3.00 U	<0.50 U, J-	<3.00 U
4-nitrophenol (100-02-7)	µg/L	<2.50 U, J-	<3.00 U	<3.00 U	<2.50 U, J-	<3.00 U	<2.50 U, J-	<3.00 U
Acenaphthene (83-32-9)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Acenaphthylene (208-96-8)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Adamantane (281-23-2)	µg/L	<0.50 U, J-	<1.00 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U, J-
Aniline (62-53-3)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U
Anthracene (120-12-7)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Azobenzene (103-33-3)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Benzo(a)anthracene (56-55-3)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Benzo(a)pyrene (50-32-8)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Benzo(b)fluoranthene (205-99-2)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Benzo(g,h,i)perylene (191-24-2)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Benzo(k)fluoranthene (207-08-9)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Benzoic Acid (65-85-0)	µg/L	<5.00 U, J-	<3.00 U	<3.00 U	<5.00 U, J-	<3.00 U	<5.00 U, J-	<3.00 U
Benzyl alcohol (100-51-6)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Bis-(2-chloroethoxy)methane (111-91-1)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Bis-(2-chloroethyl)ether (111-44-4)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Bis-(2-chloroisopropyl)ether (108-60-1)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Bis-(2-ethylhexyl) adipate (103-23-1)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U
Bis-(2-ethylhexyl) phthalate (117-81-7)	µg/L	1.06 J-	<2.00 U	<2.00 U	<1.00 U, J-	4.34	<1.00 U, J-	<2.00 U
Butyl benzyl phthalate (85-68-7)	µg/L	<0.50 U, J-	<2.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<2.00 U
Carbazole (86-74-8)	µg/L	<0.50 U, J-	<3.00 U	<3.00 U	<0.50 U, J-	<3.00 U	<0.50 U, J-	<3.00 U
Chrysene (218-01-9)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Dibenz(a,h)anthracene (53-70-3)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Dibenzofuran (132-64-9)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Diethyl phthalate (84-66-2)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Dimethyl phthalate (131-11-3)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Di-n-butyl phthalate (84-74-2)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Di-n-octyl phthalate (117-84-0)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Diphenylamine (122-39-4)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW11 7/28/11 Round 1	GW11 3/26/12 Round 2	GW12 7/28/11 Round 1	GW12 3/25/12 Round 2	GW13 7/28/11 Round 1	GW13 3/24/12 Round 2	GW13 5/20/13 Round 3
4-chloroaniline (106-47-8)	µg/L	<1.00 U, J-	<3.00 U	<1.00 U, J-	<3.00 U	<1.00 U, J-	<3.00 U	<3.00 U
4-chlorophenyl phenyl ether (7005-72-3)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
4-nitroaniline (100-01-6)	µg/L	<0.50 U, J-	<3.00 U	<0.50 U, J-	<3.00 U	<0.50 U, J-	<3.00 U	<3.00 U
4-nitrophenol (100-02-7)	µg/L	<2.50 U, J-	<3.00 U	<2.50 U, J-	<3.00 U	<2.50 U, J-	<3.00 U	<3.00 U
Acenaphthene (83-32-9)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Acenaphthylene (208-96-8)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Adamantane (281-23-2)	µg/L	<0.50 U, J-	<1.00 U, J-	<0.50 U, J-	<1.00 U, J-	<0.50 U, J-	<1.00 U, J-	<1.00 U
Aniline (62-53-3)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U
Anthracene (120-12-7)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Azobenzene (103-33-3)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Benzo(a)anthracene (56-55-3)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Benzo(a)pyrene (50-32-8)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Benzo(b)fluoranthene (205-99-2)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Benzo(g,h,i)perylene (191-24-2)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Benzo(k)fluoranthene (207-08-9)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Benzoic Acid (65-85-0)	µg/L	<5.00 U, J-	<3.00 U	<5.00 U, J-	<3.00 U	<5.00 U, J-	<3.00 U	<3.00 U
Benzyl alcohol (100-51-6)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Bis-(2-chloroethoxy)methane (111-91-1)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Bis-(2-chloroethyl)ether (111-44-4)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Bis-(2-chloroisopropyl)ether (108-60-1)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Bis-(2-ethylhexyl) adipate (103-23-1)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U
Bis-(2-ethylhexyl) phthalate (117-81-7)	µg/L	<1.00 U, J-	<2.00 U	<1.00 U, J-	<2.00 U	<1.00 U, J-	<2.00 U	<2.00 U
Butyl benzyl phthalate (85-68-7)	µg/L	2.16 J-	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<1.00 U
Carbazole (86-74-8)	µg/L	<0.50 U, J-	<3.00 U	<0.50 U, J-	<3.00 U	<0.50 U, J-	<3.00 U	<3.00 U
Chrysene (218-01-9)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Dibenz(a,h)anthracene (53-70-3)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Dibenzofuran (132-64-9)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Diethyl phthalate (84-66-2)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Dimethyl phthalate (131-11-3)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Di-n-butyl phthalate (84-74-2)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Di-n-octyl phthalate (117-84-0)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Diphenylamine (122-39-4)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW14 3/27/12 Round 2	GW14 5/20/13 Round 3	GW15 3/25/12 Round 2	GW16 3/27/12 Round 2	GW17 3/27/12 Round 2	GW18 5/20/13 Round 3	GW19 5/20/13 Round 3
4-chloroaniline (106-47-8)	µg/L	<3.00 U	<3.00 U	<3.00 U	<3.00 U	<3.00 U	NS	NS
4-chlorophenyl phenyl ether (7005-72-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
4-nitroaniline (100-01-6)	µg/L	<3.00 U	<3.00 U	<3.00 U	<3.00 U	<3.00 U	NS	NS
4-nitrophenol (100-02-7)	µg/L	<3.00 U	<3.00 U	<3.00 U	<3.00 U	<3.00 U	NS	NS
Acenaphthene (83-32-9)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Acenaphthylene (208-96-8)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Adamantane (281-23-2)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U, J-	<1.00 U, J-	NS	NS
Aniline (62-53-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Anthracene (120-12-7)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Azobenzene (103-33-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Benzo(a)anthracene (56-55-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Benzo(a)pyrene (50-32-8)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Benzo(b)fluoranthene (205-99-2)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Benzo(g,h,i)perylene (191-24-2)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Benzo(k)fluoranthene (207-08-9)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Benzoic Acid (65-85-0)	µg/L	<3.00 U	<3.00 U	<3.00 U	<3.00 U	<3.00 U	NS	NS
Benzyl alcohol (100-51-6)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Bis-(2-chloroethoxy)methane (111-91-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Bis-(2-chloroethyl)ether (111-44-4)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Bis-(2-chloroisopropyl)ether (108-60-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Bis-(2-ethylhexyl) adipate (103-23-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Bis-(2-ethylhexyl) phthalate (117-81-7)	µg/L	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	NS	NS
Butyl benzyl phthalate (85-68-7)	µg/L	<2.00 U	<1.00 U	<2.00 U	<2.00 U	<2.00 U	NS	NS
Carbazole (86-74-8)	µg/L	<3.00 U	<3.00 U	<3.00 U	<3.00 U	<3.00 U	NS	NS
Chrysene (218-01-9)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Dibenz(a,h)anthracene (53-70-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Dibenzofuran (132-64-9)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Diethyl phthalate (84-66-2)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Dimethyl phthalate (131-11-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Di-n-butyl phthalate (84-74-2)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Di-n-octyl phthalate (117-84-0)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Diphenylamine (122-39-4)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	SW01 7/25/11 Round 1	SW01 5/18/13 Round 3	SW02 7/25/11 Round 1	SW02 3/23/12 Round 2	SW02 5/18/13 Round 3	SW03 7/27/11 Round 1	SW03 3/26/12 Round 2
4-chloroaniline (106-47-8)	µg/L	<1.00 U	<3.00 U	<1.00 U	<3.00 U	<3.00 U	<1.00 U, J-	<3.00 U
4-chlorophenyl phenyl ether (7005-72-3)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
4-nitroaniline (100-01-6)	µg/L	<0.50 U	<3.00 U	<0.50 U	<3.00 U	<3.00 U	<0.50 U, J-	<3.00 U
4-nitrophenol (100-02-7)	µg/L	<2.50 U	<3.00 U	<2.50 U	<3.00 U	<3.00 U	<2.50 U, J-	<3.00 U
Acenaphthene (83-32-9)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Acenaphthylene (208-96-8)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Adamantane (281-23-2)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U, J-	<1.00 U	<0.50 U, J-	<1.00 U, J-
Aniline (62-53-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U
Anthracene (120-12-7)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Azobenzene (103-33-3)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Benzo(a)anthracene (56-55-3)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Benzo(a)pyrene (50-32-8)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Benzo(b)fluoranthene (205-99-2)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Benzo(g,h,i)perylene (191-24-2)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Benzo(k)fluoranthene (207-08-9)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Benzoic Acid (65-85-0)	µg/L	<5.00 U	<3.00 U	<5.00 U	<3.00 U	<3.00 U	<5.00 U, J-	<3.00 U
Benzyl alcohol (100-51-6)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Bis-(2-chloroethoxy)methane (111-91-1)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Bis-(2-chloroethyl)ether (111-44-4)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Bis-(2-chloroisopropyl)ether (108-60-1)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Bis-(2-ethylhexyl) adipate (103-23-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U
Bis-(2-ethylhexyl) phthalate (117-81-7)	µg/L	<1.00 U	<2.00 U	<1.00 U	<2.00 U	<2.00 U	<1.00 U, J-	<2.00 U
Butyl benzyl phthalate (85-68-7)	µg/L	<0.50 U	<1.00 U	<0.50 U	<2.00 U	<1.00 U	<0.50 U, J-	<2.00 U
Carbazole (86-74-8)	µg/L	<0.50 U	<3.00 U	<0.50 U	<3.00 U	<3.00 U	<0.50 U, J-	<3.00 U
Chrysene (218-01-9)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Dibenz(a,h)anthracene (53-70-3)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Dibenzofuran (132-64-9)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Diethyl phthalate (84-66-2)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Dimethyl phthalate (131-11-3)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Di-n-butyl phthalate (84-74-2)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Di-n-octyl phthalate (117-84-0)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Diphenylamine (122-39-4)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW01 7/25/11 Round 1	GW01 5/17/13 Round 3	GW02 7/25/11 Round 1	GW02 5/18/13 Round 3	GW03 7/25/11 Round 1	GW03 3/23/12 Round 2	GW03 5/20/13 Round 3
Fluoranthene (206-44-0)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Fluorene (86-73-7)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Hexachlorobenzene (118-74-1)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Hexachlorobutadiene (87-68-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U, J-
Hexachlorocyclopentadiene (77-47-4)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U, J-
Hexachloroethane (67-72-1)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U, J-
Indeno(1,2,3-cd)pyrene (193-39-5)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Isophorone (78-59-1)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U, J-
Naphthalene (91-20-3)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U, J-
Nitrobenzene (98-95-3)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U, J-
N-nitrosodimethylamine (62-75-9)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<0.50 U	<1.00 U
N-nitrosodi-n-propylamine (621-64-7)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Pentachlorophenol (87-86-5)	µg/L	<1.00 U	<2.00 U	<1.00 U	<2.00 U	<1.00 U, J-	<1.00 U	<2.00 U
Phenanthrene (85-01-8)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Phenol (108-95-2)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
Pyrene (129-00-0)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Pyridine (110-86-1)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Squalene (111-02-4)	µg/L	<1.00 U	<2.00 U	<1.00 U	<2.00 U	<1.00 U, J-	<2.00 U	<2.00 U
Terpiniol (98-55-5)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U, J-
tri-(2-butoxyethyl) phosphate (78-51-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW04 7/25/11 Round 1	GW04 3/23/12 Round 2	GW04 5/18/13 Round 3	GW05 7/26/11 Round 1	GW05 3/23/12 Round 2	GW05 5/17/13 Round 3
Fluoranthene (206-44-0)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Fluorene (86-73-7)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Hexachlorobenzene (118-74-1)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Hexachlorobutadiene (87-68-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Hexachlorocyclopentadiene (77-47-4)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Hexachloroethane (67-72-1)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U
Indeno(1,2,3-cd)pyrene (193-39-5)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Isophorone (78-59-1)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Naphthalene (91-20-3)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Nitrobenzene (98-95-3)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
N-nitrosodimethylamine (62-75-9)	µg/L	<0.50 U	<0.50 U	<1.00 U	<0.50 U	<0.50 U	<1.00 U
N-nitrosodi-n-propylamine (621-64-7)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Pentachlorophenol (87-86-5)	µg/L	<1.00 U	<1.00 U	<2.00 U	<1.00 U	<1.00 U	<2.00 U
Phenanthrene (85-01-8)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Phenol (108-95-2)	µg/L	<0.50 U	<2.00 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U
Pyrene (129-00-0)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Pyridine (110-86-1)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
Squalene (111-02-4)	µg/L	<1.00 U	<2.00 U	<2.00 U	<1.00 U	<2.00 U	<2.00 U
Terpiniol (98-55-5)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U
tri-(2-butoxyethyl) phosphate (78-51-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW06 7/26/11 Round 1	GW06 3/24/12 Round 2	GW06 5/19/13 Round 3	GW07 7/26/11 Round 1	GW07 5/19/13 Round 3
Fluoranthene (206-44-0)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Fluorene (86-73-7)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Hexachlorobenzene (118-74-1)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Hexachlorobutadiene (87-68-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
Hexachlorocyclopentadiene (77-47-4)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Hexachloroethane (67-72-1)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U
Indeno(1,2,3-cd)pyrene (193-39-5)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Isophorone (78-59-1)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Naphthalene (91-20-3)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Nitrobenzene (98-95-3)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
N-nitrosodimethylamine (62-75-9)	µg/L	<0.50 U	<0.50 U	<1.00 U	<0.50 U	<1.00 U
N-nitrosodi-n-propylamine (621-64-7)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Pentachlorophenol (87-86-5)	µg/L	<1.00 U	<1.00 U	<2.00 U	<1.00 U	<2.00 U
Phenanthrene (85-01-8)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Phenol (108-95-2)	µg/L	1.39	<2.00 U	<2.00 U	<0.50 U	<2.00 U
Pyrene (129-00-0)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Pyridine (110-86-1)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
Squalene (111-02-4)	µg/L	<1.00 U	<2.00 U	<2.00 U	<1.00 U	<2.00 U
Terpiniol (98-55-5)	µg/L	<0.50 U	<1.00 U	<1.00 U	<0.50 U	<1.00 U
tri-(2-butoxyethyl) phosphate (78-51-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW08 7/27/11 Round 1	GW08 3/24/12 Round 2	GW08 5/19/13 Round 3	GW09 7/27/11 Round 1	GW09 5/17/13 Round 3	GW10 7/27/11 Round 1	GW10 3/26/12 Round 2
Fluoranthene (206-44-0)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Fluorene (86-73-7)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Hexachlorobenzene (118-74-1)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Hexachlorobutadiene (87-68-3)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U
Hexachlorocyclopentadiene (77-47-4)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Hexachloroethane (67-72-1)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U
Indeno(1,2,3-cd)pyrene (193-39-5)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Isophorone (78-59-1)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Naphthalene (91-20-3)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Nitrobenzene (98-95-3)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
N-nitrosodimethylamine (62-75-9)	µg/L	<0.50 U, J-	<0.50 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<0.50 U
N-nitrosodi-n-propylamine (621-64-7)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Pentachlorophenol (87-86-5)	µg/L	<1.00 U, J-	<1.00 U	<2.00 U	<1.00 U, J-	<2.00 U	<1.00 U, J-	<1.00 U
Phenanthrene (85-01-8)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Phenol (108-95-2)	µg/L	<0.50 U, J-	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U
Pyrene (129-00-0)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Pyridine (110-86-1)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
Squalene (111-02-4)	µg/L	<1.00 U, J-	<2.00 U	<2.00 U	<1.00 U, J-	<2.00 U	<1.00 U, J-	<2.00 U
Terpiniol (98-55-5)	µg/L	<0.50 U, J-	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U
tri-(2-butoxyethyl) phosphate (78-51-3)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW11 7/28/11 Round 1	GW11 3/26/12 Round 2	GW12 7/28/11 Round 1	GW12 3/25/12 Round 2	GW13 7/28/11 Round 1	GW13 3/24/12 Round 2	GW13 5/20/13 Round 3
Fluoranthene (206-44-0)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Fluorene (86-73-7)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Hexachlorobenzene (118-74-1)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Hexachlorobutadiene (87-68-3)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U
Hexachlorocyclopentadiene (77-47-4)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Hexachloroethane (67-72-1)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U
Indeno(1,2,3-cd)pyrene (193-39-5)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Isophorone (78-59-1)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Naphthalene (91-20-3)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Nitrobenzene (98-95-3)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
N-nitrosodimethylamine (62-75-9)	µg/L	<0.50 U, J-	<0.50 U	<0.50 U, J-	<0.50 U	<0.50 U, J-	<0.50 U	<1.00 U
N-nitrosodi-n-propylamine (621-64-7)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Pentachlorophenol (87-86-5)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<2.00 U
Phenanthrene (85-01-8)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Phenol (108-95-2)	µg/L	1.31 J-	<2.00 U	<0.50 U, J-	<2.00 U	<0.50 U, J-	<2.00 U	<2.00 U
Pyrene (129-00-0)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Pyridine (110-86-1)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
Squalene (111-02-4)	µg/L	<1.00 U, J-	<2.00 U	<1.00 U, J-	<2.00 U	<1.00 U, J-	<2.00 U	<2.00 U
Terpiniol (98-55-5)	µg/L	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<0.50 U, J-	<1.00 U	<1.00 U
tri-(2-butoxyethyl) phosphate (78-51-3)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	GW14 3/27/12 Round 2	GW14 5/20/13 Round 3	GW15 3/25/12 Round 2	GW16 3/27/12 Round 2	GW17 3/27/12 Round 2	GW18 5/20/13 Round 3	GW19 5/20/13 Round 3
Fluoranthene (206-44-0)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Fluorene (86-73-7)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Hexachlorobenzene (118-74-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Hexachlorobutadiene (87-68-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Hexachlorocyclopentadiene (77-47-4)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Hexachloroethane (67-72-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Indeno(1,2,3-cd)pyrene (193-39-5)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Isophorone (78-59-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Naphthalene (91-20-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Nitrobenzene (98-95-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
N-nitrosodimethylamine (62-75-9)	µg/L	<0.50 U	<1.00 U	<0.50 U	<0.50 U	<0.50 U	NS	NS
N-nitrosodi-n-propylamine (621-64-7)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Pentachlorophenol (87-86-5)	µg/L	<1.00 U	<2.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Phenanthrene (85-01-8)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Phenol (108-95-2)	µg/L	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	NS	NS
Pyrene (129-00-0)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Pyridine (110-86-1)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
Squalene (111-02-4)	µg/L	<2.00 U	<2.00 U	<2.00 U	<2.00 U	<2.00 U	NS	NS
Terpiniol (98-55-5)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS
tri-(2-butoxyethyl) phosphate (78-51-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	NS	NS

Table B-6 Sample Results - Semivolatile Organic Compounds (Washington County, Pennsylvania)

Parameter (CAS Number)	Sample Sample Date Unit	SW01 7/25/11 Round 1	SW01 5/18/13 Round 3	SW02 7/25/11 Round 1	SW02 3/23/12 Round 2	SW02 5/18/13 Round 3	SW03 7/27/11 Round 1	SW03 3/26/12 Round 2
Fluoranthene (206-44-0)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Fluorene (86-73-7)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Hexachlorobenzene (118-74-1)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Hexachlorobutadiene (87-68-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U
Hexachlorocyclopentadiene (77-47-4)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Hexachloroethane (67-72-1)	µg/L	<1.00 U, J-	<1.00 U	<1.00 U, J-	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U
Indeno(1,2,3-cd)pyrene (193-39-5)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Isophorone (78-59-1)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Naphthalene (91-20-3)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Nitrobenzene (98-95-3)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
N-nitrosodimethylamine (62-75-9)	µg/L	<0.50 U	<1.00 U	<0.50 U	<0.50 U	<1.00 U	<0.50 U, J-	<0.50 U
N-nitrosodi-n-propylamine (621-64-7)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Pentachlorophenol (87-86-5)	µg/L	<1.00 U	<2.00 U	<1.00 U	<1.00 U	<2.00 U	<1.00 U, J-	<1.00 U
Phenanthrene (85-01-8)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Phenol (108-95-2)	µg/L	<0.50 U	<2.00 U	<0.50 U	<2.00 U	<2.00 U	<0.50 U, J-	<2.00 U
Pyrene (129-00-0)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Pyridine (110-86-1)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
Squalene (111-02-4)	µg/L	<1.00 U	<2.00 U	<1.00 U	<2.00 U	<2.00 U	<1.00 U, J-	<2.00 U
Terpiniol (98-55-5)	µg/L	<0.50 U	<1.00 U	<0.50 U	<1.00 U	<1.00 U	<0.50 U, J-	<1.00 U
tri-(2-butoxyethyl) phosphate (78-51-3)	µg/L	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U, J-	<1.00 U

Table B-7 Sample Results - Water Isotopes, Strontium Isotopes, and Radiological Parameters (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW01 7/25/11 Round 1	GW01 5/17/13 Round 3	GW02 7/25/11 Round 1	GW02 5/18/13 Round 3	GW03 7/25/11 Round 1	GW03 3/23/12 Round 2	GW03 5/20/13 Round 3
Water Isotopes								
δ^2H	‰	-54.96	-54.59	-54.93	-56.02	-54.95	-53.90	-56.40
$\delta^{18}O$	‰	-9.01	-8.60	-9.01	-8.66	-9.04	-8.42	-8.85
Strontium Isotopes								
Sr	µg/L	516	483	448	443	719	525	568
Rb	µg/L	<0.5	<1	<0.5	<1	0.70	0.64	<1
$^{87}Sr/^{86}Sr$	Atom Ratio	0.711222	0.711221	0.711229	0.711236	0.711634	0.711549	0.711571
1/Sr	L/µg	0.0019	0.00207	0.0022	0.00226	0.0014	0.00190	0.00176
Rb/Sr	Weight Ratio	NR	NR	NR	NR	0.0010	0.001219	NR
Radiological Parameters								
Gross Alpha	pCi/L	NA	<3.0 U	NA	<3.0 U	NA	<3.0 U	<3.0 U
Gross Beta	pCi/L	NA	<4.0 U	NA	<4.0 U	NA	<4.0 U	<4.0 U
Radium-226	pCi/L	NA	<1.0 U	NA	<1.0 U	NA	<1.0 U	<1.0 U
Radium-228	pCi/L	NA	<1.0 U	NA	<1.0 U	NA	<1.0 U	<1.0 U

Table B-7 Sample Results - Water Isotopes, Strontium Isotopes, and Radiological Parameters (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW04 7/25/11 Round 1	GW04 3/23/12 Round 2	GW04 5/18/13 Round 3	GW05 7/26/11 Round 1	GW05 3/23/12 Round 2	GW05 5/17/13 Round 3	GW06 7/26/11 Round 1	GW06 3/24/12 Round 2	GW06 5/19/13 Round 3
Water Isotopes										
δ^2H	‰	-54.57	-53.09	-54.65	-54.60	-52.52	-56.97	-53.84	-52.07	-54.23
$\delta^{18}O$	‰	-8.88	-8.29	-8.59	-8.10	-8.25	-8.97	-7.47	-8.36	-8.54
Strontium Isotopes										
Sr	µg/L	810	779	888	1550	1050	1190	197	626	216
Rb	µg/L	1.0	0.80	<1	1.0	1.3	1.1	0.8	1.2	<1
$^{87}Sr/^{86}Sr$	Atom Ratio	0.711614	0.711619	0.711629	0.711733	NR	0.711710	0.711706	0.711694	0.711675
1/Sr	L/µg	0.0012	0.00128	0.00113	0.0006	0.00095	0.00084	0.0051	0.00160	0.00463
Rb/Sr	Weight Ratio	0.0012	0.001027	NR	0.0006	0.001238	0.000924	0.0041	0.001917	NR
Radiological Parameters										
Gross Alpha	pCi/L	NA	<3.0 U	<3.0 U	NA	<3.0 U	<3.0 U	NA	<3.0 U	<3.0 U
Gross Beta	pCi/L	NA	<4.0 U	<4.0 U	NA	<4.0 U	<4.0 U	NA	<4.0 U	<4.0 U
Radium-226	pCi/L	NA	<1.0 U	<1.0 U	NA	<1.0 U	<1.0 U	NA	<1.0 U	<1.0 U
Radium-228	pCi/L	NA	<1.0 U	<1.0 U	NA	<1.0 U	<1.0 U	NA	<1.0 U	<1.0 U

Table B-7 Sample Results - Water Isotopes, Strontium Isotopes, and Radiological Parameters (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW07 7/26/11 Round 1	GW07 5/19/13 Round 3	GW08 7/27/11 Round 1	GW08 3/24/12 Round 2	GW08 5/19/13 Round 3	GW09 7/27/11 Round 1	GW09 5/17/13 Round 3	GW10 7/27/11 Round 1	GW10 3/26/12 Round 2
Water Isotopes										
$\delta^{2}H$	‰	-53.88	-55.97	-54.01	-53.14	-54.22	-54.83	-55.34	-53.40	-51.85
$\delta^{18}O$	‰	-7.75	-8.72	-7.80	-8.40	-8.67	-8.50	-8.74	-7.71	-8.16
Strontium Isotopes										
Sr	µg/L	204	213	229	200	214	388	581	689	570
Rb	µg/L	<0.5	<1	2.2	1.9	1.4	0.8	2.6	1.0	1.1
$^{87}Sr/^{86}Sr$	Atom Ratio	0.711858	0.711852	0.711499	0.711536	0.711557	0.711092	0.711538	0.712666	0.712645
1/Sr	L/µg	0.0049	0.00469	0.0044	0.00500	0.00467	0.0026	0.00172	0.0015	0.00175
Rb/Sr	Weight Ratio	NR	NR	0.0096	0.009500	0.006542	0.0021	0.004475	0.0015	0.001930
Radiological Parameters										
Gross Alpha	pCi/L	NA	<3.0 U	NA	<3.0 U	<3.0 U	NA	6.3	NA	<3.0 U
Gross Beta	pCi/L	NA	<4.0 U	NA	<4.0 U	<4.0 U	NA	10.3	NA	<4.0 U
Radium-226	pCi/L	NA	<1.0 U	NA	<1.0 U	<1.0 U	NA	<1.0 U	NA	<1.0 U
Radium-228	pCi/L	NA	<1.0 U	NA	<1.0 U	<1.0 U	NA	<1.0 U	NA	<1.0 U

Table B-7 Sample Results - Water Isotopes, Strontium Isotopes, and Radiological Parameters (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW11 7/28/11 Round 1	GW11 3/26/12 Round 2	GW12 7/28/11 Round 1	GW12 3/25/12 Round 2	GW13 7/28/11 Round 1	GW13 3/24/12 Round 2	GW13 5/20/13 Round 3	GW14 3/27/12 Round 2	GW14 5/20/13 Round 3
Water Isotopes										
δ^2H	‰	-54.07	-52.93	-53.91	-51.76	-54.25	-53.18	-54.20	-52.67	-55.04
$\delta^{18}O$	‰	-7.59	-8.21	-8.39	-8.29	-8.42	-8.38	-8.57	-8.28	-8.67
Strontium Isotopes										
Sr	µg/L	306	301	294	159	811	699	592	509	467
Rb	µg/L	0.8	0.82	0.6	0.72	<1	0.83	<2	0.47	<2
$^{87}Sr/^{86}Sr$	Atom Ratio	0.712993	0.713013	0.712413	0.712448	0.711904	0.711940	0.711955	0.712120	0.712126
1/Sr	L/µg	0.0033	0.00332	0.0034	0.00629	0.0012	0.00143	0.00169	0.00196	0.00214
Rb/Sr	Weight Ratio	0.0026	0.002724	0.0020	0.004528	NR	0.001187	NR	0.000923	NR
Radiological Parameters										
Gross Alpha	pCi/L	NA	<3.0 U	NA	<3.0 U	NA	<3.0 U	<3.0 U	<3.0 U	<3.0 U
Gross Beta	pCi/L	NA	<4.0 U	NA	<4.0 U	NA	<4.0 U	<4.0 U	<4.0 U	<4.0 U
Radium-226	pCi/L	NA	<1.0 U	NA	<1.0 U	NA	<1.0 U	<1.0 U	<1.0 U	<1.0 U
Radium-228	pCi/L	NA	<1.0 U	NA	<1.0 U	NA	<1.0 U	<1.0 U	<1.0 U	<1.0 U

Table B-7 Sample Results - Water Isotopes, Strontium Isotopes, and Radiological Parameters (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW15 3/25/12 Round 2	GW16 3/27/12 Round 2	GW17 3/27/12 Round 2	GW18 5/20/13 Round 3	GW19 5/20/13 Round 3
Water Isotopes						
δ^2H	‰	-53.26	-52.18	-52.64	-59.00	-55.25
$\delta^{18}O$	‰	-8.46	-8.30	-8.25	-9.14	-8.80
Strontium Isotopes						
Sr	µg/L	211	243	64.9	NS	NS
Rb	µg/L	0.40	0.63	0.83	NS	NS
$^{87}Sr/^{86}Sr$	Atom Ratio	0.711983	0.712797	0.712210	NS	NS
1/Sr	L/µg	0.00474	0.00412	0.01541	NS	NS
Rb/Sr	Weight Ratio	0.001896	0.002593	0.012789	NS	NS
Radiological Parameters						
Gross Alpha	pCi/L	<3.0 U	<3.0 U	<3.0 U	NS	NS
Gross Beta	pCi/L	<4.0 U	<4.0 U	<4.0 U	NS	NS
Radium-226	pCi/L	<1.0 U	<1.0 U	<1.0 U	NS	NS
Radium-228	pCi/L	<1.0 U	<1.0 U	<1.0 U	NS	NS

Table B-7 Sample Results - Water Isotopes, Strontium Isotopes, and Radiological Parameters (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	SW01 7/25/11 Round 1	SW01 5/18/13 Round 3	SW02 7/25/11 Round 1	SW02 3/23/12 Round 2	SW02 5/18/13 Round 3	SW03 7/27/11 Round 1	SW03 3/26/12 Round 2
Water Isotopes								
δ^2H	‰	-55.08	-56.18	-53.72	-51.67	-55.94	-54.16	-53.63
$\delta^{18}O$	‰	-9.00	-8.81	-8.03	-8.20	-8.83	-8.20	-8.50
Strontium Isotopes								
Sr	µg/L	774	622	380	605	313	374	336
Rb	µg/L	<0.5	<1	0.6	0.54	<1	<0.5	0.20
$^{87}Sr/^{86}Sr$	Atom Ratio	0.711421	0.711372	0.711506	0.711100	0.711491	0.712527	0.712556
1/Sr	L/µg	0.0013	0.00161	0.0026	0.00165	0.00319	0.0027	0.00298
Rb/Sr	Weight Ratio	NR	NR	0.0016	0.000893	NR	NR	0.000595
Radiological Parameters								
Gross Alpha	pCi/L	NA	<3.0 U	NA	<3.0 U	<3.0 U	NA	<3.0 U
Gross Beta	pCi/L	NA	<4.0 U	NA	<4.0 U	<4.0 U	NA	<4.0 U
Radium-226	pCi/L	NA	<1.0 U	NA	<1.0 U	<1.0 U	NA	<1.0 U
Radium-228	pCi/L	NA	<1.0 U	NA	<1.0 U	<1.0 U	NA	<1.0 U

Table B-8 Sample Results - Isotech Gas Isotopes (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW01 7/25/11 Round 1	GW01 5/17/13 Round 3	GW02 7/25/11 Round 1	GW02 5/18/13 Round 3	GW03 7/25/11 Round 1	GW03 3/23/12 Round 2	GW03 5/20/13 Round 3
Helium	%	NR	NR	NR	NR	NR	NR	NR
Hydrogen	%	NR	ND	NR	ND	NR	ND	ND
Argon	%	1.54	1.70	1.68	1.74	1.40	1.50	1.36
Oxygen	%	4.30	1.30	5.02	1.46	24.89	20.55	27.33
Carbon dioxide	%	6.94	10.26	5.52	6.82	4.46	7.51	5.25
Nitrogen	%	87.22	86.74	87.78	89.98	69.23	70.40	66.06
Carbon monoxide	%	ND	ND	ND	ND	0.018	0.038	ND
Methane	%	ND	0.0014	0.0031	0.0033	ND	0.0021	0.0014
Ethane	%	ND	ND	ND	ND	ND	ND	ND
Ethene	%	ND	ND	ND	ND	ND	ND	ND
Propane	%	ND	ND	ND	ND	ND	ND	ND
Isobutane	%	ND	ND	ND	ND	ND	ND	ND
Normal Butane	%	ND	ND	ND	ND	ND	ND	ND
Isopentane	%	ND	ND	ND	ND	ND	ND	ND
Normal Pentane	%	ND	ND	ND	ND	ND	ND	ND
Hexane Plus	%	ND	ND	ND	ND	ND	ND	ND
$\delta^{13}C_{CH4}$	‰	NR	NR	NR	NR	NR	NR	NR
$\delta^{2}H_{CH4}$	‰	NR	NR	NR	NR	NR	NR	NR
$\delta^{13}C_{C2H6}$	‰	NR	NR	NR	NR	NR	NR	NR
$\delta^{13}C_{DIC}$	‰	-15.10	-15.0	-14.60	-14.6	-13.56	-14.67	-13.9
Specific Gravity		1.018	1.033	1.012	1.014	1.032	1.043	1.039
BTU		0	0	0	0	0	0	0
Helium dilution	factor	0.70	0.78	0.71	0.76	0.70	0.71	0.72

Table B-8 Sample Results - Isotech Gas Isotopes (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW04 7/25/11 Round 1	GW04 3/23/12 Round 2	GW04 5/18/13 Round 3	GW05 7/26/11 Round 1	GW05 3/23/12 Round 2	GW05 5/17/13 Round 3	GW06 7/26/11 Round 1	GW06 3/24/12 Round 2	GW06 5/19/13 Round 3
Helium	%	NR	NR	NR	NR	ND	NR	NR	NR	NR
Hydrogen	%	NR	ND	ND	NR	ND	ND	NR	ND	ND
Argon	%	1.63	1.72	1.70	1.51	1.4	1.47	1.21	1.45	1.16
Oxygen	%	6.69	4.21	2.09	10.89	20.93	10.83	4.26	2.73	0.24
Carbon dioxide	%	5.51	5.13	5.81	12.06	12.74	14.47	0.79	6.16	2.32
Nitrogen	%	86.00	88.75	90.12	75.54	64.91	73.23	65.43	85.04	65.09
Carbon monoxide	%	ND	ND	ND	ND	0.023	ND	0.007	ND	ND
Methane	%	0.169	0.193	0.284	ND	0.0011	0.0012	28.29	4.62	31.18
Ethane	%	ND	ND	ND	ND	ND	ND	0.0151	0.0038	0.011
Ethene	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Propane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isobutane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Normal Butane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isopentane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Normal Pentane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexane Plus	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
$\delta^{13}C_{CH4}$	‰	NR	NR	NR	NR	NR	NR	-55.34	-52.51	-55.16
$\delta^{2}H_{CH4}$	‰	NR	NR	NR	NR	NR	NR	-175.9	-160.9	-179.4
$\delta^{13}C_{C2H6}$	‰	NR	NR	NR	NR	NR	NR	NR	NR	NR
$\delta^{13}C_{DIC}$	‰	-16.66	-16.46	-15.7	-13.04	-14.77	-13.5	-11.38	-13.14	-11.4
Specific Gravity		1.013	1.008	1.008	1.055	1.07	1.068	0.866	0.992	0.856
BTU		2	2	3	0	0	0	287	47	316
Helium dilution	factor	0.72	0.75	0.75	0.69	0.72	0.74	0.66	0.71	0.68

Table B-8 Sample Results - Isotech Gas Isotopes (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW07 7/26/11 Round 1	GW07 5/19/13 Round 3	GW08 7/27/11 Round 1	GW08 3/24/12 Round 2	GW08 5/19/13 Round 3	GW09 7/27/11 Round 1	GW09 5/17/13 Round 3	GW10 7/27/11 Round 1	GW10 3/26/12 Round 2
Helium	%	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hydrogen	%	NR	ND	NR	ND	ND	NR	ND	NR	ND
Argon	%	1.48	1.49	1.50	1.59	1.59	1.43	1.42	1.41	1.38
Oxygen	%	15.86	12.00	20.18	19.67	14.84	26.67	24.16	16.24	21.31
Carbon dioxide	%	8.31	9.10	3.17	2.99	2.48	3.97	4.36	8.29	7.75
Nitrogen	%	74.33	77.41	75.11	75.70	81.09	67.92	70.05	74.05	69.53
Carbon monoxide	%	0.018	ND	0.044	0.036	ND	0.014	ND	0.012	0.031
Methane	%	ND	0.0010	ND	0.0121	0.0027	ND	0.0051	ND	0.0011
Ethane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethene	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Propane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isobutane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Normal Butane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isopentane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Normal Pentane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexane Plus	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
$\delta^{13}C_{CH4}$	‰	NR	NR	NR	NR	NR	NR	NR	NR	NR
$\delta^{2}H_{CH4}$	‰	NR	NR	NR	NR	NR	NR	NR	NR	NR
$\delta^{13}C_{C2H6}$	‰	NR	NR	NR	NR	NR	NR	NR	NR	NR
$\delta^{13}C_{DIC}$	‰	-17.59	-17.6	-14.37	-14.55	-14.4	-14.19	-13.2	-15.65	-16.03
Specific Gravity		1.041	1.040	1.019	1.017	1.008	1.032	1.030	1.041	1.045
BTU		0	0	0	0	0	0	0	0	0
Helium dilution	factor	0.68	0.70	0.72	0.72	0.73	0.70	0.72	0.70	0.73

Table B-8 Sample Results - Isotech Gas Isotopes (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW11 7/28/11 Round 1	GW11 3/26/12 Round 2	GW12 7/28/11 Round 1	GW12 3/25/12 Round 2	GW13 7/28/11 Round 1	GW13 3/24/12 Round 2	GW13 5/20/13 Round 3	GW14 3/27/12 Round 2	GW14 5/20/13 Round 3
Helium	%	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hydrogen	%	NR	ND	NR	ND	NR	ND	ND	ND	ND
Argon	%	1.55	1.60	1.51	1.56	1.33	1.42	1.38	1.54	1.52
Oxygen	%	4.69	3.89	10.07	15.85	25.55	26.17	27.73	21.12	16.97
Carbon dioxide	%	6.59	6.85	6.63	7.74	6.04	6.07	3.87	4.38	7.02
Nitrogen	%	87.17	87.66	81.78	74.82	67.08	66.34	67.02	72.94	74.48
Carbon monoxide	%	ND	ND	0.015	0.031	ND	ND	ND	ND	ND
Methane	%	ND	0.0014	ND	0.0007	ND	ND	0.0019	0.0151	0.0117
Ethane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethene	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Propane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isobutane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Normal Butane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isopentane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Normal Pentane	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexane Plus	%	ND	ND	ND	ND	ND	ND	ND	ND	ND
$\delta^{13}C_{CH4}$	‰	NR	NR	NR	NR	NR	NR	NR	NR	NR
$\delta^{2}H_{CH4}$	‰	NR	NR	NR	NR	NR	NR	NR	NR	NR
$\delta^{13}C_{C2H6}$	‰	NR	NR	NR	NR	NR	NR	NR	NR	NR
$\delta^{13}C_{DIC}$	‰	-14.28	-14.41	-16.34	-15.98	-15.74	-15.07	-14.4	-14.70	-14.7
Specific Gravity		1.016	1.017	1.024	1.038	1.041	1.043	1.032	1.027	1.036
BTU		0	0	0	0	0	0	0	0	0
Helium dilution	factor	0.68	0.70	0.69	0.72	0.71	0.72	0.73	0.72	0.74

Table B-8 Sample Results - Isotech Gas Isotopes (Washington County, Pennsylvania)

Parameter	Sample Sample Date Unit	GW15 3/25/12 Round 2	GW16 3/27/12 Round 2	GW17 3/27/12 Round 2	GW18 5/20/13 Round 3	GW19 5/20/13 Round 3
Helium	%	NR	NR	NR	NS	NS
Hydrogen	%	ND	ND	ND	NS	NS
Argon	%	1.49	1.36	0.581	NS	NS
Oxygen	%	21.85	20.43	2.31	NS	NS
Carbon dioxide	%	5.76	12.21	0.18	NS	NS
Nitrogen	%	70.88	65.98	21.96	NS	NS
Carbon monoxide	%	0.020	0.023	ND	NS	NS
Methane	%	0.0011	0.0014	74.34	NS	NS
Ethane	%	ND	ND	0.631	NS	NS
Ethene	%	ND	ND	ND	NS	NS
Propane	%	ND	ND	ND	NS	NS
Isobutane	%	ND	ND	ND	NS	NS
Normal Butane	%	ND	ND	ND	NS	NS
Isopentane	%	ND	ND	ND	NS	NS
Normal Pentane	%	ND	ND	ND	NS	NS
Hexane Plus	%	ND	ND	ND	NS	NS
$\delta^{13}C_{CH4}$	‰	NR	NR	-76.02	NS	NS
$\delta^{2}H_{CH4}$	‰	NR	NR	-238.8	NS	NS
$\delta^{13}C_{C2H6}$	‰	NR	NR	NR	NS	NS
$\delta^{13}C_{DIC}$	‰	-15.20	-18.14	-7.79	NS	NS
Specific Gravity		1.035	1.068	0.667	NS	NS
BTU		0	0	765	NS	NS
Helium dilution	factor	0.73	0.71	0.63	NS	NS

Table B-8 Sample Results - Isotech Gas Isotopes (Washington County, Pennsylvania)

Parameter	Sample / Sample Date / Unit	SW01 7/25/11 Round 1	SW01 5/18/13 Round 3	SW02 7/25/11 Round 1	SW02 3/23/12 Round 2	SW02 5/18/13 Round 3	SW03 7/27/11 Round 1	SW03 3/26/12 Round 2
Helium	%	NR	NR	NR	NR	NR	NR	NR
Hydrogen	%	NR	ND	NR	ND	ND	NR	ND
Argon	%	1.39	1.44	1.38	1.38	1.31	1.40	1.45
Oxygen	%	25.29	26.23	28.71	31.69	33.00	21.57	21.30
Carbon dioxide	%	4.10	2.37	0.76	0.58	0.44	9.19	7.76
Nitrogen	%	69.17	69.96	69.08	66.29	65.24	67.76	69.46
Carbon monoxide	%	0.049	ND	0.050	0.050	ND	0.085	0.035
Methane	%	ND	0.0008	0.0205	0.0064	0.0135	ND	ND
Ethane	%	ND	ND	ND	ND	ND	ND	ND
Ethene	%	ND	ND	ND	ND	ND	ND	ND
Propane	%	ND	ND	ND	ND	ND	ND	ND
Isobutane	%	ND	ND	ND	ND	ND	ND	ND
Normal Butane	%	ND	ND	ND	ND	ND	ND	ND
Isopentane	%	ND	ND	ND	ND	ND	ND	ND
Normal Pentane	%	ND	ND	ND	ND	ND	ND	ND
Hexane Plus	%	ND	ND	ND	ND	ND	ND	ND
$\delta^{13}C_{CH4}$	‰	NR	NR	NR	NR	NR	NR	NR
$\delta^{2}H_{CH4}$	‰	NR	NR	NR	NR	NR	NR	NR
$\delta^{13}C_{C2H6}$	‰	NR	NR	NR	NR	NR	NR	NR
$\delta^{13}C_{DIC}$	‰	-14.41	-12.9	-12.83	-12.64	-11.9	-16.22	-15.71
Specific Gravity		1.030	1.022	1.017	1.020	1.020	1.053	1.045
BTU		0	0	0	0	0	0	0
Helium dilution	factor	0.71	0.73	0.74	0.73	0.73	0.72	0.72

Appendix C
Background Data
Retrospective Case Study in Southwestern Pennsylvania

U.S. Environmental Protection Agency
Office of Research and Development
Washington, DC

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EPA/600/R-14/084

Table of Contents

List of Tables

List of Figures

C.1. Land Use

This section presents descriptions of land uses in Washington County as a whole, followed by descriptions of land uses in and around the sampling points of this study. Building on information provided in the Background section of this report, information on the use of planted/cultivated land can be obtained from the Cropland Data Layer produced by the US Department of Agriculture's National Agricultural Statistics Service, which provides data on agricultural uses of land based on satellite imagery and extensive agricultural ground checking of the imagery (US Department of Agriculture, 2012). Figure C1 shows land uses, including the agricultural uses, in Washington County in 2012. Table C1 shows the percentages of county land devoted to the largest agricultural uses. Alfalfa growing was the largest agricultural land use accounting for approximately 19% of land in the county.

Turning to land use changes, data from the US Geological Survey's National Land Cover Database for 1992 and 2006 are not directly comparable (US Geological Survey, 2012). However, it is possible to compare data from 1992 to data from 2001, and to then compare data from 2001 to that from 2006 to identify changes in land use in the 1992 to 2001 and 2001 to 2006 sub-periods (Multi-Resolution Land Characteristics Consortium, 2013). Figure C2 shows land use changes between 1992 and 2001 and between 2001 and 2006, respectively. Table C2 contains data on the changes in land use in the same two sub-periods. It can be seen from the table that a very small proportion of the land in the county changed use in each sub-period and that <1% of the county's land was developed and thereby converted to urban land in each sub-period.

This lack of significant change in land use is consistent with the relative stability of the county's population (i.e., an indicator of the intensity of land use) over decades as indicated by US Census data (see Figure C3) (US Census Bureau, 2013a, 2013b, 2013c). In 2011, the population density in the county was approximately 243 persons per square mile, as compared to approximately 285 persons per square mile for the entire state (US Census Bureau, 2012a). In 2010, the percentage of the land in the county taken up by urban areas (i.e., another indicator of the intensity of land use) was 11.8%, as compared to 10.5% for the entire state (US Census Bureau, 2012b).

Employment is another broad indicator of land use in the county. Table C3 identifies the largest industries, by employment, in the county. Among the production industries (i.e., manufacturing, mining, and utilities), manufacturing is the largest individual industry, accounting for just over 1 in 6 jobs in the county.

C.2. Search Areas

C.2.1. Land Use

Figures C4 through C8, which were created using data from the National Land Cover Database, show land use maps for Search Areas C, D, E, F and 7H, respectively, in 1992 and 2006. The search areas encompass a 3-mile search radius in the Southern Area and 1-mile or 3-mile search radii around sampling points in the Northern Area. These search areas are used to focus the analysis of land use patterns and environmental records searches in the areas around the sampling points of this study. Tables C4 through C8 contain data on land use in Search Areas C, D, E, F and 7H, respectively, in 1992 and 2006. Although the data for land use in the two years are not comparable due to methodological differences, they do indicate that forest cover and planted/cultivated land accounted for the vast majority of land use in all of the search areas in both years.

C.2.2. Crop Land

Figures C9 through C13 show land uses, including the agricultural uses of land, in Search Areas C, D, E, F, and 7H, respectively, in 2012. Tables C9 through C13 show the percentages of land devoted to the largest agricultural uses in Search Areas C, D, E, F and 7H, respectively. Alfalfa growing comprises the largest agricultural land use in all of the search areas, with the percentage of land devoted to alfalfa growing ranging from 24.5% in Search Area 7H to 53.6% in Search Area E.

C.2.3. Land Use Changes

Figures C14 through C18 show land use changes in Search Areas C, D, E, F and 7H, respectively, between 1992 and 2001 and between 2001 and 2006. Tables C14 through C18 present the changes in land use in the two sub-periods. The tables show that, in general, only a tiny proportion of the land in the search areas changed use in either sub-period. In the particular case of Search Area E, no land changed use between 2001 and 2006.

C.3. Environmental Records Search

Environmental record searches for the Northern and Southern areas were obtained by Environmental Data Resources, Inc. (EDR). EDR provides a service for searching publically available databases and also provides data from their own proprietary databases. The database searches included records reviews of several federal, state, tribal, and EDR proprietary environmental databases for the two study areas with regard to the documented use, storage, or release of hazardous materials or petroleum products (see Attachment 1).[1] Record dates varied based on the particular database from which the record was obtained. EDR began collecting a majority of the records in 1991 from the standard databases (State Hazardous Sites Cleanup Act Site Lists [SHWS]; Landfills [LF]; Leaking Underground Storage Tanks [LUST]; Underground Storage Tanks [UST]; Resource Conservation and Recovery Act [RCRA]; National Priority List [NPL]; Comprehensive Environmental Response, Compensation and Liability Information System [CERCLIS]; etc.). However, some databases (e.g., Spills) may have records dating back to the 1980s.

The record search areas were based on 1- and 3-mile-radius search areas centered around a single sampling point or a cluster of EPA sampling points. These search areas were chosen based on professional judgment considering the large size of the study area, as described below:

[1] Note: Environmental Data Resources Inc. (EDR) does not search the EnviroFacts and its associated EnviroMapper databases, but searches 19 of the 20 environmental databases covered by EnviroFacts, either as standalone databases (such as CERCLIS, RCRA, TSCA, etc.) or as databases searched as part of the Facility Index System/Facility Registry System (FINDS) database. The only EnviroFacts database that is not reviewed as part of an EDR search is the Cleanups in My Community (Cleanup) database, which maps and lists areas where hazardous waste is being or has been cleaned up throughout the United States. However, it is likely the information in the Cleanup database is also found in other databases that are part of EDR searches.

1. In general, a 3-mile search radius extended from either a specific production well (e.g., the 7H well for the Southern Area) or the mean center point based on the sample cluster locations (Northern Area).
2. In the Northern Area, there were sample points beyond the 3-mile radius. In those cases, an additional 1-mile radius was generated for each extraneous point that was not clustered with other points.
3. Lastly, if a sample point was less than 1 mile from the edge of the 3-mile search radius, they were considered an extraneous point and a 1-mile radius was used.

The identified records included historically contaminated properties; businesses that use, generate, transport, or dispose of hazardous materials or petroleum products in their operations; active contaminated sites that are currently under assessment and/or remediation; sites that have NPDES and SPDES permits; and active and abandoned mines and landfills. All properties listed in the Environmental Records Search Report were reviewed and screened based on the EDR record search findings to determine whether they are potential candidate causes. The criteria used for the screening included relevant environmental information (including, but not limited to, notices of violations, current and historical use of the site, materials and wastes at the site, releases and/or spills) and distance from the sampling points.

Sites that could not be mapped due to poor or inadequate address information were not included on the EDR Radius Map. However, EDR, determined that based on the limited address information available, it is possible that these sites could be located within the stated search radius (e.g., zip code listed within searched radius) and are listed on the Environmental Records Search Report as "orphan sites." Even though they were not mappable, the orphan sites were screened to the extent possible based on limited information on those sites available through additional searches of the databases listed above and information obtained through internet searches (i.e., EPA and eFACTS Web sites).

C.3.1. Oil and Gas Well Inventory

Well inventories were prepared for the same search areas described above for the EDR reports and for the land use analysis. All oil and gas wells within these areas were selected for review. Specific focus was placed on wells within 1 mile of EPA sampling locations. Information was obtained from desktop surveys performed using searchable state agency databases. The oldest well spud date identified in this study was June 1982.

C.3.2. State Record Summary

The Pennsylvania Department of Environmental Protection (PADEP) Web site containing Pennsylvania's Environment Facility Application Compliance Tracking System (eFACTS at http://www.ahs.dep.pa.gov/eFACTSWeb/criteria_site.aspx) was used to find up-to-date well records for wells within the search radii. The database provides information on inspection and pollution prevention visits, including a listing of all inspections that have occurred at each well on record, whether violations were noted, and any enforcement that may have resulted. The system provides multiple options to search for records. Due to the large number of wells in each study area, this record search was performed only on oil and gas wells within a 1-mile radius of each EPA sampling point. Not all of the state's records are included in the state's electronic database. Access to additional paper records can be obtained by appointment only from the particular state regional office. The oldest violation identified by the desktop survey for this investigation is from April 1987.

C.4. Evaluation of Data for the Northern Area

C.4.1. Northern Area EDR Search Results

Four separate search radii (search areas) were established to perform database searches that captured all 11 EPA sampling points (see Figure C19). The search radii for Search Areas C, D, E, and F ranged from 1 to 3 miles. The database search located 30 mapped sites within these search areas. An additional 140 orphan sites were identified during the searches. Orphan sites are those sites with poor locational information in the databases that may or may not exist outside the actual search radius. EPA attempted to locate these sites with information available in the reports and through internet searches to aid in determining the potential of these sites as a candidate cause. The evaluation of records is summarized in Tables C19 through C22.

Of the 170 sites contained in the EDR reports, only 33 were retained as potential candidate causes. Sites were retained only if they were within a plausible distance from an EPA sampling point (i.e., a distance the contaminant could plausibly migrate from the source to the sampling location. In this case, EPA conservatively chose a 2-mile radius) and consisted of an incident that involved a contaminant(s) of concern (petroleum product, brine, or fracturing fluid constituent). The following is a summary of the potential candidate causes and the databases used to identify them:

- **US MINES and MINES -** Two databases were used to identify mines: US MINES, which is maintained by the United States Department of Energy and includes all mine identification numbers issued for mines active or opened since 1971 and violation information; and MINES, which is maintained by the Pennsylvania Spatial Data Access (PASDA) and includes the approximate locations of Abandoned Mine Land Problem Areas containing public health, safety, and public welfare problems created by past coal mining. Abandoned and active mine lands can contribute to poor water quality over large areas and thus are retained as a potential candidate cause until more data, such as hydrologic framework, can be evaluated to make a more accurate determination. One US Mines site was retained and is located in Search Area F within about 0.4 miles of SWPAGW09.
- Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS)/CERCLIS - No Further Remedial Action Planned (NFRAP) - These databases contain sites that are, or were, under evaluation for inclusion in the National Priority List (NPL)/Superfund Program because of a potential uncontrolled release of hazardous waste. A total of two CERCLIS sites were retained, one in Search Area C (orphan site) and the other site in Search Area F (orphan site). The orphan site in Search Area F was also listed in the FINDS database. However, the location information for both sites could not be accurately determined based on information in the report or information found through internet searches. Additional

location information and information in regards to the status of the potential uncontrolled hazardous waste release is needed for these sites.

- **Emergency Response Notification System (ERNS)** - This database records and stores information on reported releases of oil and hazardous substances. A total of 13 ERNS subject sites were retained, with one site in Search Area C, five sites in Search Area D, one site in Search Area E, and six sites in Search Area F. One of the sites in Search Area F was also listed in the VCP and FINDS databases. The ERNS records may include multiple calls about the same property over time. The emergency response records included releases of natural gas, methanol, unknown causes of diesel and other air odors, aboveground storage tank (AST) explosion, ground water contamination, and leaks of unknown substances.

- **Historic Landfills (HIST LF) -** This database contains a listing of inactive non-hazardous facilities, solid waste facilities, or abandoned landfills, although portions of this database are no longer maintained by the PADEP. Two HIST LF sites were retained, one site in Search Area C (orphan site) and one site in Search Area D (orphan site), primarily because the location could not be determined. Without further information about these landfills, particularly their locations, they cannot be ruled out as potential contributors to ground water quality impacts.

- **UST/LUST/AST Storage Tanks -** Includes sites listed in one of three databases: Underground Storage Tank (UST), which contains a list of registered USTs regulated under the Resource Conservation and Recovery Act (RCRA); Leaking Underground Storage Tank (LUST) Incident Reports, which contains an inventory of reported leaking USTs that comes from the Department of Environmental Resources' list of confirmed releases; and Aboveground Storage Tank (AST), which contains a list of registered ASTs from the PADEP's listing of Pennsylvania regulated ASTs. A total of six UST sites (three in Search Area F, two in Search Area C, and one in Search Area D), two LUST (one in Search Area F and one in Search Area C), and three AST sites (one each in Search Areas E, D, and F) were retained. Besides a known leaking UST in Search Area F, the other 10 sites were orphans included as potential contributors to ground water quality impacts due to their proximity to the nearest sampling point or because the location could not be determined.

- **US Hist Auto STAT -** This database is a select list of business directories of potential gas station/filling station/service station sites that were available to EDR that may not show up in current government record searches. A total of three US HIST Auto STAT sites were retained, all of which are located in Search Area F, as potential gas station/filling station/service station sites and were included as potential contributors to ground water quality impacts due to their proximity to the nearest sampling point. One of the sites was also listed in the NPDES, FINDS, and Manifest databases.

- **Facility Index System (FINDS) -** This database contains both facility information and other sources of information from the EPA/National Technical Information Service (NTIS). Two different FIND sites were retained, both of which are located in Search Area F: one site involves a gas station with an NPDES permit, and the other involves violations related to the improper storage of the flammable liquids in tanks that lacked sufficiently sized venting capability and maintenance of the thief hatches. Both sites were included as potential contributors to ground water quality impacts due to their proximity to the nearest sampling point.

C.4.2. Oil and Gas Well Inventory Summary

As described above, the EPA sampling locations were compared to the distance to the inventory of wells identified in the PADEP oil and gas well database files as of May 20, 2013(see Table C23).

The Northern Area of Washington County was split into four distinct regions, designated as "Search C" through "Search F" (see Figure C19). There are 188 oil and gas wells in these four search areas, of which 108 are within 1 mile of EPA sampling points (see Table C24).

In addition to obtaining well inventory data, Google Earth Aerial Imagery from 1988 to 2012 was reviewed to determine whether impoundments or reserve pits associated with oil and gas wells were present in the study area. Prior to 2008, no impoundments/reserve pits were visible in the aerial images that were reviewed. However, since these features are relatively short-term and the time frame between the images can span multiple years, additional impoundments/reserve pits could have been present but not captured by the available imagery. Since 2008, at least 24 impoundments and 10 reserve pits were identified in the study area. Most of these impoundments/reserve pits were installed after 2010; however, at least three impoundments were installed in 2008. The distances of the impoundments/reserve pits from the EPA sampling locations are identified in Table C25, and the locations relative to the search areas are shown on Figure C20. The specific use of each impoundment is unknown; however, impoundments are generally used to store fresh water for hydraulic fracturing, and are later mixed with treated flowback fluids (brines and spent hydraulic fracturing fluid) from the hydraulic fracturing process. In addition, many of the well pads contain, or previously contained, reserve pits, which are generally used for drill cuttings.

In summary, numerous oil and gas production wells are located in the study area, most well pads contain/contained a reserve pit, and many of the well pads were associated with an impoundment. However, all of the impoundments/reserve pits identified from the aerial imagery are located within Search Areas C, D, and F. The presence of numerous oil and gas wells, reserve pits, and impoundments increases the probability of one or more of these features to be a potential source of contamination.

C.4.3. State Record Summary

Notice of Violations. The notice of violation records within a 1-mile radius of Search Areas C, D, E, and F included 96 oil and gas wells scattered throughout the following townships: Canton - 7, Cross Creek - 19, Hopewell - 9, and Mount Pleasant - 61 (see Table C26). Nine of the wells are listed as inactive or plugged. No violations were reported for 86 of the wells; however, violations were reported for the remaining 25 wells and 2 impoundments. All of the violations noted in eFACTS for these wells are listed as corrected or abated, with the exception of two instances where the resolution was not listed and four instances where Legacy Data was listed in the resolution field. Fines ranging from $17,500 to $58,000 were applied for some of these violations (although these fines may reflect violations at multiple facilities).

The following details for the most notable violations that could be linked to a candidate cause are summarized in Table C27 along with the distance of the violation from the nearest EPA sampling points:

- **LOWRY WILLIAM UNIT 3H -** A violation involving the discharge of industrial waste, including drill cuttings, oil, brine, and/or silt was noted during an inspection performed as a result of an incident-response to accident or event stream for well LOWRY WILLIAM UNIT 3H, located in Hopewell Township (Search Area C) in February 2010. The EPA sampling point closest to this unit is SWPAGW08 (0.8 miles to the southeast).
- **ALEXANDER UNIT 2 -** A similar violation involving the discharge of industrial waste, including drill cuttings, oil, brine, and/or silt was noted during an inspection performed in March 2008 due to a complaint about well ALEXANDER UNIT 2, located in Mount Pleasant Township (Search Area D). During this inspection, a second violation involving the discharge of pollutional material to waters of the Commonwealth was noted. The sampling points closest to this unit are SWPAGW02 (0.6 miles to the southeast), SWPASW01 (0.6 miles to the southeast), SWPAGW01 (0.8 miles to the southeast), and SWPAGW03 1.8 miles to the northwest. The EPA surface water sampling location is approximately 50 feet lower in elevation than the point of discharge; however, the sampling location was a small stream with no apparent connection to the spill site.
- **CHRISTMAN UNIT 2 -** A violation involving the discharge of pollutional material to waters of the Commonwealth was noted for CHRISTMAN UNIT 2, located in Cross Creek Township (Search Area F), during a site restoration inspection performed in April 2008. The EPA sampling points closest to this unit are SWPAGW05 (1 mile to the north/northeast), SWPAGW06 (1.9 miles to the northwest), SWPAGW07 (1.8 miles to the northwest), and SWPAGW09 (1.9 miles to the northwest).
- **COWDEN 47H -** A violation involving the discharge of pollutional material to waters of the Commonwealth was also noted for COWDEN 47H, located in Cross Creek Township (Search Area F), during a site restoration inspection performed in April 2008. The EPA sampling points closest to this unit are SWPAGW06 (0.9 miles to the northwest), SWPAGW07 (0.8 miles to the northwest), SWPAGW09 (0.9 miles to the northwest), and SWPAGW05 (1.6 miles to the northeast).
- **OHIO VALLEY LBC Unit 8H -** Failure to properly store, transport, process or dispose of a residual waste, and failure to properly control or dispose of industrial or residual waste to prevent pollution of waters of the Commonwealth in Search Area F. The EPA sampling points closest to this unit are SWPAGW05 (0.4 miles to the west) and SWPAGW03 (0.9 miles to the northeast).
- **BEST IMPOUNDMENT DAM -** Impoundment not structurally sound, impermeable, 3rd-party protected, greater than 20 inches of seasonal high ground water table (March 17, 2010) in Search area D. The EPA sampling point closest to this impoundment is SWPAGW08 (0.1 miles to the west).
- **CARTER IMPOUNDMENT -** Failure to properly store, transport, process or dispose of a residual waste, and failure to properly control or dispose of industrial or residual waste to prevent pollution of waters of the Commonwealth in Search Area E. The EPA sampling points closest to

this impoundment are SWPAGW04 (0.3 miles to south/southeast) and SWPASW02 (0.4 miles to the south/southeast).

Each of these violations could be a potential candidate cause.

C.5. Evaluation of Data for the Southern Area

C.5.1. Southern Area EDR Search Results

The environmental database search for the Southern Area was completed using one 3-mile search radius (Site-7H Search) centered around the Yeager 7H well at Latitude 40.0915270 (40° 5′ 29.40′′) and Longitude 80.2281111 (80° 13′ 41.16′′) (see Figure C19). This center point was used to efficiently capture information for a cluster of sampling points in the Southern Area. EDR located a total of 27 sites within the 3-mile search radius. An additional 18 orphan sites were identified during the searches. EPA attempted to locate these sites with information available in the reports and through internet searches to aid in determining the potential of these sites as a candidate cause. The evaluation of records is summarized in Table C28.

Of the 45 sites, a total of 22 records (16 sites) were retained as potential candidate causes and were identified in the databases described below:

- **US MINES and MINES -** Two databases were used to identify mines: US MINES, which is maintained by the United States Department of Energy and includes all mine identification numbers issued for mines active or opened since 1971 and violation information; and MINES, which is maintained by the Pennsylvania Spatial Data Access (PASDA) and includes the approximate location of Abandoned Mine Land Problem Areas containing public health, safety, and public welfare problems created by past coal mining. Abandoned and active mine lands can contribute to poor water quality over large areas and thus are retained as a potential candidate cause until more data, such as hydrologic framework, can be evaluated to make a more accurate determination. Two abandoned mine land sites were retained, both located approximately 1.5 miles northeast from sampling location SWPAGW13.

- Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS)/CERCLIS-No Further Remedial Action Planned (NFRAP) - These databases contain sites that are under, or were under, evaluation for inclusion on the National Priority List (NPL)/Superfund Program because of a potential uncontrolled release of hazardous waste. One orphan CERCLIS landfill site was retained, the location of which could not be accurately determined based on information in the report. Without further information about this landfill, particularly the location, it cannot be ruled out as a potential contributor to ground water quality impacts.

- **Emergency Response Notification System (ERNS) -** This database records and stores information on reported releases of oil and hazardous substances. The ERNS records may include multiple calls about the same property over time. Two ERNS records (also in the Spills database) were retained that included incidents reported from an address near the Yeager impoundment regarding Range Resources notifications of releases to the ground and/or water from a frac water retaining pond and a tanker. The site of the releases is likely the Yeager impoundment. Another cluster of ERNS records was reported from a different address (0.5 miles east of Yeager 7H) regarding a frac pond overflowing into the stream system on the property.

- **UST/LUST/AST Storage Tanks -** Includes sites listed in one of three databases: Underground Storage Tank (UST) contains a list of registered USTs regulated under the Resource Conservation and Recovery Act (RCRA); Leaking Underground Storage Tank (LUST) Incident Reports contains an inventory of reported leaking USTs that comes from the PADEP list of confirmed releases; and Aboveground Storage Tank (AST) contains list of registered ASTs from the PADEP listing of Pennsylvania regulated ASTs. A total of one UST and two LUST sites were retained. Two leaking USTs (one gasoline and one diesel) are located approximately 1.2 miles from the sampling points, with the other two orphan sites included as potential contributors to ground water quality impacts due to their proximity to the nearest sampling point or because the location could not be determined.

- **US Hist STAT Auto -** This database is a select list of business directories of potential gas station/filling station/service station sites that were available to EDR that may not show up in current government record searches. A total of four US HIST Auto STAT sites were retained as potential gas station/filling station/service station sites and were included as potential contributors to ground water quality impacts due to their proximity to the nearest sampling point. One of these sites was also listed in the RCRA-Small Quantity Generator, FINDS, and Manifest databases.

- **Facility Index System (FINDS) -** This database contains both facility information and other sources of information from the EPA/NTIS. Two FIND sites were retained. One was an orphan site that involved a violation for not submitting a discharge monitoring report for discharging gasoline-contaminated water from a remediation system. This site was included as a potential contributor to ground water quality impacts due to its proximity to the nearest sampling point. The other site is a compressor station 0.68 miles southeast of SWPAGW11. No details were reported, but compressor stations could be a source of contamination.

- **Manifest Sites -** This database includes sites that have used manifests (a document that lists and tracks hazardous waste from a generator through transporters to a disposal facility) in the states of PA, CT, NJ, NY, RI, VT, and WI. One Manifest site was retained because the site was reported to contain metal drums, barrels, and kegs. Although the contents are unknown, the site was retained because the containers' contents are a potential source of contamination.

- **RCRA Non-Gen/No Longer Regulated (NLR) Site -** This database includes selective information on sites that generate, transport, store, treat, and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste. One site located approximately 1.48 miles north-northeast of SWPAGW13 was retained because of methanol waste handling.

- **US Hist Cleaners –** This database includes searches of selected national collections of business directories and has collected listings of potential dry cleaner sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include dry cleaning establishments. The categories reviewed included, but were not limited to, dry cleaners, cleaners, laundry, laundromat, cleaning/laundry, wash and dry, etc. This database falls within a category of information EDR classifies as "High Risk Historical Records", or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but which may not show up in current government records searches. Although no releases were identified in the record, a site located 1.3 miles southwest of SWPAGW11 was retained because it is a potential source of contamination.

C.5.2. Oil and Gas Well Inventory Summary

As described above, the EPA sampling locations were compared to the inventory of wells identified in the PADEP database files as of May 20, 2013 (see Table C23).

There are 152 oil and gas wells in the 3-mile search area. Of the 152 wells, 33 are within 1 mile of the EPA sampling points. Table C29 summarizes the number of oil and gas wells within the search area and the number of oil and gas wells within a 1-mile radius of Yeager 7H.

Google Earth Aerial Imagery was also reviewed as described above for the SWPA Northern Area. Prior to 2008, no impoundments/reserve pits were visible in the aerial images reviewed. However, since these features are relatively short-term and the time frame between the images can span multiple years, additional impoundments/reserve pits could have been present but not captured by the available Google Earth Imagery. Since 2008, six impoundments and two reserve pits were identified in the study area associated with the wells listed above. Most of these impoundments/reserve pits were installed after 2009; however, one impoundment was installed in 2008. The distances of the impoundments/reserve pits from the EPA sampling locations are identified in Table C30, and the locations within the search area are shown on Figure C21. The specific use of each impoundment is unknown; however, impoundments are generally used to store fresh water for hydraulic fracturing, and are later mixed with treated flowback fluids (brines and spent hydraulic fracturing fluid) from the hydraulic fracturing process. In addition, many of the well pads contain, or previously contained, reserve pits, which are generally used for drill cuttings.

In summary, there are numerous production wells in the study area, most well pads contain a reserve pit, and many of the well pads are associated with an impoundment. The presence of numerous oil and gas wells, reserve pits, and impoundments increases the probability of one or more of these features to be a potential candidate cause.

C.5.3. State Record Summary

Notice of Violations. Notice of violations records within the 1-mile-radius of the Yeager 7H well were reviewed for 38 oil and gas wells, one pit, and one impoundment. Four of the wells are located in South Franklin Township, and 34 are located in Amwell Township; the pit and impoundment also are located in Amwell Township (see Table C31). These notices of violations were inventoried using eFACTS. Seven of the wells are listed as inactive or plugged. No violations were reported for 26 of the wells, and two wells and the one pit did not have any inspections. Violations were reported for the remaining four wells and the impoundment.

All the violations noted in eFACTS for these wells are listed as corrected or abated, with one exception where a resolution is not listed. Fines ranging from $18,025 to $49,500 were applied for some of these violations (although these fines may reflect violations at multiple facilities). Additional details are provided in Table C31.

Details for the most notable violations that could be linked to a candidate cause are listed below and summarized on Table C32. The distance of the violation from the nearest EPA sampling points also is provided on Table C32:

- **Yeager Unit 7H -** Failure to properly control or dispose of industrial or residual waste to prevent pollution of waters of the Commonwealth from the Yeager Unit 7H well. All of the EPA sampling points are in the immediate vicinity of this well (i.e., 0.1 to 0.5 miles).
- **Sierzega Unit 2H -** Failure to properly store, transport, process, or dispose of a residual waste. The EPA sampling point closest to this unit is SWPAGW11 (0.6 miles to the north/northwest). All of the other sampling points are less than 1 mile away.
- **Yeager Impoundment -** Failure to properly control or dispose of industrial or residual waste to prevent pollution of waters of the Commonwealth.

Each of these violations could be a potential candidate cause.

C.6. References

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Appendix C Tables

Table C1 Major Agricultural Land Uses in Washington County (2012)

Agricultural Land Use	% of County Land
Alfalfa	19.1
Grassland/herbaceous	3.8
Other hay/non-alfalfa	1.0
Fallow/idle crops	0.9
Corn	0.9
Soybeans	0.7

Source: U.S. Department of Agriculture, 2012.

Table C2 Changes in Land Use, 1992 to 2001 and 2001 to 2006, in Washington County

	% of County Land Area	
Change in Land Use	1992 to 2001	2001 to 2006
No change	97.8	98.9
Change in land use	2.2	1.1
- to agriculture	0.7	0.1
- to forest	0.5	0.0
- to urban	0.5	0.7
- other changes	0.5	0.3

Source US Geological Survey, 2012.

Table C3 Largest Industries, by Employment, in Washington County

Industry	Employees
Health care and social assistance	10,463
Manufacturing	10,333
Retail trade	9,868
Local government	6,980
Accommodation and food service	5,852
Construction	5,841
Wholesale trade	2,931
Other services, except public administration	2,829
Administration/support, waste management/remediation services	2,349
Transportation and warehousing	2,218
All other sectors	20,300
Total employment for all sectors	79,964

Source: Washington County (2005), derived from PA Center for Workforce Information and Analysis.

Table C4 Land Use in Search Area C in 1992 and 2006

Land Use	1992 Square Miles	1992 % of Total	2006 Square Miles	2006 % of Total
Planted/cultivated	2.15	68	1.67	53
Forest	1.01	32	1.33	42
Developed	0.00	0	0.14	4
Others	0.00	0	0.02	0
Total	3.15	100	3.15	100

Source: US Geological Survey, 2012.
Note: Totals may not sum exactly due to rounding.

Table C5 Land Use in Search Area D in 1992 and 2006

Land Use	1992 Square Miles	1992 % of Total	2006 Square Miles	2006 % of Total
Planted/cultivated	1.61	51	1.28	41
Forest	1.54	49	1.70	54
Developed	0.00	0	0.13	4
Water	0.00	0	0.01	0
Barren	0.00	0	0.02	1
Total	3.16	100	3.15	100

Source: US Geological Survey, 2012.
Note: Totals may not sum exactly due to rounding.

Table C6 Land Use in Search Area E in 1992 and 2006

Land Use	1992 Square Miles	1992 % of Total	2006 Square Miles	2006 % of Total
Planted/cultivated	2.51	80	2.24	71
Forest	0.64	20	0.81	26
Developed	0.00	0	0.10	3
Total	3.16	100	3.16	100

Source: US Geological Survey, 2012.
Note: Totals may not sum exactly due to rounding.

Table C7 Land Use in Search Area F in 1992 and 2006

Land Use	1992 Square Miles	1992 % of Total	2006 Square Miles	2006 % of Total
Planted/cultivated	15.54	55	12.64	45
Forest	12.60	44	13.84	49
Water	0.15	1	0.26	1
Developed	0.09	0	1.47	5
Barren	0.01	0	0.04	0
Herbaceous	0.00	0	0.14	0
Total	28.39	100	28.39	100

Source: US Geological Survey, 2012.
Note: Totals may not sum exactly due to rounding.

Table C8 Land Use in Search Area 7H in 1992 and 2006

Land Use	1992 Square Miles	1992 % of Total	2006 Square Miles	2006 % of Total
Forest	14.59	51	16.62	59
Planted/cultivated	13.34	47	9.06	32
Developed	0.46	2	2.37	8
Water	0.02	0	0.06	0
Barren	0.00	0	0.09	0
Shrubland	0.00	0	0.01	0
Herbaceous	0.00	0	0.20	1
Total	28.41	100	28.41	100

Source: US Geological Survey, 2012.
Note: Totals may not sum exactly due to rounding

Table C9 Major Agricultural Land Uses in Search Area C

Agricultural Land Use	% of Land
Alfalfa	46.3
Grassland/herbaceous	2.5
Corn	1.2
Fallow/idle crops	0.8
Soybeans	0.4

Source: US Department of Agriculture, 2012.

Table C10 Major Agricultural Land Uses in Search Area D

Agricultural Land Use	% of Land
Alfalfa	29.2
Grassland/herbaceous	3.5
Corn	2.3
Fallow/idle crops	1.7
Soybeans	1.2

Source: US Department of Agriculture, 2012.

Table C11 Major Agricultural Land Uses in Search Area E

Agricultural Land Use	% of Land
Alfalfa	53.6
Grassland/herbaceous	5.1
Fallow/idle crops	3.1
Soybeans	3.0
Corn	2.0
Other hay/non-alfalfa	0.8

Source: US Department of Agriculture, 2012.

Table C12 Major Agricultural Land Uses in Search Area F

Agricultural Land Use	% of Land
Alfalfa	33.6
Grassland/herbaceous	4.1
Corn	1.8
Fallow/idle crops	1.2
Soybeans	1.0
Other hay/non-alfalfa	0.4

Source: US Department of Agriculture, 2012.

Table C13 Major Agricultural Land Uses in Search Area 7H

Agricultural Land Use	% of Land
Alfalfa	24.5
Grassland/herbaceous	3.3
Fallow/idle crops	0.9
Corn	0.5
Other hay/non-alfalfa	0.2

Source: US Department of Agriculture, 2012.

Table C14 Changes in Land Use, 1992 to 2001 and 2001 to 2006, in Search Area C

Change in Land Use	% of Land 1992 to 2001	% of Land 2001 to 2006
No change	98.0	99.2
Change in land use		
- to agriculture	1.0	0.3
- to forest	0.9	0.0
- to grassland/shrub	0.1	0.0
- to barren	0.0	0.5

Source: US Geological Survey, 2012.

Table C15 Changes in Land Use, 1992 to 2001 and 2001 to 2006, in Search Area D

Change in Land Use	% of Land 1992 to 2001	% of Land 2001 to 2006
No change	98.7	99.3
Change in land use		
- to agriculture	1.0	0.0
- to forest	0.1	0.0
- to urban	0.1	0.0
- to barren	0.0	0.7

Source: US Geological Survey, 2012.

Table C16 Changes in Land Use, 1992 to 2001 and 2001 to 2006, in Search Area E

Change in Land use	% of Land 1992 to 2001	% of Land 2001 to 2006
No change	99.1	100.0
Change in land use		
- to agriculture	0.8	0.0
- to forest	0.1	0.0

Source: US Geological Survey, 2012.

Table C17 Changes in Land Use, 1992 to 2001 and 2001 to 2006, in Search Area F

Change in Land Use	% of Land	
	1992 to 2001	2001 to 2006
No change	98.5	99.8
Change in land use		
- to agriculture	1.0	0.1
- to forest	0.4	0.0
- to barren	0.0	0.1
- other change	0.1	0.0

Source: US Geological Survey, 2012.

Table C18 Changes in Land Use, 1992 to 2001 and 2001 to 2006, Search Area 7H

Change in Land Use	% of Land	
	1992 to 2001	2001 to 2006
No change	98.9	99.6
Changed in land use		
- to agriculture	0.4	0.1
- to forest	0.3	0.0
- to urban	0.2	0.0
- to barren	0.0	0.3
- other change	0.1	0.0

Source: US Geological Survey, 2012.

Table C19 **Environmental Database Review Summary**
Southwestern Pennsylvania
Northern Area - Search Area C

Database	Name of Facility	Facility Address	Distance from Nearest Sample Point	Potential Candidate Cause: Yes/No	Potential Candidate Cause: Justification	Ground Water Wells
ERNS	Not Reported	42 Wotring Rd. #1	0.26 mi. WNW of SWPAGW08	Yes	Emergency response request from public complaining of diesel-like odor in the evenings. Record indicates several potential responsible parties, including drilling and ponding operations in vicinity.	10 Federal USGS Wells 0 Federal FRDS Public Water Supply System 24 State Wells
ORPHAN ARCHIVE UST	Washington East Washington Junction	RR1	NI	Yes	Record is for a 1,000-gallon gasoline tank. Site included due to potential for contamination.	
Orphan RCRA-CESQG, FINDS, MANIFEST	Cessna Auto Body	1515 Route 136	8.75 mi. SE of SWPAGW08	No	Small-quantity generator of ignitable, lead, benzene, methyl ethyl keytone, and volatile compounds. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan UST	PITT Ohio Term	Route 136 N	8.1 mi. SE of SWPAGW08	No	Record is for a 12,000-gallon diesel UST. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan CERCLIS-NFRAP	Falconi Route 18	Route 18	>6.5 mi. SE of SWPAGW08	No	Site is no longer under consideration for inclusion on EPA NPL. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan ARCHIVE UST	Karluk Supply	Route 18N	>5.0 mi. E of SWPAGW08	No	Record is for a 1,500-gallon tank containing kerosene. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan LUST	Washington OPR CTR	Route 19	>6.0 mi. E of SWPAGW08	No	Record is for a leaking tank containing petroleum. Cleanup completed. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan HIST LF	Roseto Dump	Listed as Route 191; assumed to be an error and Route 19 used	>6.0 mi. E of SWPAGW08	No	Site is listed as a historic landfill. Little information available. Uncontrolled landfills can impact water quality; however, not a likely source of contamination due to distance from nearest sampling point.	
Orphan RCRA NonGen / NLR, FINDS	Courtney Contracting Corp	Corporation is currently listed at 320 Springdale Road, Venetia, PA	>15 mi. ENE of SWPAGW08	No	Record is for a transporter of hazardous waste; no violations reported.	
Orphan NPDES	Trinity South Elem Sch WWTP	2500 South Main Street	8.1 mi. SE of SWPAGW08	No	Elementary school, no violations cited.	
Orphan ARCHIVE UST	GG&C Bus Co	1100 West Chestnut St.	4.6 mi. E of SWPAGW08	No	Record is for a 2,000-gallon tank holding diesel fuel. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan RCRA-CESQG, FINDS, MANIFEST	Kenny's Autobody	3445 Route 40 W	>9.0 mi. SE of SWPAGW08	No	Small-quantity generator of ignitable and volatile wastes. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan LUST	PPL Elimsport Substa	Route 54	NI	Yes	Record is for a leaking tank containing petroleum. Cleanup completed. Site included due to potential for contamination.	
Orphan ICIS	Wheeling Pittsburgh Steel Corp	Allenport Plant - Allenport Boro	>29 mi. SE of SWPAGW05	No	Record is for a civil judicial action against this company. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan RMP	Washington East Washington Joint A	98 Arden Station Rd.	5.4 mi. NE of SWPAGW08	No	Liquid waste treatment unit but has no accident history. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan NPDES	SGT Patrick McMullen	PA Army National Guard	4.75 mi. NW of SWPAGW08	No	In database for NPDES program. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan NPDES, FINDS	Washington Penn Plastic Co Inc.	1500 Weirich, Washington, PA	3.3 mi. NE of SWPAGW08	No	Manufacturer of polypropylene and polyethylene compounds. In database for NPDES program. Not a likely source of contamination due to distance from nearest sampling point.	

Table C19 **Environmental Database Review Summary**
Southwestern Pennsylvania
Northern Area - Search Area C

Database	Name of Facility	Facility Address	Distance from Nearest Sample Point	Potential Candidate Cause Yes/ No	Potential Candidate Cause Justification	Ground Water Wells
Orphan ARCHIVE UST	Washington Co Jail Courthouse	Beau St.	5.9 mi. NE of SWPAGW08	No	Record is for a 10,000-gallon heating oil tank. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan FINDS	Washington ENGR & CONSTR	PO Box 1203, Washington, PA	>20 mi. ENE of SWPAGW08	No	Site had a permit (PAG-056182) for discharge from gasoline-contaminated-ground water remediation systems (ceased in Nov. 2011), with only an administration violation for incomplete DMR. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan RCRA-SQG, FINDS	Douglas Battery Service Center	East Buffalo Church Rd.	NI	No	Small-quantity generator of lead and corrosives. No record of a release.	
Orphan MANIFEST	BP Oil Co 07607/New Site 25972	Cameron & Route 19	8 mi. E of SWPAGW08	No	Record is for disposal of 150 gallons of ignitable waste and 150 gallons of benzene. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan MANIFEST	Washington County Housing Authority	100 N Franklin St.	6.8 mi. SE of SWPAGW08	No	Record is for transportation of 90 pounds of ignitable waste and 8 gallons of an unreported waste. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan FINDS	Multi Chem Group LLC Washington FA	200 Detroit St.	7.3 mi. ESE of SWPAGW08	No	Site is in the state Environmental Cleanup and Brownfields Program. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan DRYCLEANERS	Imperial Clnr & Tailors/Washington	Hemlock St.	7 mi. SE of SWPAGW08	No	Record is for drycleaner operations. Dry-cleaning contaminants not found in EPA samples. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan LUST	Washington BP 964	2433 W Jefferson Street	3.8 mi. SE of SWPAGW08	No	Record is for a leaking tank containing petroleum. Cleanup completed. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan CERCLIS-NFRAP	Tri-State Engineering	Jefferson Ave.	>0.80 mi. S of SWPAGW08	Yes	Site is no longer under consideration for inclusion on EPA NPL. Cannot be found in state records. Site included due to potential for contamination.	
Orphan LUST	Exxon RAS 2 0578	879 Jefferson Ave.	5.5 mi. SE of SWPAGW08	No	Record is for a leaking tank containing petroleum. Cleanup completed. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan NPDES	United Refining Co of PA	Kwik Fill 79 S	>16.0 mi. E of SWPAGW08	No	In database for NPDES program. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan ARCHIVE UST	Scott Motors	W Liberty & Jefferson Ave (intersection does not exist)	NI	Yes	Tank used to store used motor oil and auto fluids. Site included due to potential for contamination.	
Orphan MANIFEST	Columbia Gas Transmission LLC LOWR	4301 Infirmary Rd., West Carroll, OH	>200 mi. W of SWPAGW08	No	Record is for transportation and disposal of ignitable waste. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan RCRA-CESQG, FINDS	Washington Armory	78 Maiden St.	6.9 mi. SE of SWPAGW08	No	Small-quantity generator of ignitable and volatile wastes. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan NPDES	Victory Storage Field - Pipeline 1	Address not properly entered into EDR database. Locations are in West Virginia	>9.4 mi. W of SWPAGW08	No	NPDES site located in West Virginia. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan ARCHIVE AST	Washington Opr Ctr	2 Manifold Rd.	8 mi. SE of SWPAGW08	No	Leaking UST containing petroleum; cleanup completed. Not a likely source of contamination due to distance from nearest sampling point.	

Table C19 **Environmental Database Review Summary**
Southwestern Pennsylvania
Northern Area - Search Area C

Database	Name of Facility	Facility Address	Distance from Nearest Sample Point	Potential Candidate Cause Yes/No	Potential Candidate Cause Justification	Ground Water Wells
Orphan NPDES	Lines 1758 & 10100 - Longwall Mining	Address not properly entered into EDR database. Locations are in West Virginia	>9.4 mi. W of SWPAGW08	No	Record is for a wastewater discharge permit, which can impact ground water quality. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan NPDES	Line 1754 - Longwall Mining					
Orphan NPDES	Line 8243 - Cathodic Protection Pr					
Orphan NPDES	Line 1528 - Replacement Project					
Orphan NPDES	Lines 1758 10100 - Longwal Mining					
Orphan CERCLIS	Yeager Impoundment Site	400 McAdams Rd.	11.6 mi. SE of SWPAGW08	No	Site is listed in CERCLIS database as a removal only site (no assessment needed). Not a likely source of contamination due to distance from nearest sampling point.	
Orphan ARCHIVE AST	Bell of PA	Meadowland Blvd.	5.3 mi. ESE of SWPAGW08	No	Record is for two 450-gallon storage tanks containing motor oil. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan LUST	Washington Work Ctr	Meadowlands Blvd.	5.3 mi. ESE of SWPAGW08	No	Leaking storage tank. Remedial action initiated. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan HIST LF	Washington Twp Landfill	Off of Forbees Rd. & Slatington (separate records)	NI	Yes	Two records for same site. Listed as historic landfill. Landfills can potentially impact ground water quality over large areas.	
Orphan NPDES	Washington KOA Campground	7 KOA Rd.	9 mi. SE of SWPAGW08	No	In database for NPDES program. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan AST	Lowes of Washington PA 0671	Strabane Sq.	6.7 mi. SE of SWPAGW08	No	Record is for an active 1,500-gallon AST used to store diesel. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan HIST LF	Washington Township Landfill	Tower Rd.	>18.0 mi. S of SWPAGW08	No	Not a likely source of contamination due to distance from nearest sampling point.	
Orphan FINDS	Washington County	Non-specific	Non-specific/located within the county	No	Record is for National Emissions Inventory. Not a source of contaminants; monitoring air pollutants.	
Orphan DRYCLEANERS	Checkers one hour Clnr/Washington	Washington Plz.	NI	No	Record is for drycleaner operations. No indication of release.	
Orphan FINDS	Waste Management of PA Inc.	Washington Hauling	4.0 mi. SE of SWPAGW08	No	In database for NPDES program. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan RCRA-CESQG	Multi Chem Group LLC Washington FA	200 W Wiley Ave.	5.1 mi. SE of SWPAGW08	No	Small-quantity generator of ignitable, corrosive, barium, silver, chloroform, and volatile wastes. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan ARCHIVE UST, RMP	Washington Steel Corp	Woodland Ave.	5.1 mi. SE of SWPAGW08	No	Record is for a 2,000-gallon tank containing gasoline. No record of a release. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan FINDS, RMP	Allegheny Ludlum Cor/Washington FL	Woodland Ave.	4.9 mi. SE of SWPAGW08	No	Facility is listed in the emission inventory system. One accident reported was a release of one pound of 70% hydrogen fluoride/hydrofluoric acid in gaseous form. Not a likely source of contamination due to distance from nearest sampling point.	

Table C19 Environmental Database Review Summary
Southwestern Pennsylvania
Northern Area - Search Area C

Database	Name of Facility	Facility Address	Distance from Nearest Sample Point	Potential Candidate Cause Yes/ No	Potential Candidate Cause Justification	Ground Water Wells
Orphan US MINES	Therm-o-rock East Inc.	Therm-o-rock PA Plant	>21 mi. ESE of SWPAGW08	No	Facility is listed as a vermiculite plant. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan FINDS	Washington Wash Stp	102 Arden Station Rd.	4.7 mi. SE of SWPAGW08	No	Site is listed as a ground water quality monitoring point. Not a source of ground water quality impacts.	

Primary Source: Environmental records search report by Environmental Data Resources, Inc. (EDR)

Notes:
ORPHAN SITE: A site of potential environmental interest that appear in the records search but due to incomplete location information (i.e., address and coordinates) is unmappable and not included in the records search report provided by EDR Inc.

Search Area C
EDR Inquiry Number: 3602489.7s
EDR Search Radius: 1 mi.
Search Center: Lat. 40.2333000 (40° 13' 59.88'') Long. 80.3410000 (-80° 20' 27.60'')

Key:
AST = Above ground storage tank.
DMR = Discharge Monitoring Report
E = East.
EPA = Environmental Protection Agency
FRDS = Federal Reporting Data System.
mi = Mile.
N = North.
NE = Northeast.
NI = No information.
NPL = National Priorities List
NPDES = National Pollutant Discharge Elimination System.
PA = Pennsylvania.
RCRA = Resource Conservation and Recovery Act
USGS = United States Geological Survey.
UST = Underground storage tank.
W = West.
S = South.

Databases:
ARCHIVE AST: Local list of Archived Above Ground Storage Tank Sites
ARCHIVE UST: Local list of Archived Underground Storage Tank Sites
AST: Listing of Pennsylvania Regulated Aboveground Storage Tanks
CERC-NFRAP: Federal CERCLIS (Comprehensive Environmental Response, Compensation, and Liability Information System) NFRAP (No Further Remedial Action Planned) site list
DRYCLEANERS: Listing of drycleaner facility locations.
ERNS: Emergency Reponse Notification System
FINDS: Facility Index System/Facility Registry System
FTTS : FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act) Tracking System
HIST LF: Abandoned Landfill Inventory
ICIS: Compliance Information System
LUST: Leaking Underground Storage Tank Sites
MANIFEST: Hazardous waste manifest information
NPDES: National Pollutant Discharge Elimination System Permit Listing
RCRA-CESQG: Federal RCRA (Resource Conservation and Recovery Act) Conditionally Exempt Small Quantity Generator List
RCRA NonGen / NLR: RCRA: Non Generators List
RMP: Risk Management Plans Records
US HIST AUTO STATION: EDR exclusive database of listings of potential gas station, filling station, or service station sites .
US MINES: Mines Master Index File. The source of this database is the Dept. of Labor, Mine Safety and Health Administration

Table C20 Environmental Database Review Summary
Southwestern Pennsylvania
Northern Area - Search Area D

Database	Name of Facility	Facility Address	Distance from Nearest Sample Point	Potential Candidate Cause: Yes/ No	Potential Candidate Cause: Justification	Ground Water Wells
ERNS	Private Residence	200 McCarrell Rd. Hickory, PA 15340	0.05 mi. S from SWPAGW02	Yes	Caller (on 03/08/10) stated their water supply is contaminated because of gas well drilling in the area that is affecting their well water. Caller had their property tested by the Department of Environmental Protection (DEP) in November 2009 and it was determined the area is contaminated. Caller also stated they have had contamination problems for years. Also, they stated that there have been animals in the area that died because of the contamination. Acrylonitrile is listed as the spilled material. On a separate report, caller stated (5/11/2010) that there was a strong natural gas odor coming from an unknown source in the vicinity of the address location. Caller did not know the exact source of natural gas odor, but the smell	0 Federal USGS Wells 1 Federal FRDS Public Water Supply System 3 State Wells
ERNS	Private Residence	200 McCarrell Rd. Hickory, PA 15340	0.05 mi. S from SWPAGW02	Yes	Caller reported on 5/23/2010 a discharge of an unknown oil from a leaking line attached to a Range Resources separator tank due to an unknown cause at this time. Caller stated this leak has occurred several times before. Media reported to have been affected: land, soil, possibly a nearby stream.	
ERNS	Private residences at 200 McCarrell Rd. & 220 McCarrell Rd.	220 McCarrell Rd. Hickory, PA 15340	0.1 mi. S from SWPAGW01	Yes	Caller stated (3/10/10) their water is contaminated because of nearby gas drilling (approx. 1,000 feet from their property) being performed (Mark West/Range Resources). Caller suspected the materials involved are contaminating their water supply. Caller has notified several agencies about this incident. Acrylonitrile, chloroform, m p-xylenes, toluene, iron, and manganese are listed as spilled material in the report.	
ERNS	Private Residence	162 McCarrell Rd. Hickory, PA 15340	0.3 mi. NNW from SWPASW01	Yes	Caller stated (8/7/2010) while looking out the window they observed brown foggy smoke coming from the compression station due to unknown causes (they also took 3 photos).	
ERNS	Private residence at well number GULLA #1	29 Guilla Lane Hickory, PA 15340	0.15 mi. SSW from SWPAGW02	Yes	Caller reported on 5/23/2010 a discharge of an unknown oil from a leaking line attached to a separator tank due to an unknown cause at this time. Caller stated this leak has occurred several times before.	
FINDS	MARK WEST FULTON COMPRESSOR STATION	103 Washington Ave. Hickory, PA 15340	1 mi NE of from SWPAGW02	No	Not a likely a source of contamination due to no record of a release or violation.	
FINDS, RMP	WASHINGTON COMPRESSOR STATION	2 Elm Rd. Hickory, PA 15340	0.7 mi NE from SWPAGW02	No	Not a likely a source of contamination due to no record of a release or violation.	
Orphan ARCHIVE AST	CORWIN JEEP SALES & SVC	Route 50 Hickory, PA 15340	1.5 NW from SWPAGW02	Yes	Used motor oil AST-site in Environmental Cleanup & Brownfields and Waste Handling DEP programs. Site included due to potential for contamination.	
Orphan HIST LF	HICKORY-KINGSLEY TWP LANDFILL	Route 666 Hickory, PA 15340	NI	Yes	Historical landfill. Actual location cannot be determined. Landfill activities may impact regional ground water quality. Site included due to potential for contamination.	
Orphan FINDS, US AIRS	MARKWEST LIBERTY MIDSTREAM & RESOURCES/F	Between Washington Ave. & McCarrell Rd. Hickory, PA 15340	0.6 NE from SWPAGW02	No	Site has permit for stationary sources of air pollution. Not a likely source of contamination due to no violations found in PA eFACTS.	
Orphan ARCHIVE UST	FRANKS EXCAVATING	Elm Rd. Hickory, PA 15340	NI	Yes	Record is for a diesel UST. The location could not be determined. Site included due to potential for contamination.	
Orphan FINDS, US AIRS	MARKWEST LIBERTY MIDSTREAM & RESOURCES/N	Hwy 231 Mount Pleasant, PA 15666	0.6 NE from SWPAGW02	No	Site has permit for stationary sources of air pollution. Not a likely source of contamination due to no violations found in PA eFACTS.	
Orphan US MINES	THERM-O-ROCK EAST INC	THERM-O-ROCK PLANT Washington County	> 19 mi SE from SWPAGW01	No	Facility is listed as a vermiculite plant. Not a likely source of contamination due to distance from nearest sampling point.	

Table C20 Environmental Database Review Summary
Southwestern Pennsylvania
Northern Area - Search Area D

Database	Name of Facility	Facility Address	Distance from Nearest Sample Point	Potential Candidate Cause: Yes/ No	Potential Candidate Cause: Justification	Ground Water Wells

Primary Source: Environmental records search report by Environmental Data Resources, Inc. (EDR)

Notes:

ORPHAN SITE: A site of potential environmental interest that appear in the records search but due to incomplete location information (i.e., address and coordinates) is unmappable and not included in the records search report provided by EDR Inc.

Search Area D

EDR Inquiry Number:3602489.10s

EDR Search Radius: 1 mi.

Search Center: Lat. 40.2752000 (40° 16' 30.72''), Long. 80.3036000 (-80° 18' 12.96'')

Key:

AST = Above ground storage tank.
DEP = Department of Environmental Protection
E = East.
FRDS = Federal Reporting Data System.
mi = Mile.
N = North.
NI = No information.
PA = Pennsylvania.
RCRA = Resource Conservation and Recovery Act
USGS = United States Geological Survey.
UST = Underground storage tank.
W = West.
S = South.

Databases:

ARCHIVE AST: Local list of Archived Above Ground Storage Tank Sites
ARCHIVE UST: Local list of Archived Underground Storage Tank Sites
ERNS: Emergency Reponse Notification System
FINDS: Facility Index System/Facility Registry System
HIST LF: Abandoned Landfill Inventory
PA eFACTS = Pennsylvania Environmental Facility Application Compliance Tracking System
RMP: Risk Management Plans Records
US MINES: Mines Master Index File. The source of this database is the Dept. of Labor, Mine Safety and Health Administration

Table C21 Environmental Database Review Summary
Southwestern Pennsylvania
Northern Area, Search Area E

Database	Name of Facility	Facility Address	Distance from Nearest Sample Point	Potential Candidate Cause: Yes/ No	Potential Candidate Cause: Justification	Groundwater Wells
ERNS	PRIVATE RESIDENCE	101 WALNUT RD. MCDONALD, PA 15057	0.69 mi. NNW of SWPAGW04	Yes	Facility reported emergency releases to soil. Caller stated that PADEP came out to the location and stated that the pond needed to be treated. Caller reported an odor suspected to be from a frac pond.	10 Federal USGS Wells 0 Federal FRDS Public Water Supply System 10 State Wells
FINDS, NPDES	MOYER SR STP	231 WALNUT RD. MCDONALD, PA 15057	0.63 mi. W of SWPAGW04	No	NPDES permit to Tributary to Raccoon Creek. Not a likely source of contaminations due to no violations cited.	
Orphan ARCHIVE AST	CORWIN JEEP SALES & SVC	ROUTE 50 HICKORY, PA 15340	1.1 mi. NW of SWPAGW04	Yes	Used motor oil AST. Site in environmental clean-up, brownfields and waste handing DEP programs. Site included due to potential for contamination.	
Orphan MANIFEST	RANGE RESOURCES	FORT CHERRY ROAD HICKORY, PA 15340	<1 mi. NE of SWPAGW04	No	Shipped drums of benzene. Not a likely source of contamination due to no spills or violations recorded.	
Orphan CERC-NFRAP	WASHINGTON COUNTY DRUM DUMP	ROUTE 22 ROBINSON TWP, PA 15057	> 7 mi. north of SWPAGW04	No	Facility is a known or suspected abandoned, inactive, or uncontrolled hazardous waste site, but does not qualify for the NPL based on existing information. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan LUST, AST	CECIL TWP WASHINGTON CNTY	SR 50 & TR 662 MCDONALD, PA 15057	5.5 mi. NE of SWPAGW04	No	Leaking UST containing petroleum and AST containing diesel. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan RCRA NonGen / NLR, FINDS	SUNOCO SERVICE STATION-MCDONALD	ROUTE 980 MCDONALD, PA 15057	3.5 mi. E of SWPAGW04	No	Inactive site. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan ICIS	IRELAND OIL, INCORPORATED	LAUREL HILL SOUTH FAYETTE TWP MCDONALD, PA 15057	4.4 mi. NE of SWPAGW04	No	Ireland Oil has been cited for TSCA 16 action for penalty multiple times for unknown reason. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan FINDS, US AIRS	MARKWEST LIBERTY MIDSTREAM & RESOURCES/N	HWY 231 MOUNT PLEASANT, PA 15340	2.7 mi. N of SWPAGW04	No	Facility has permit for stationary sources for air pollution. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan US MINES	THERM-O-ROCK EAST INC	THERM-O-ROCK PA PLANT WASHINGTON COUNTY	> 20 mi. SE of SWPAGW04	No	Vermiculite plant. Not a likely source of contamination due to distance from nearest sampling point.	

Primary Source: Environmental records search report by Environmental Data Resources, Inc. (EDR)

Notes:
ORPHAN SITE: A site of potential environmental interest that appear in the records search but due to incomplete location information (i.e., address and coordinates) is unmappable and not included in the records search report provided by EDR Inc.
Search Area E
EDR Inquiry Number:3602489.13s
EDR Search Radius: 1 mi.
Search Center: Lat. 40.3241000 (40° 19' 26.76''), Long. 80.2972000 (-80° 17' 49.92'')

Key:

AST = Above ground storage tank.
DEP = Department of Environmental Protection
E = East.
FRDS = Federal Reporting Data System.
mi = Mile.
N = North.
NI = No information.
NPDES = National Pollutant Discharge Elimination System.
NPL = National Priorities List.
PA = Pennsylvania.
RCRA = Resource Conservation and Recovery Act
USGS = United States Geological Survey.
UST = Underground storage tank.
W = West.
S = South.
TSCA = Toxic Substances Control Act.

Databases:
ARCHIVE AST: Local list of Archived Above Ground Storage Tank Sites
AST: Listing of Pennsylvania Regulated Aboveground Storage Tanks
CERC-NFRAP: Federal CERCLIS (Comprehensive Environmental Response, Compensation, and Liability Information System) NFRAP (No Further Remedial Action Planned) site list
ERNS: Emergency Reponse Notification System
FINDS: Facility Index System/Facility Registry System
ICIS: Compliance Information System
LUST: Leaking Underground Storage Tank Sites
MANIFEST: Hazardous waste manifest information
NPDES: National Pollutant Discharge Elimination System Permit Listing
RCRA NonGen / NLR: RCRA: Non Generators List
US AIRS: Aerometric Information Retrieval System Facility Subsystem
US MINES: Mines Master Index File. The source of this database is the Dept. of Labor, Mine Safety and Health Administration

Table C22 **Environmental Database Review Summary**
Southwestern Pennsylvania
Northern Area - Search Area F

				Potential Candidate Cause		
Database	Name of Facility	Site Location Address	Distance from Nearest Sample Point	Yes/ No	Justification	Groundwater Wells
ERNS	Private residence	151 Avella Rd. Hickory, PA 15340	0.04 N mi. W of SWPAGW03	Yes	9/25/2012 - Medium affected: Air – Caller stated that there was a strong odor of rubber in the air with no signs of smoke. Caller also stated that there are multiple businesses behind their house that could possibly be the source of the odor. Site included due to proximity to sample point.	59 Federal USGS Wells 1 Federal FRDS Public Water System 114 State Wells
ERNS	Stewart Compressor Station	Avella Rd. & Caldwell Rd. Hickory, PA	0.8 mi. W of SWPAGW03	Yes	4/16/10 - Caller stated that a gas plant is leaking gas. A natural gas line at the facility (Williams Gas) appeared to have ruptured. Site included due to potential for contamination.	
ERNS FINDS VCP		185 Avella Rd. Hickory, PA 15340	0.21 mi. W of SWPAGW03	Yes	(ERNS) 3/1/11 - Caller reported an empty condensate AST exploded due to an unknown cause. Caller stated the incident probably involved over $50,000 worth of damage. Caller also stated the storage tank was with a compressor station associated with a non-regulated gathering pipeline. (FINDS) EPA determined that MarkWest violated the general duty clause by failing to (a) provide proper storage of the flammable liquids in the tanks because the tanks lacked sufficiently sized venting capability and (b) maintain the thief hatches. EPA Region III issued an Administrative Settlement Agreement and Order on Consent, where MarkWest agreed to install appropriately sized emergency vents on the tanks and adopt an approved maintenance schedule at 10 inspected facilities and 4 additional compressor stations in Pennsylvania. (VCP) A Pittsburgh Post-Gazette October 11, 2011, article reported to the PADEP that an accidental spill of 100 - 200 gallons of methanol occurred near an AST at the Stewart compressor station on 1/23/11. According to the article, MarkWest removed about 10 yards of soil from the site and drilled seven monitoring wells within 1 day of the spill. Four wells drilled at the perimeter of the compressor site did not detect methanol migrating off site. Of the three wells drilled at the source of the release, two detected methanol at levels below the drinking water supply aquifer standard, while one well sampling detected methanol above the standard. http://www.post-gazette.com/stories/local/marcellusshale/firm-continues-cleanup-of-methanol-spill-318563/#ixzz2VMJc4pKp	
ERNS	Private residence	179 Avella Rd. Hickory, PA	0.16 mi. W of SWPAGW03	Yes	03/17/10 Medium affected: Air - Caller reported a strong chemical smell, possibly sulfur or burning rubber, in the air from an unknown source. Caller states there are two companies in the area that could be the responsible party, William's Gas and MarkWest. 6/8/10 - Medium affected: Air - Caller reported that they got a sore throat from chemical fumes in the air when going for a walk that morning. This has been an ongoing problem for about a year. There are three natural gas companies in the immediate area (Williams Gas/Mark West/Range Resources). 1/6/11-Medium affected: Air - Caller reported they are surrounded by three chemical facilities that may be releasing harmful odors into the air.	
ERNS	Private residence	240 County Park Rd. Avella, PA 15312	0.03 mi. SE of SWPAGW07	Yes	3/15/2011 - Medium affected: Air – Caller stated that they smelled a strong natural gas odor and could see a blue fog entering the valley. She stated that an unknown amount of natural gas has been released by a nearby well (Atlas). Site included due to proximity to sample point.	
ERNS	NA	1043 Burgettstown Road Hickory, PA 15340	1.67 mi. N of SWPAGW03	No	10/23/08 Caller reported that a pickup truck crossed the center line and struck a school bus. No environmental releases.	
US Hist Auto Stat	Bongiorni Auto Wrecking	1043 Burgettstown Road Hickory, PA 15340	1.67 mi. N of SWPAGW03	Yes	Site in historical directory as a potential gas station/filling station/service station sites. Site included due to potential for contamination.	
LUST, UST	Hickory BP	Route 18 & 50 Hickory, PA 15340	0.6 mi ENE of SWPAGW03	Yes	The site contains a leaking UST containing gasoline. No VOCs were detected in the EPA samples. Site included due to potential for contamination.	
US MINES	Avella Mining Inc.	NI	0.44 mi. SSW of SWPAGW09	Yes	Mining activities in proximity to sampling location. Site included due to potential for contamination.	

Table C22 **Environmental Database Review Summary**
Southwestern Pennsylvania
Northern Area - Search Area F

Database	Name of Facility	Site Location Address	Distance from Nearest Sample Point	Potential Candidate Cause Yes/No	Potential Candidate Cause Justification	Groundwater Wells
FINDS RCRA-CESQG	C&J Metals	4481 Henderson Rd. Hickory, PA 15340	0.58 mi. ENE of SWPAGW03	No	Conditionally exempt small-quantity generator. No violations recorded.	
ERNS	Private residence	Avella Road Hickory, PA 15340	approx. 0.5 mi ENE of SWPAGW03	Yes	2/7/11 - Medium affected: Air – Caller reported that it was calm outside and they smelled a very strong odor of sulfur and burning tires. They stated that she had a metal taste in her mouth and her nose was burning. The caller stated that there are three gas companies in the area [and] that they had to have released some sort of chemical. Site included due to proximity to sample point.	
US Hist Auto Stat	Hoppers Car Care	4481 Henderson Rd. Hickory, PA 15340	approx. 0.58 mi ENE of SWPAGW03	Yes	Site in historical directory as a potential gas station/filling station/service station sites. Site included due to potential for contamination.	
FINDS	Ruff Creek BP	221 Main St. Hickory, PA 15340	0.63 mi. ENE of SWPAGW03	Yes	Gas station with NPDES permit. Petroleum contaminants not found in the EPA study samples. Site included due to potential for contamination.	
NPDES, FINDS, MANIFEST, US Hist Auto Stat	Hickory Amoco	221 Main St. Hickory, PA 15340	0.63 mi. ENE of SWPAGW03	Yes	Site in historical directory as a potential gas station/filling station/service station sites. The FINDS record points to the NPDES permit. No violations of the NPDES permit were found. The MANIFEST records indicate several shipments of ignitable and benzene wastes. Site included due to potential for contamination.	
FINDS	Hickory United Presb Church	210 Main St. Hickory, PA 15340	0.7 mi. ENE of SWPAGW03	No	Record indicates that the site is included in the PA eFACTS but could not be found in this database to understand the nature of the record. Not a likely source of impacts to ground water quality.	
FINDS	Cr Pastries	65 Ihnat Ln. Avella, PA 15312	0.26 mi. SSW of SWPAGW09	No	Record indicates that the site is included in the PA eFACTS but could not be found in this database to understand the nature of the record. Not a likely source of impacts to ground water quality.	
3 FINDS, US AIRS, RMP	Laurel Mountain Midstream Stewart Plant/Stewart Compressor Station	70 Caldwell Rd. Hickory, PA 15340	0.7 mi. S of SWPAGW03	No	The facility is a natural gas compressor station. The three FINDS records are associated with a violation of health and safety related to an air pollution incident. The RMP details a risk management plan that is put in place for the facility. Not a likely source of contaminants or issues found in nearby EPA sample points.	
FINDS, NPDES, US AIRS	Avella Area School District/Avella El	1000 Avella Rd. Avella, PA 15312	0.95 mi. WSW of SWPAGW09	No	Records are for air permit and stormwater discharge permit (NPDES). Facility is a school and not a likely source for impacts to ground water quality.	
NPDES	Lindley & Raber Sftf	4141 Henderson Rd. Hickory, PA 15340	1.0 mi. SSE of SWPAGW03	No	In NPDES database, no violations cited.	
FINDS	Cornerstone Care Dental	1227 Smith Twp State Rd. Burgettstown, PA 15021	2.52 mi. NW of SWPAGW03	No	Site participates in Radiation Protection Program and Safe Drinking Program (Noncommunity Water System Plan Approval). A fluoride violation was found for permit PWSID-5630838. Not a likely source of contamination due to distance from nearest sampling point.	
FINDS	Renz Comp Station	4050 Henderson Rd. Hickory, PA 15340	1.06 mi. E of SWPAGW03 and 1.33 mi. W of SWPAGW02	No	Site participates in PADEP Air Quality Program.	
FINDS	Goodwins Village Green	4051 Henderson Rd. Hickory, PA 15340	1.06 mi. E of SWPAGW03 and 1.33 mi. W of SWPAGW02	No	Site participates in PADEP Safe Drinking Water and Water Planning and Conservation programs - no other information was found.	
Orphan AST	Breezy Heights Farm	Route 844 Avella, PA 15312	2.9 mi. SW of SWPAGW09	No	Record is for a 2,000-gallon tank of diesel fuel. No violations recorded. Not a likely source of contamination due to distance from nearest sampling point.	

Table C22 **Environmental Database Review Summary**
Southwestern Pennsylvania
Northern Area - Search Area F

Database	Name of Facility	Site Location Address	Distance from Nearest Sample Point	Potential Candidate Cause Yes/ No	Justification	Groundwater Wells
Orphan ARCHIVE UST	Royale Helicopter Service, Inc.	Route 18 Burgettstown, PA 15021	>6.0 mi. N of SWPAGW03	No	Record is for a 10,000-gallon tank holding aviation fluid. Related contaminants not detected in nearby EPA samples. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan NPDES	Live Nation - Post Gazette Pavilio	Route 18 Burgettstown, PA 15022	10.2 mi. N of SWPAGW03	No	In NPDES database, no violations cited.	
Orphan MANIFEST	Union Electric Steel Corp Harmon C	Route 18 Burgettstown, PA 15023	8.8 mi. NNE of SWPAGW03	No	Records document several large shipments (over 10,000 lbs) of emission control dust/sludge generated from the furnace during steel making process. No records of release. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan ARCHIVE UST, LUST	Harrys	Route 18 Burgettstown, PA 15024	13.6 mi. NE of the SWPAGW03	No	LUST record is for a vehicular overfill. ARCHIVE UST record is for an inspection of USTs on property. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan ARCHIVE AST	Bologna Coal	Route 18 Burgettstown, PA 15025	>6.0 mi. N of SWPAGW03	No	Record is for a 1,000-gallon tank with substance listed as "other". Not a likely source of contamination due to distance from nearest sampling point.	
Orphan BROWNFIELDS	Starpointe Business Park	Route 18 and 22 Burgettstown, PA 15025	6.8 mi. N of SWPAGW03	No	Site is listed as vacant land. Brownfields are abandoned or underutilized industrial or commercial properties with perceived or actual environmental contamination. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan ARCHIVE UST	Cloverleaf Oil Co	Route 18 N & E 22ND Burgettstown, PA 15025	6.8 mi. N of SWPAGW03	No	Record is for three 6,000-gallon tanks, two containing gasoline and one diesel. Although contamination was detected, not a likely source of contamination due to distance from nearest sample point.	
Orphan ARCHIVE UST	Ford Garage	Route 18 Burgettstown, PA 15025	>6.0 mi. N of SWPAGW03	No	Record is for a 7,000-gallon heating oil tank. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan ARCHIVE AST	M&M Equip Sales Co	Route 18 Burgettstown, PA 15025	>6.0 mi. N of SWPAGW03	No	Record is for a 400-gallon diesel tank. Although contamination was detected in the EPA samples, not a likely source of contamination due to distance from nearest sampling point.	
Orphan ARCHIVE UST	Route 18 Office	Route 18 Burgettstown, PA 15025	>6.0 mi. N of SWPAGW03	No	Record is for 10,000-gallon diesel tank and 6,000-gallon gasoline tank. No petroleum compounds detected in EPA samples. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan CERCLIS-NFRAP	Chemical Leaman Tank Lines, Inc	Route 22 Burgettstown, PA 15025	>9.2 mi. N of SWPAGW03	No	Site was evaluated as an uncontrolled release site of hazardous waste for inclusion into the Superfund program, but did not qualify. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan NPDES	Hanover Twp Sa - Bavington Stp	Bavington Rd. Burgettstown, PA 15025	>7.3 mi. N of SWPAGW03	No	Permit is for treated sewage discharge. No violations noted.	
Orphan NPDES	Beech Hollow Power Project	Beech Hollow Rd. Robinson, PA 15025	8 mi. NE of SWPAGW03	No	Permit is for industrial discharge, which can impact ground water quality if not properly done. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan ICIS	R&W Oil Products, LLC	67 Old Steubenville Pike Burgettstown, PA 15025	11.5 mi. NW of SWPAGW03	No	Record for enforcement action against company for violation of Spill Prevention Control and Countermeasures Program. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan Archive AST	Five Points Trucking Inc	Old Route 18 Burgettstown, PA 15025	>6.0 mi. N of SWPAGW03	No	Record is for a 8,000-gallon diesel fuel tank. Although contamination was detected in EPA samples, not a likely source of contamination due to distance from nearest sampling point.	
Orphan Archive AST	Iannetti Garden Ctr	Old Route 22 Burgettstown, PA 15025	>9.2 mi. N of SWPAGW03	No	Record is for a 2,000-gallon heating oil tank. Although contamination was detected in EPA samples, not a likely source of contamination due to distance from nearest sampling point.	
Orphan Archive AST	Herbert Grubbs	N PA 18 Burgettstown, PA 15025	>6.0 mi. N of SWPAGW03	No	Record is for a 1,000-gallon diesel fuel tank. Although contamination was detected in EPA samples, not a likely source of contamination due to distance from nearest sampling point.	

Table C22 Environmental Database Review Summary
Southwestern Pennsylvania
Northern Area - Search Area F

Database	Name of Facility	Site Location Address	Distance from Nearest Sample Point	Potential Candidate Cause: Yes/ No	Potential Candidate Cause: Justification	Groundwater Wells
Orphan CERCLIS-NFRAP	Starvaggi Ind Inc Hanover Twp Land	USHY 22 Burgettstown, PA 15025	>9.2 mi. N of SWPAGW03	No	Facility is a former landfill that is being addressed under the state Environmental and Brownfields Cleanup Program. Landfills can impact water quality over large areas, but not a likely source of contamination due to distance from nearest sampling point.	
Orphan ARCHIVE AST	Corwin Jeep Sales & Svc	Route 50 Hickory, PA 15340	1.5 mi. E of SWPAGW03	Yes	Used motor oil AST. Site in environmental cleanup, brownfields and waste handing DEP programs. Site included due to potential for contamination.	
Orphan ARCHIVE UST	Franks Excavating	49 Elm Rd. Hickory, PA 15340	1.5 mi. ESE of SWPAGW03	Yes	Record is for a 2,000-gallon tank containing diesel fuel. Site included due to potential for contamination.	
Orphan CERCLIS, FINDS	Mays/Bologna	TWHY 336 Jefferson TWP, PA 15312	NI	Yes	Facility is a known or suspected abandoned, inactive, or uncontrolled hazardous waste site, but does not qualify for the NPL based on existing information. Waste site location could not be determined. Site included due to potential for contamination.	
Orphan CERCLIS-NFRAP	Washington County Drum Dump	Route 22 McDonald, PA 15057	9.0 mi. N of SWPAGW03	No	Facility is a known or suspected abandoned, inactive, or uncontrolled hazardous waste site, but does not quality for the NPL based on existing information. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan AST	Cecil Twp Washington Cnty	HC 50 & TRL 662 McDonald, PA 15057	7.7 mi. E of SWPAGW03	No	Leaking UST containing petroleum and AST containing diesel. Although contamination was detected in EPA samples, not a likely source of contamination due to distance from nearest sampling point.	
Orphan RCRA NonGen / NLR, FINDS	SUNOCO SERVICE STATION-MCDONALD	Route 980 McDonald, PA 15057	8.6 mi. NE of SWPAGW03	No	Inactive site. No records of violations.	
Orphan ICIS	Ireland Oil, Incorporated	Laurel Hill South Fayette Twp. McDonald, PA 15057	8.4 mi. NE of SWPAGW03	No	Ireland Oil has been cited for TSCA 16 action for penalty multiple times for unknown reasons. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan RCRA-TSDF, RCRA NonGen/NLR, FINDS	Chemical Leaman Tank Lines Inc	Route 22 Paris, PA 15021	>11.6 mi. NW of SWPAGW05	No	Record is for a licensed waste transporter. No violations cited.	
Orphan UST	State Line Sales II	35 Old Steubenville Pike Paris, PA 15021	8.9 mi. N of SWPAGW05	No	Record is for two 12,000-gallon tanks, one containing gasoline and the other diesel. No recorded releases. Although contamination was detected in EPA samples, not a likely source of contamination due to distance from nearest sampling point.	
Orphan ARCHIVE UST	Washington East Washington Junct	RR1	NI	Yes	Record is for a 1,000-gallon gasoline tank. Site included due to potential for contamination.	
Orphan RCRA-CESQG, FINDS, MANIFEST	Cessna Auto Body	1515 Route 136	11.0 mi. SE of SWPAGW05	No	Small-quantity generator of ignitable, lead, benzene, methyl ethyl keytone, and volatile compounds. No record of release. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan UST	PITT Ohio Term	Route 136 N	>10.5 mi. SE of SWPAGW05	No	Diesel UST. Although contamination was detected in EPA samples, not a likely source of contamination due to distance from nearest sampling point.	
Orphan CERCLIS-NFRAP	Falconi Rte 18	Route 18	>0.6 mi. SE of SWPAGW08	No	Site is no longer under consideration for inclusion on EPA NPL. No contaminants found in nearby EPA samples.	
Orphan ARCHIVE UST	Karluk Supply	Route 18N	>0.6 mi. E of SWPAGW03	Yes	Record is for a 1,500-gallon tank containing kerosene. Site included due to potential for contamination.	
Orphan RCRA NonGen / NLR, FINDS	Courtney Contracting Corp	Corporation is currently listed at 320 Springdale Road, Venetia, PA	>14.0 mi. E of SWPAGW05	No	Record is for a transporter of hazardous waste; no violations reported.	

Table C22 Environmental Database Review Summary
Southwestern Pennsylvania
Northern Area - Search Area F

Database	Name of Facility	Site Location Address	Distance from Nearest Sample Point	Potential Candidate Cause: Yes/No	Potential Candidate Cause: Justification	Groundwater Wells
Orphan NPDES	Trinity South Elem Sch WWTP	2500 South Main Street	11.4 mi. SE of SWPAGW05	No	Elementary school, no violations cited.	
Orphan FINDS, RCRA-CESQG, MANIFEST	Kenny's Body Shop	3445 Route 40 West	9.2 mi. S of SWPAGW05	No	No violations, typical contaminants associated with auto body shops not found in study samples. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan ICIS	Wheeling Pittsburgh Steel Corp	Allenport Plant - Allenport Boro	>27 mi. SE of SWPAGW08	No	Record is for a civil judicial action against this company. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan RMP	Washington-East Washington Joint A	98 Arden Station Rd. Washington, PA 15301	7.2 mi. SE of SWPAGW05	No	Liquid waste treatment plant with no reported violations. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan NPDES	SGT Patrick McMullen	PA Army National Guard	10.7 mi. SSE of SWPAGW05	No	In database for NPDES program, no violations cited.	
Orphan ARCHIVE UST	Washington Co Jail Courthouse	Beau St.	9.7 mi. SE of SWPAGW03	No	Record is for a 10,000-gallon heating oil tank. Although contamination was detected in EPA samples, not a likely source of contamination due to distance from nearest sampling point.	
Orphan FINDS	Washington ENGR & CONSTR	PO Box 1203, Washington, PA	>20 mi. ENE of SWPAGW03	No	Site had a permit (PAG-056182) for discharge from gasoline-contaminated-ground water remediation systems (ceased in Nov. 2011), with only an administration violation for incomplete DMR. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan MANIFEST	BP Oil Co 07607 / New Site 25972	Cameron & Route 19	9.6 mi. SE of SWPAGW05	No	Record is for transport of 150 gallons of ignitable waste and 150 gallons of benzene. No records of a release.	
Orphan MANIFEST	Washington County Housing Authority	100 N Franklin St.	9.4 mi. SE of SWPAGW05	No	Record is for transportation of 90 pounds of ignitable waste and 8 gallons of an unreported waste. No record of a release.	
Orphan FINDS	Multi Chem Group LLC Washington FA	200 Detroit St.	10.5 mi. SE of SWPAGW05	No	Site is in the state Environmental Cleanup and Brownfields Program. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan DRYCLEANERS	Imperial Clnr & Tailors/Washington	Hemlock St.	9.8 mi. SE of SWPAGW05	No	Record is for drycleaning operations. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan MANIFEST	Doud Bts	241 McAleer Rd., Sewickley	22.1 mi. NE of SWPAGW03	No	Manifest is for transportation of ignitable and benzene wastes. No record of a release.	
Orphan LUST	Washington Bp 964	2433 W Jefferson St. Washington, PA 15301	6.7 mi. SSE of SWPAGW05	No	Record is for leaking tank containing petroleum compounds. Remediation completed. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan NPDES	United Refining Co of PA	KWIK Fill S-85	>16 mi. E of SWPAGW03	No	Record is for NPDES monitoring point, no violation cited.	
Orphan MANIFEST	Columbia Gas Transmission LLC LOWR	4301 Infirmary Rd., West Carroll, OH	>200 mi. W of SWPAGW09	No	Record is for transportation and disposal of ignitable waste. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan RCRA-CESQG, FINDS	Washington Armory	78 Maiden St.	9.9 mi. SE of SWPAGW09	No	Small-quantity generator of ignitable and volatile wastes. No violations cited. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan NPDES	Victory Storage Field - Pipeline 1	Address not properly entered into EDR database. Locations are in West Virginia	>6.5 mi. W of SWPAGW09	No	NPDES site located in West Virginia.	
Orphan ARCHIVE AST	Washington Opr Ctr	2 Manifold Rd.	8.9 mi. SE of SWPAGW05	No	Leaking UST containing petroleum, cleanup completed. Not a likely source of contamination due to distance from nearest sampling point.	

Table C22 **Environmental Database Review Summary**
Southwestern Pennsylvania
Northern Area - Search Area F

Database	Name of Facility	Site Location Address	Distance from Nearest Sample Point	Potential Candidate Cause		Groundwater Wells
				Yes/ No	Justification	
Orphan NPDES	Lines 1758 & 10100 - Longwall Mini	Address not properly entered into EDR database. Locations are in West Virginia	>6.5 mi. west of SWPAGW09	No	Record is for a wastewater discharge permit, which can impact ground water quality. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan NPDES	Line 1754 - Longwall Mining - Stri					
Orphan NPDES	Line 8243 - Cathodic Protection Pr					
Orphan NPDES	Line 1528 - Replacement Project					
Orphan NPDES	Lines 1758 10100 - Longwall Mining					
Orphan CERCLIS	Yeager Impoundment Site	400 McAdams Rd.	14.6 mi. SSE of SWPAGW05	No	Site is listed in CERCLIS database as a removal only site (no assessment needed). Not a likely source of contamination due to distance from nearest sampling point.	
Orphan ARCHIVE AST	Bell of PA	Meadowland Blvd.	8.3 mi. SE of SWPAGW03	No	Record is for two 450-gallon storage tanks containing motor oil. Not a likely source of ground water impacts due to distance from nearest sampling point.	
Orphan FINDS, US AIRS	MARKWEST LIBERTY MIDSTREAM & RESOURCES/N	Hwy 231 Mount Pleasant, PA 15666	>7.5 mi. SW of SWPAGW09	No	Site has permit for stationary sources of air pollution. No violations found in PA eFACTS.	
Orphan FINDS, US AIRS	MARKWEST LIBERTY MIDSTREAM & RESOURCES/L	Lowry Ln. off Willow Rd. Hopewell Twp, PA 15312	>1.5 mi. NW of SWPAGW08	No	Site has permit for stationary sources of air pollution. Not a likely source of contamination due to distance from nearest sampling point and no violations found.	
Orphan FINDS, US AIRS	MARKWEST LIBERTY MIDSTREAM & RESOURCES/G	Route 18, Henderson Ave. Mt. Pleasant Twp, PA	>5.1 mi. SE of SWPAGW08	No	Site has permit for stationary sources of air pollution. Not a likely source of contamination due to distance from nearest sampling point and no violations found.	
Orphan FINDS, US AIRS	MARKWEST LIBERTY MIDSTREAM & RESOURCES/F	Between Washington Ave. and McCarrell Rd. Hickory, PA 15340	>0.3 mi. ENE of SWPAGW02	No	Site has permit for stationary sources of air pollution. Not a likely source of contamination due to no violations found.	
Orphan ARCHIVE UST	South Franklin Township Garage	2 Old Scales Rd. Washington, PA 15301	12.8 mi. SSE of SWPAGW05	No	Record is for two 1,000-gallon tanks, one containing gasoline and the other diesel. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan NPDES	Washington KOA Campground	7 KOA Rd.	11.7 mi. SE of SWPAGW05	No	In database for NPDES program, no violations cited.	
Orphan AST	Lowes of Washington PA 0671	Strabane Sq.	9.3 mi. SE of SWPAGW05	No	Record is for an active 1,500-gallon AST used to store diesel. No records of release. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan NPDES, FINDS	Washington Penn Plastic Co Inc	1500 Weirich, Washington, PA	8.3 mi. SW of SWPAGW03	No	Manufacturer of polypropylene and polyethylene compounds. In database for NPDES program, no violations cited.	
Orphan DRYCLEANERS	Checkers one hour Clnr/Washington	Washington Plz	NI	No	Record is for drycleaning operations. Not a likely source of contaminants due to no releases or incidents found.	
Orphan FINDS	Waste Management of PA Inc.	Washington Hauling	6.8 mi. SE of SWPAGW05	No	In database for NPDES program, no violations cited.	
Orphan RCRA-CESQG	Multi Chem Group LLC Washington FA	200 W Wyley Ave.	8.4 mi. SE of SWPAGW05	No	Small-quantity generator of ignitable, corrosive, barium, silver, chloroform, and volatile wastes. No records of a release or violations.	

Table C22 Environmental Database Review Summary
Southwestern Pennsylvania
Northern Area - Search Area F

Database	Name of Facility	Site Location Address	Distance from Nearest Sample Point	Potential Candidate Cause: Yes/No	Potential Candidate Cause: Justification	Groundwater Wells
Orphan FINDS, RMP	Allegheny Ludlum Cor/Washington FL	Woodland Ave.	7.7 mi. SE of SWPAGW05	No	Facility is enlisted in the emission inventory system. One accident reported a release of one pound of 70% hydrogen fluoride/hydrofluoric acid in gaseous form. No other violations noted. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan ARCHIVE UST, RMP	Washington Steel Corp	Woodland Ave.	7.9 mi. SE of SWPAGW05	No	Record is for a 2,000-gallon tank containing gasoline. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan US MINES	Therm-O-Rock East Inc	THERM-O-ROCK PA PLANT Washington, PA 15301	>21 mi. SE of SWPAGW03	No	Facility is listed as a vermiculite plant. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan FINDS	Washington E Wash Stp	102 Arden Station Rd. Washington, PA 15301	7.25 mi. SE of SWPAGW05	No	Site is listed as a groundwater quality monitoring point. Not a source of ground water quality impacts.	

Primary Source: Environmental records search report by Environmental Data Resources, Inc. (EDR)

Notes:

ORPHAN SITE: A site of potential environmental interest that appear in the records search but due to incomplete location information (i.e., address and coordinates) is unmappable and not included in the records search report provided by EDR Inc.

Search Area C

EDR Inquiry Number:3602489.16s

EDR Search Radius: 3 mi.

Search Center: Lat. 40.2890000 (40. 17' 20.40''), Long. 80.3782000 (-80. 22' 41.52'')

Key:

AST = Above ground storage tank.
DEP = Department of Environmental Protection
DMR = Discharge Monitoring Report
E = East.
EPA = Environmental Protection Agency
FRDS = Federal Reporting Data System.
mi = Mile.
N = North.
NI = No information.
NPDES = National Pollutant Discharge Elimination System.
NPL = National Priorities List.
PA = Pennsylvania.
RCRA = Resource Conservation and Recovery Act
USGS = United States Geological Survey.
UST = Underground storage tank.
W = West.
S = South.
TSCA = Toxic Substances Control Act.

Databases:

ARCHIVE AST: Local list of Archived Above Ground Storage Tank Sites
ARCHIVE UST: Local list of Archived Underground Storage Tank Sites
AST: Listing of Pennsylvania Regulated Aboveground Storage Tanks
BROWNFIELDS: Listing of abandoned or underused industrial or commercial properties where redevelopmentis complicated by actual or perceived environmental contamination.
CERC-NFRAP: Federal CERCLIS (Comprehensive Environmental Response, Compensation, and Liability Information System) NFRAP (No Further Remedial Action Planned) site list
DRYCLEANERS: Listing of drycleaner facility locations.
ERNS: Emergency Reponse Notification System
FINDS: Facility Index System/Facility Registry System
ICIS: Compliance Information System
LUST: Leaking Underground Storage Tank Sites
MANIFEST: Hazardous waste manifest information
NPDES: National Pollutant Discharge Elimination System Permit Listing
PA eFACTS = Pennsylvania Environmental Facility Application Compliance Tracking System
RCRA-CESQG: Federal RCRA (Resource Conservation and Recovery Act) Conditionally Exempt Small Quantity Generator List
RCRA NonGen / NLR: RCRA: Non Generators List
RCRA-TSDF: Listing of RCRA hazardous waste treament, storage, and disposal facilities.
RMP: Risk Management Plans Records
US AIRS: Aerometric Information Retrieval System Facility Subsystem
US HIST AUTO STATION: EDR exclusive database of listings of potential gas station, filling station, or service station sites .
US MINES: Mines Master Index File. The source of this database is the Dept. of Labor, Mine Safety and Health Administration
UST: Listing of Pennsylvania Regulated Underground Storage Tanks
VCP: Voluntary Cleanup Sites

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
JM BEST INC	ANNA B JOHNSON 1	230981	232958	189351	125-21461	Active	4	Northern-C	40.233825	-80.358182
RANGE RESOURCES APPALACHIA LLC	BEST UNIT 1H	710282	710073	975132	125-23277	Active	4	Northern-C	40.232829	-80.338027
RANGE RESOURCES APPALACHIA LLC	BEST UNIT 2H	710282	710194	975425	125-23283	Active	4	Northern-C	40.232801	-80.337972
RANGE RESOURCES APPALACHIA LLC	BEST UNIT 3H	710282	710200	975443	125-23282	Active	4	Northern-C	40.232801	-80.337916
RANGE RESOURCES APPALACHIA LLC	BEST UNIT 4H	710282	710203	975446	125-23284	Active/Regulatory Inactive Status	523	Northern-C	40.232801	-80.337860
RANGE RESOURCES APPALACHIA LLC	BEST UNIT 5H	710282	712206	979010	125-23370	Active	4	Northern-C	40.232774	-80.337777
RANGE RESOURCES APPALACHIA LLC	BEST UNIT 6H	710282	712198	979001	125-23368	Active	4	Northern-C	40.232774	-80.337694
RANGE RESOURCES APPALACHIA LLC	BEST UNIT 7H-A	710282	712200	979004	125-23369	Active	4	Northern-C	40.232774	-80.337638
JM BEST INC	HAROLD L WARD 1	230980	232957	189350	125-21460	Active	4	Northern-C	40.228881	-80.326898
JM BEST INC	HUNTER 1	230971	232948	189341	125-21446	Active	4	Northern-C	40.230808	-80.341348
RANGE RESOURCES APPALACHIA LLC	LBROS UNIT 1H	710872	710556	976056	125-23308	Active	4	Northern-C	40.244162	-80.341694
RANGE RESOURCES APPALACHIA LLC	LBROS UNIT 2H	706655	707104	970121	125-23199	Operator Reported Not Drilled	401	Northern-C	40.246273	-80.338888
RANGE RESOURCES APPALACHIA LLC	LBROS UNIT 2H	710872	712196	978999	125-23367	Active	4	Northern-C	40.244440	-80.341638
RANGE RESOURCES APPALACHIA LLC	LBROS UNIT 3H	710872	717564	988063	125-23696	Active	4	Northern-C	40.244162	-80.341583
RANGE RESOURCES APPALACHIA LLC	LBROS UNIT 4H	710872	717567	988066	125-23695	Active/Regulatory Inactive Status	523	Northern-C	40.244135	-80.341694
RANGE RESOURCES APPALACHIA LLC	LBROS UNIT 5H	710872	718284	989357	125-23705	Active	4	Northern-C	40.244135	-80.341638

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	LOWRY WILLIAM UNIT 3H	705262	705998	968192	125-23169	Active	4	Northern-C	40.243801	-80.347111
RANGE RESOURCES APPALACHIA LLC	LOWRY WILLIAM UNIT 4H	705262	711104	977035	125-23326	Operator Reported Not Drilled	401	Northern-C	40.243773	-80.347083
RANGE RESOURCES APPALACHIA LLC	ODONNELL JOSEPH UNIT 1H	747809	758767	1092275	125-24939	Active	4	Northern-C	40.232117	-80.351511
RANGE RESOURCES APPALACHIA LLC	ODONNELL JOSEPH UNIT 1H	747809	743219	1046029	125-24483	Operator Reported Not Drilled	401	Northern-C	40.232117	-80.351511
RANGE RESOURCES APPALACHIA LLC	ODONNELL JOSEPH UNIT 2H	747809	758766	1092274	125-24940	Active	4	Northern-C	40.232194	-80.351467
RANGE RESOURCES APPALACHIA LLC	ODONNELL JOSEPH UNIT 2H	747809	743221	1046033	125-24484	Operator Reported Not Drilled	401	Northern-C	40.232194	-80.351467
RANGE RESOURCES APPALACHIA LLC	ODONNELL JOSEPH UNIT 3H	747809	758768	1092276	125-24941	Active	4	Northern-C	40.232225	-80.351292
RANGE RESOURCES APPALACHIA LLC	ODONNELL JOSEPH UNIT 3H	747809	743224	1046038	125-24485	Operator Reported Not Drilled	401	Northern-C	40.232225	-80.351292
RANGE RESOURCES APPALACHIA LLC	ODONNELL JOSEPH UNIT 4H	747809	758769	1092277	125-24942	Active	4	Northern-C	40.232150	-80.351336
RANGE RESOURCES APPALACHIA LLC	ODONNELL JOSEPH UNIT 4H	747809	743227	1046048	125-24486	Operator Reported Not Drilled	401	Northern-C	40.232150	-80.351336
RANGE RESOURCES APPALACHIA LLC	WARD HAROLD UNIT 3H	729196	729314	1011354	125-24119	Active	4	Northern-C	40.229500	-80.323278
RANGE RESOURCES APPALACHIA LLC	WARD HAROLD UNIT 4H	729196	726348	1005899	125-23975	Active	4	Northern-C	40.229278	-80.323278
RANGE RESOURCES APPALACHIA LLC	WARD HAROLD UNIT 5H	729196	735516	1022979	125-24329	Active	4	Northern-C	40.229447	-80.323281
RANGE RESOURCES APPALACHIA LLC	WARD HAROLD UNIT 6H	729196	726350	1005904	125-23974	Active	4	Northern-C	40.229389	-80.323278

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	WARD HAROLD UNIT 7H	729196	726352	1005908	125-23976	Active	4	Northern-C	40.229333	-80.323306
RANGE RESOURCES APPALACHIA LLC	WARD HAROLD UNIT 8H	729196	728858	1010571	125-24070	Active	4	Northern-C	40.229278	-80.323306
UNKNOWN OPR	ALEXANDER 1	694188	697275	952453	125-02162	Inactive/Plugged Well	361	Northern-D	40.282995	-80.313054
RANGE RESOURCES APPALACHIA LLC	ALEXANDER UNIT 1H	671310	679750	1059485/919746	125-22366	Inactive/Plugged Well	361	Northern-D	40.287944	-80.314167
RANGE RESOURCES APPALACHIA LLC	ALEXANDER UNIT 2	677900	684689	929500	125-22447	Active	4	Northern-D	40.283301	-80.310137
RANGE RESOURCES APPALACHIA LLC	BEAUMARIAGE UNIT 1H	710306	710099	975241	125-23280	Active	4	Northern-D	40.270301	-80.308332
RANGE RESOURCES APPALACHIA LLC	BEAUMARIAGE UNIT 2H	710306	715586	984681	125-23591	Active	4	Northern-D	40.270329	-80.308387
RANGE RESOURCES APPALACHIA LLC	DEISEROTH 1	617889	638693	773283	125-22088	Active	4	Northern-D	40.280023	-80.291998
RANGE RESOURCES APPALACHIA LLC	DEISEROTH 2	658182	669855	900012	125-22238	Active	4	Northern-D	40.284467	-80.291859
RANGE RESOURCES APPALACHIA LLC	DEISEROTH 3	685807	690741	940391	125-22629	Active	4	Northern-D	40.278912	-80.296942
RANGE RESOURCES APPALACHIA LLC	GULLA UNIT 1	654660	667163	894128/ 1059467	125-22212	Inactive/Plugged Well	361	Northern-D	40.275861	-80.307889
RANGE RESOURCES APPALACHIA LLC	GULLA UNIT 10H	696176	698722	955525	125-22941	Active	4	Northern-D	40.274000	-80.318361
RANGE RESOURCES APPALACHIA LLC	GULLA UNIT 2	663024	673686	907935	125-22262	Proposed But Never Materialized	6	Northern-D	40.275967	-80.307804
RANGE RESOURCES APPALACHIA LLC	GULLA UNIT 3	662874	673558	907735	125-22261	Active	4	Northern-D	40.272722	-80.314389
RANGE RESOURCES APPALACHIA LLC	GULLA UNIT 4	663028	673690	907940	125-22263	Proposed But Never Materialized	6	Northern-D	40.277801	-80.313804

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	GULLA UNIT 5H	662794	673492	907638	125-22259	Inactive/Plugged Well	361	Northern-D	40.283134	-80.302943
RANGE RESOURCES APPALACHIA LLC	GULLA UNIT 6	667184	676703	913790	125-22300	Active	4	Northern-D	40.272440	-80.313193
RANGE RESOURCES APPALACHIA LLC	GULLA UNIT 9	686044	690903	940705	125-22639	Active	4	Northern-D	40.272412	-80.308637
DORSO LP	MCBURNEY 2	683232	688784	936815	125-22563	Active	4	Northern-D	40.288328	-80.305637
DORSO LP	MCBURNEY 3	683234	688785	936818	125-22562	Active	4	Northern-D	40.285606	-80.307554
RANGE RESOURCES APPALACHIA LLC	MITCHELL JAMES UNIT 1	690617	694422	947123	125-22798	Operator Reported Not Drilled	401	Northern-D	40.276495	-80.301331
RANGE RESOURCES APPALACHIA LLC	MITCHELL JAMES UNIT 2H	690619	694424	947127	125-22799	Active	4	Northern-D	40.271829	-80.298220
RANGE RESOURCES APPALACHIA LLC	MITCHELL JAMES UNIT 3	690622	694426	947132	125-22800	Operator Reported Not Drilled	401	Northern-D	40.272829	-80.303943
RANGE RESOURCES APPALACHIA LLC	MITCHELL JAMES UNIT 4H	690625	694427	947133	125-22801	Active	4	Northern-D	40.269606	-80.301776
RANGE RESOURCES APPALACHIA LLC	MITCHELL JAMES UNIT 5	699404	701291	959980	125-23024	Operator Reported Not Drilled	401	Northern-D	40.268051	-80.297637
RANGE RESOURCES APPALACHIA LLC	PEACOCK 1	665389	675451	911372	125-22282	Operator Reported Not Drilled	401	Northern-D	40.285523	-80.298331
RANGE RESOURCES APPALACHIA LLC	PEACOCK 1	692042	695605	949496	125-22856	Operator Reported Not Drilled	401	Northern-D	40.285773	-80.298359
RANGE RESOURCES APPALACHIA LLC	PEACOCK 3	685810	690744	940396	125-22630	Operator Reported Not Drilled	401	Northern-D	40.288967	-80.298803

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	PEACOCK 3	692708	696117	950407	125-22864	Active	4	Northern-D	40.289717	-80.298081
RANGE RESOURCES APPALACHIA LLC	PEACOCK UNIT 1H	694522	697536	952949	125-22900	Active	4	Northern-D	40.283801	-80.297748
RANGE RESOURCES APPALACHIA LLC	RENZ 2	652177	665248	890481	125-22205	Active	4	Northern-D	40.276912	-80.286303
RANGE RESOURCES APPALACHIA LLC	COWDEN UNIT 1H	699408	701294	959984	125-23023	Active	4	Northern-E	40.330106	-80.281747
RANGE RESOURCES APPALACHIA LLC	COWDEN UNIT 2H	699408	710403	975786	125-23304	Active	4	Northern-E	40.330106	-80.281692
RANGE RESOURCES APPALACHIA LLC	COWDEN UNIT 2H	699497	701354	960094	125-23031	Operator Reported Not Drilled	401	Northern-E	40.327022	-80.283636
RANGE RESOURCES APPALACHIA LLC	COWDEN UNIT 3	699409	701297	959987	125-23022	Operator Reported Not Drilled	401	Northern-E	40.333467	-80.283942
RANGE RESOURCES APPALACHIA LLC	COWDEN UNIT 3H	718740	717353	987674	125-23693	Active	4	Northern-E	40.328133	-80.295887
RANGE RESOURCES APPALACHIA LLC	COWDEN UNIT 4H	718740	719624	992092	125-23780	Active	4	Northern-E	40.328083	-80.295944
RANGE RESOURCES APPALACHIA LLC	COWDEN UNIT 5H	718740	719628	992097	125-23781	Active	4	Northern-E	40.328083	-80.296056
RANGE RESOURCES APPALACHIA LLC	COWDEN UNIT 6H	718740	719631	992103	125-23782	Active	4	Northern-E	40.328083	-80.296000
RANGE RESOURCES APPALACHIA LLC	DRUGMAND UNIT 1H	725295	723862	1001096	125-23888	Active	4	Northern-E	40.320306	-80.302333
RANGE RESOURCES APPALACHIA LLC	DRUGMAND UNIT 2H	725295	723864	1001098	125-23889	Active	4	Northern-E	40.320361	-80.302306
RANGE RESOURCES APPALACHIA LLC	DRUGMAND UNIT 3H	725295	723219	999756	125-23853	Active	4	Northern-E	40.320389	-80.302278
RANGE RESOURCES APPALACHIA LLC	DRUGMAND UNIT 4H	725295	723870	1001104	125-23890	Active	4	Northern-E	40.320444	-80.302222

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	DRUGMAND UNIT 5H	725295	723873	1001108	125-23891	Active	4	Northern-E	40.320389	-80.302222
RANGE RESOURCES APPALACHIA LLC	DRUGMAND UNIT 6H	725295	723876	1001114	125-23892	Active	4	Northern-E	40.320472	-80.302167
RANGE RESOURCES APPALACHIA LLC	DRUGMAND UNIT 7H	725295	723879	1001124	125-23893	Active	4	Northern-E	40.320278	-80.302306
RANGE RESOURCES APPALACHIA LLC	DRUGMAND UNIT 8H	725295	723884	1001131	125-23894	Active	4	Northern-E	40.320333	-80.302278
RANGE RESOURCES APPALACHIA LLC	PARRY UNIT 1H	710284	711701	978139	125-23345	Operator Reported Not Drilled	401	Northern-E	40.314495	-80.282942
RANGE RESOURCES APPALACHIA LLC	PARRY UNIT 2H	710284	710076	975137	125-23276	Operator Reported Not Drilled	401	Northern-E	40.314523	-80.282886
RANGE RESOURCES APPALACHIA LLC	PETRICCA UNIT 1H	701857	703251	963675	125-23085	Operator Reported Not Drilled	6	Northern-E	40.314773	-80.286275
RANGE RESOURCES APPALACHIA LLC	CARNS DONALD B UNIT 3H	775482	768692	1115244	125-27109	Active	4	Northern-F	40.328981	-80.359236
RANGE RESOURCES APPALACHIA LLC	CARNS DONALD B UNIT 4H	775482	768704	1115259	125-27110	Active	4	Northern-F	40.328911	-80.359178
RANGE RESOURCES APPALACHIA LLC	CARNS DONALD UNIT 11H	756325	749535	1070786	125-24686	Active	4	Northern-F	40.325378	-80.372906
RANGE RESOURCES APPALACHIA LLC	CARNS DONALD UNIT 12H	756325	748292	1063808/1063809	125-24657	Active	4	Northern-F	40.325453	-80.372861
RANGE RESOURCES APPALACHIA LLC	CARNS DONALD UNIT 13H	756325	748293	1063810	125-24658	Active	4	Northern-F	40.325528	-80.372814
RANGE RESOURCES APPALACHIA LLC	CARNS DONALD UNIT 19H	756325	750145	1071990	125-24698	Active	4	Northern-F	40.325425	-80.373036
RANGE RESOURCES APPALACHIA LLC	CARNS DONALD UNIT 20H	756325	750147	1071997	125-24699	Active	4	Northern-F	40.325500	-80.372989
RANGE RESOURCES APPALACHIA LLC	CARNS DONALD UNIT 21H	756325	750149	1071999	125-24700	Active	4	Northern-F	40.325572	-80.372944

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	CARNS UNIT 1	687544	692090	942827	125-22708	Operator Reported Not Drilled	401	Northern-F	40.275801	-80.379306
RANGE RESOURCES APPALACHIA LLC	CARNS UNIT 2	687545	692091	942828	125-22709	Active	4	Northern-F	40.280579	-80.379973
RANGE RESOURCES APPALACHIA LLC	CARNS UNIT 3	687546	692093	942830	125-22710	Operator Reported Not Drilled	401	Northern-F	40.276995	-80.385390
RANGE RESOURCES APPALACHIA LLC	CARNS UNIT 4	687548	692095	942833	125-22711	Operator Reported Not Drilled	401	Northern-F	40.281745	-80.386029
RANGE RESOURCES APPALACHIA LLC	CARNS UNIT 7H	687545	711107	977038	125-23327	Operator Reported Not Drilled	401	Northern-F	40.280523	-80.379973
RANGE RESOURCES APPALACHIA LLC	CARTER UNIT 3	681094	687277	934028	125-22499	Inactive/Plugged Well	361	Northern-F	40.305500	-80.326306
RANGE RESOURCES APPALACHIA LLC	CHECHUCK GEORGE UNIT 1H	762436	755861	1085535/1085538	125-24858	Active	4	Northern-F	40.309478	-80.406956
RANGE RESOURCES APPALACHIA LLC	CHECHUCK GEORGE UNIT 2H	762436	755862	1085539	125-24859	Active	4	Northern-F	40.309325	-80.406878
RANGE RESOURCES APPALACHIA LLC	CHECHUCK GEORGE UNIT 3H	762436	755864	1085541	125-24860	Active	4	Northern-F	40.309519	-80.406822
RANGE RESOURCES APPALACHIA LLC	CHECHUCK GEORGE UNIT 4H	762436	755866	1085544	125-24861	Active	4	Northern-F	40.309367	-80.406744
RANGE RESOURCES APPALACHIA LLC	CHRISTMAN UNIT 1	660999	672160	904847	125-22252	Active	4	Northern-F	40.268912	-80.371139
RANGE RESOURCES APPALACHIA LLC	CHRISTMAN UNIT 2	663030	673692	907946	125-22264	Active	4	Northern-F	40.265389	-80.366222
RANGE RESOURCES APPALACHIA LLC	CHRISTMAN UNIT 3	663193	673800	908148	125-22265	Active	4	Northern-F	40.270245	-80.377306
RANGE RESOURCES APPALACHIA LLC	CHRISTMAN UNIT 4	676912	683957	928188	125-22440	Active	4	Northern-F	40.260662	-80.375973

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	CHRISTMAN UNIT 5	676049	683326	927022	125-22431	Inactive/Plugged Well	361	Northern-F	40.270940	-80.363722
RANGE RESOURCES APPALACHIA LLC	CHRISTMAN UNIT 6	676264	683486	927320	125-22434	Inactive/Plugged Well	361	Northern-F	40.266051	-80.358833
RANGE RESOURCES APPALACHIA LLC	CHRISTMAN UNIT 7	681990	687924	935212	125-22522	Operator Reported Not Drilled	401	Northern-F	40.255857	-80.370278
RANGE RESOURCES APPALACHIA LLC	CHRISTMAN UNIT 8	686043	690901	940703	125-22638	Inactive/Plugged Well	361	Northern-F	40.261995	-80.371778
RANGE RESOURCES APPALACHIA LLC	COOPER CHARLES 2	685053	690097	939325	125-22602	Operator Reported Not Drilled	401	Northern-F	40.313189	-80.332943
RANGE RESOURCES APPALACHIA LLC	COOPER CHARLES 3	685805	690739	940388	125-22628	Operator Reported Not Drilled	401	Northern-F	40.310106	-80.330471
RANGE RESOURCES APPALACHIA LLC	COSTANZO UNIT 1H	722452	720649	994291	125-23803	Active	4	Northern-F	40.266778	-80.354778
RANGE RESOURCES APPALACHIA LLC	COSTANZO UNIT 2H	722452	720652	994298	125-23804	Active	4	Northern-F	40.266833	-80.354778
ATLAS RESOURCES LLC	COWDEN 40	704773	705610	967535	125-23161	Active	4	Northern-F	40.280467	-80.361167
ATLAS RESOURCES LLC	COWDEN 41	715957	714881	983561	125-23537	Active	4	Northern-F	40.281134	-80.365945
ATLAS RESOURCES LLC	COWDEN 41	705314	706036	968247	125-23171	Operator Reported Not Drilled	401	Northern-F	40.279412	-80.368695
ATLAS RESOURCES LLC	COWDEN 42	705317	706038	968249	125-23172	Operator Reported Not Drilled	401	Northern-F	40.276940	-80.366556
ATLAS RESOURCES LLC	COWDEN 46	696345	698847	955722	125-22957	Active/Regulatory Inactive Status	523	Northern-F	40.272134	-80.384195

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
ATLAS RESOURCES LLC	COWDEN 47	696349	698849	955724	125-22958	Operator Reported Not Drilled	401	Northern-F	40.269384	-80.385195
CHEVRON APPALACHIA LLC	COWDEN 47H	696349	709984	975006	125-23271	Active	4	Northern-F	40.269384	-80.385195
ATLAS RESOURCES LLC	COWDEN 48	696376	698863	955743	125-22959	Operator Reported Not Drilled	401	Northern-F	40.268968	-80.390473
ATLAS RESOURCES LLC	COWDEN 48	696376	709985	975007	125-23270	Active	4	Northern-F	40.268968	-80.390473
ATLAS RESOURCES LLC	COWDEN 48H	696376	713189	980728	125-23429	Regulatory Inactive Status	523	Northern-F	40.268968	-80.390473
ATLAS RESOURCES LLC	COWDEN 50	701286	702762	962630	125-23070	Active/Regulatory Inactive Status	523	Northern-F	40.270412	-80.398168
ATLAS RESOURCES LLC	COWDEN 51	696353	698851	955726	125-22960	Active/Regulatory Inactive Status	523	Northern-F	40.274745	-80.391279
ATLAS RESOURCES LLC	COWDEN 53	696397	698881	955768	125-22961	Active/Regulatory Inactive Status	523	Northern-F	40.270079	-80.402085
ATLAS RESOURCES LLC	COWDEN 75	696349	712440	979387	125-23376	Active	4	Northern-F	40.269412	-80.385001
ATLAS RESOURCES LLC	COWDEN 76	696376	714608	983162	125-23515	Active	4	Northern-F	40.269134	-80.390390
ATLAS RESOURCES LLC	COWDEN 76	696376	712439	979385	125-23377	Operator Reported Not Drilled	401	Northern-F	40.268968	-80.390279
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK CNTY PARK 10	692562	696001	950130	125-22860	Operator Reported Not Drilled	401	Northern-F	40.262996	-80.395918
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK CNTY PARK 12	689602	693636	945732	125-22763	Operator Reported Not Drilled	401	Northern-F	40.257579	-80.374084

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK CNTY PARK 3	686953	691615	942027	125-22673	Operator Reported Not Drilled	401	Northern-F	40.255579	-80.377695
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK CNTY PARK 4	686955	691616	942028	125-22674	Operator Reported Not Drilled	401	Northern-F	40.253523	-80.381556
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK CNTY PARK 7H	686894	696015	950154	125-22861	Active	4	Northern-F	40.260912	-80.390612
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK CNTY PARK 8-H	690273	694153	946680	125-22793	Active	4	Northern-F	40.262829	-80.388001
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK CNTY PARK 9H-A	686894	691570	941934	125-22668	Active	4	Northern-F	40.261023	-80.390668
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 1	687960	692389	943322	125-22728	Operator Reported Not Drilled	401	Northern-F	40.263246	-80.383251
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 11	687962	692391	943324	125-22729	Proposed But Never Materialized	401	Northern-F	40.261221	-80.383380
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 14H	704936	705743	967785	125-23165	Active	4	Northern-F	40.246662	-80.381251
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 15H	704936	706489	968947	125-23182	Active	4	Northern-F	40.246662	-80.381306
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 16H	704936	710371	975719	125-23300	Active	4	Northern-F	40.246690	-80.381334
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 17H	747426	751011	1074565	125-24743	Active	4	Northern-F	40.263508	-80.408856
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 18H	747426	751012	1074566	125-24744	Active	4	Northern-F	40.263567	-80.408778
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 19H	747426	728779	1010469	125-24054	Operator Reported Not Drilled	401	Northern-F	40.263586	-80.408753

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 19H	747426	716265	985783	125-23631	Operator Reported Not Drilled	401	Northern-F	40.263496	-80.408613
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 19H	747426	751078	1074720	125-24754	Active	4	Northern-F	40.263625	-80.408703
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 20H	747426	716263	985781	125-23630	Operator Reported Not Drilled	401	Northern-F	40.263523	-80.408585
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 20H	732122	728785	1010478	125-24055	Operator Reported Not Drilled	401	Northern-F	40.263489	-80.408828
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 21H	747426	728767	1010448	125-24056	Operator Reported Not Drilled	401	Northern-F	40.263528	-80.408778
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 21H	747426	716262	985780	125-23629	Operator Reported Not Drilled	401	Northern-F	40.263551	-80.408529
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 22H	747426	716259	985776	125-23628	Operator Reported Not Drilled	401	Northern-F	40.263607	-80.408502
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 22H	747426	728754	1010434	125-24057	Operator Reported Not Drilled	401	Northern-F	40.263567	-80.408728
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 25H	686894	723353	1000031	125-23859	Active	4	Northern-F	40.261056	-80.390972
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 41H	752479	761869	1099859	125-26980	Active	4	Northern-F	40.254722	-80.378031
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 42H	752479	759270	1093691	125-26928	Active	4	Northern-F	40.254772	-80.377906
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 43H	752479	761871	1099865/1111620	125-26981	Active	4	Northern-F	40.254847	-80.377956
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 44H	752479	761872	1099871	125-26982	Active	4	Northern-F	40.254919	-80.378003

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 45H	747426	751013	1074567	125-24745	Active	4	Northern-F	40.263433	-80.408753
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 45H	747426	745682	1051121	125-24568	Operator Reported Not Drilled	401	Northern-F	40.263508	-80.408856
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 46H	747426	751014	1074568	125-24746	Active	4	Northern-F	40.263489	-80.408678
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 46H	747426	745704	1051166	125-24569	Operator Reported Not Drilled	401	Northern-F	40.263567	-80.408778
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 47H	747426	751015	1074569	125-24747	Active	4	Northern-F	40.263547	-80.408600
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 47H	747426	745711	1051175	125-24570	Operator Reported Not Drilled	401	Northern-F	40.263625	-80.408703
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 5	685522	690478	939958	125-22618	Active	4	Northern-F	40.250718	-80.378584
RANGE RESOURCES APPALACHIA LLC	CROSS CREEK COUNTY PARK 6H	690273	695323	948937	125-22830	Active	4	Northern-F	40.262829	-80.388056
RANGE RESOURCES APPALACHIA LLC	HELSEL UNIT 1	686384	691127	941150	125-22651	Operator Reported Not Drilled	401	Northern-F	40.248885	-80.373528
RANGE RESOURCES APPALACHIA LLC	HELSEL UNIT 3	688457	692762	944109	125-22735	Operator Reported Not Drilled	401	Northern-F	40.246607	-80.378001
RANGE RESOURCES APPALACHIA LLC	HELSEL UNIT 4	688460	692765	944113	125-22736	Operator Reported Not Drilled	401	Northern-F	40.245912	-80.383306
RANGE RESOURCES APPALACHIA LLC	HELSEL UNIT 6	687100	691735	942251	125-22682	Operator Reported Not Drilled	401	Northern-F	40.252607	-80.371556

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	HELSEL UNIT 7	687101	691736	942252	125-22683	Operator Reported Not Drilled	401	Northern-F	40.252496	-80.372028
RANGE RESOURCES APPALACHIA LLC	KANCEL UNIT 2H	755544	753627	1082664/1080190	125-24805	Active	4	Northern-F	40.287303	-80.415611
RANGE RESOURCES APPALACHIA LLC	KANCEL UNIT 3H	755544	758565	1091863	125-24934	Active	4	Northern-F	40.287139	-80.415606
RANGE RESOURCES APPALACHIA LLC	KANCEL UNIT 4H	755544	753628	1082665/1080191	125-24806	Active	4	Northern-F	40.287219	-80.415608
RANGE RESOURCES APPALACHIA LLC	KANCEL UNIT 7H	755544	753629	1080195/1082666	125-24807	Active	4	Northern-F	40.287217	-80.415753
RANGE RESOURCES APPALACHIA LLC	KANCEL UNIT 8H	755544	753630	1080197/1082667	125-24808	Active	4	Northern-F	40.287136	-80.415750
JM BEST INC	KOVALICK 1	230972	232949	189342	125-21448	Active	4	Northern-F	40.259431	-80.366611
RANGE RESOURCES APPALACHIA LLC	LEHMAN UNIT 1	740688	690899	940701	125-22637	Active	4	Northern-F	40.298717	-80.378639
RANGE RESOURCES APPALACHIA LLC	LEHMAN UNIT 10H	740688	735504	1022933	125-24328	Active	4	Northern-F	40.299150	-80.379569
RANGE RESOURCES APPALACHIA LLC	LEHMAN UNIT 11H	740688	735486	1022907	125-24326	Active	4	Northern-F	40.299133	-80.379597
RANGE RESOURCES APPALACHIA LLC	LEHMAN UNIT 2H	740688	717260	987534	125-23686	Operator Reported Not Drilled	401	Northern-F	40.298884	-80.378500
RANGE RESOURCES APPALACHIA LLC	LEHMAN UNIT 2H	740688	713191	980733	125-23432	Operator Reported Not Drilled	401	Northern-F	40.298745	-80.378612
RANGE RESOURCES APPALACHIA LLC	LEHMAN UNIT 3H	740688	714740	983337	125-23519	Operator Reported Not Drilled	401	Northern-F	40.298690	-80.378667
RANGE RESOURCES APPALACHIA LLC	LEHMAN UNIT 4H	740688	714741	983338	125-23520	Operator Reported Not Drilled	401	Northern-F	40.298801	-80.378556

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	LEHMAN UNIT 5H	740688	717257	987531	125-23688	Operator Reported Not Drilled	401	Northern-F	40.298773	-80.378584
RANGE RESOURCES APPALACHIA LLC	LEHMAN UNIT 6H	740688	719455	991758	125-23776	Operator Reported Not Drilled	401	Northern-F	40.298889	-80.378694
RANGE RESOURCES APPALACHIA LLC	LEHMAN UNIT 7H	740688	735479	1022893	125-24323	Active	4	Northern-F	40.299219	-80.379689
RANGE RESOURCES APPALACHIA LLC	LEHMAN UNIT 8H	740688	735482	1022896	125-24324	Active	4	Northern-F	40.299194	-80.379617
RANGE RESOURCES APPALACHIA LLC	LEHMAN UNIT 9H	740688	735485	1022906	125-24325	Active	4	Northern-F	40.299108	-80.379525
RANGE RESOURCES APPALACHIA LLC	LOWRY WILLIAM UNIT 1	685034	690086	939309	125-22599	Operator Reported Not Drilled	401	Northern-F	40.251690	-80.360389
RANGE RESOURCES APPALACHIA LLC	LOWRY WILLIAM UNIT 10H	725420	723341	999980	125-23858	Operator Reported Not Drilled	401	Northern-F	40.251222	-80.370250
RANGE RESOURCES APPALACHIA LLC	LOWRY WILLIAM UNIT 2H-A	685045	690088	939313	125-22600	Active	4	Northern-F	40.250996	-80.367778
RANGE RESOURCES APPALACHIA LLC	LOWRY WILLIAM UNIT 5H	725420	723332	999963	125-23854	Operator Reported Not Drilled	401	Northern-F	40.251361	-80.370361
RANGE RESOURCES APPALACHIA LLC	LOWRY WILLIAM UNIT 6H	725420	723342	999989	125-23855	Operator Reported Not Drilled	401	Northern-F	40.251417	-80.370389
RANGE RESOURCES APPALACHIA LLC	LOWRY WILLIAM UNIT 7H	725420	723340	999972	125-23856	Operator Reported Not Drilled	401	Northern-F	40.251306	-80.370306
RANGE RESOURCES APPALACHIA LLC	LOWRY WILLIAM UNIT 8H	725420	723337	999969	125-23857	Operator Reported Not Drilled	401	Northern-F	40.251333	-80.370333

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	MACINTYRE UNIT 1H	754150	757692	1089541/1107656	125-24897	Active	4	Northern-F	40.293275	-80.390961
RANGE RESOURCES APPALACHIA LLC	MACINTYRE UNIT 2H	754150	757492	1089068/1107663	125-24894	Active	4	Northern-F	40.293194	-80.390931
RANGE RESOURCES APPALACHIA LLC	MACINTYRE UNIT 3H	754150	757493	1089069/1107668	125-24895	Active	4	Northern-F	40.293383	-80.390850
RANGE RESOURCES APPALACHIA LLC	MACINTYRE UNIT 4H	754150	763227	1102671	125-26996	Active	4	Northern-F	40.293306	-80.390822
RANGE RESOURCES APPALACHIA LLC	MACINTYRE UNIT 5H	754150	763289	1102799	125-26998	Active	4	Northern-F	40.293225	-80.390792
RANGE RESOURCES APPALACHIA LLC	MACINTYRE UNIT 6H	754150	764492	1105440	125-27017	Active	4	Northern-F	40.293353	-80.390989
RANGE RESOURCES APPALACHIA LLC	MARGARIA RAYMOND UNIT 1H	732213	743393	1046445	125-24488	Active	4	Northern-F	40.284842	-80.431503
RANGE RESOURCES APPALACHIA LLC	MARGARIA RAYMOND UNIT 2H	732213	742310	1043899	125-24450	Active	4	Northern-F	40.284953	-80.431508
RANGE RESOURCES APPALACHIA LLC	MARGARIA RAYMOND UNIT 3H	732213	742318	1044226/1043918	125-24451	Active	4	Northern-F	40.284956	-80.431400
RANGE RESOURCES APPALACHIA LLC	MARGARIA RAYMOND UNIT 4H	732213	742321	1043923	125-24452	Active	4	Northern-F	40.284958	-80.431294
RANGE RESOURCES APPALACHIA LLC	MENICHI UNIT 10H	737780	733263	1018615	125-24282	Active	4	Northern-F	40.304456	-80.327297
RANGE RESOURCES APPALACHIA LLC	MENICHI UNIT 2H	737780	733206	1018535	125-24283	Active	4	Northern-F	40.304381	-80.327408
RANGE RESOURCES APPALACHIA LLC	MENICHI UNIT 3H	737780	733232	1018563	125-24284	Active	4	Northern-F	40.304428	-80.327367
RANGE RESOURCES APPALACHIA LLC	MENICHI UNIT 5H	737780	733238	1018570	125-24279	Active	4	Northern-F	40.304517	-80.327286
RANGE RESOURCES APPALACHIA LLC	MENICHI UNIT 8H	737780	733252	1018603	125-24281	Active	4	Northern-F	40.304322	-80.327419
RANGE RESOURCES APPALACHIA LLC	MIDLER/FROEBE A UNIT 1H	758016	750623	1073600	125-24736	Active	4	Northern-F	40.296611	-80.411825

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	MIDLER/FROEBE A UNIT 2H	758016	750625	1073601	125-24737	Active	4	Northern-F	40.296656	-80.411733
RANGE RESOURCES APPALACHIA LLC	MIDLER/FROEBE A UNIT 3H	758016	749762	1071238	125-24689	Active	4	Northern-F	40.296519	-80.411747
RANGE RESOURCES APPALACHIA LLC	MIDLER/FROEBE A UNIT 4H	758016	749763	1071239	125-24690	Active	4	Northern-F	40.296564	-80.411656
RANGE RESOURCES APPALACHIA LLC	MIDLER/FROEBE B UNIT 5H	752758	745433	1050695/1076860/1076861	125-24545	Active	4	Northern-F	40.299369	-80.407500
RANGE RESOURCES APPALACHIA LLC	MIDLER/FROEBE B UNIT 6H	752758	745432	1050693	125-24546	Active	4	Northern-F	40.299342	-80.407361
RANGE RESOURCES APPALACHIA LLC	MIDLER/FROEBE B UNIT 7H	752758	748900	1065002	125-24670	Active	4	Northern-F	40.299183	-80.407411
RANGE RESOURCES APPALACHIA LLC	MIDLER/FROEBE B UNIT 8H	752758	745434	1050696	125-24547	Active	4	Northern-F	40.299261	-80.407386
RANGE RESOURCES APPALACHIA LLC	MILVET 1	681616	687626	934720	125-22507	Operator Reported Not Drilled	401	Northern-F	40.265884	-80.389529
RANGE RESOURCES APPALACHIA LLC	NISHNICK UNIT 2	685593	690525	940043	125-22620	Active	4	Northern-F	40.292356	-80.324388
RANGE RESOURCES APPALACHIA LLC	NISHNICK UNIT 3	685594	690526	940046	125-22621	Operator Reported Not Drilled	401	Northern-F	40.286412	-80.328388
RANGE RESOURCES APPALACHIA LLC	NISHNICK UNIT 4	688826	693054	944637	125-22746	Operator Reported Not Drilled	401	Northern-F	40.292690	-80.329499
RANGE RESOURCES APPALACHIA LLC	NISHNICK UNIT 4	686047	690905	940712	125-22640	Operator Reported Not Drilled	401	Northern-F	40.290578	-80.328666
RANGE RESOURCES APPALACHIA LLC	NISHNICK UNIT 5H	711890	711417	977593	125-23338	Operator Reported Not Drilled	401	Northern-F	40.284773	-80.324915

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	NISHNICK UNIT 6H	717523	728798	1010495	125-24059	Operator Reported Not Drilled	401	Northern-F	40.292206	-80.329953
RANGE RESOURCES APPALACHIA LLC	NISHNICK UNIT 6H	717523	716268	985789	125-23632	Operator Reported Not Drilled	401	Northern-F	40.292245	-80.329693
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 1	675146	682645	925807	125-22420	Inactive/Plugged Well	361	Northern-F	40.268051	-80.347638
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 10H	710286	718663	990057	125-23714	Operator Reported Not Drilled	401	Northern-F	40.277134	-80.349555
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 11H	710286	729940	1012417	125-24148	Active	4	Northern-F	40.277083	-80.349764
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 12H	710286	729951	1012435	125-24147	Active	4	Northern-F	40.277131	-80.349797
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 13H	710286	718661	990056	125-23715	Operator Reported Not Drilled	401	Northern-F	40.277194	-80.349833
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 14H	710286	729954	1012439	125-24146	Active	4	Northern-F	40.277047	-80.349697
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 15H	710286	729950	1012432	125-24149	Active	4	Northern-F	40.277181	-80.349831
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 16H	710286	729945	1012423	125-24144	Active	4	Northern-F	40.277033	-80.349731
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 2A	674954	682500	925581	125-22414	Inactive/Plugged Well	361	Northern-F	40.275134	-80.342944
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 3	674953	682497	925579	125-22415	Inactive/Plugged Well	361	Northern-F	40.276690	-80.354306
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 4	676263	683485	927319	125-22433	Inactive/Plugged Well	361	Northern-F	40.271218	-80.353500
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 6	680845	687068	933685	125-22495	Inactive/Plugged Well	361	Northern-F	40.274356	-80.348861

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 7	689161	693313	945108	125-22751	Operator Reported Not Drilled	401	Northern-F	40.271329	-80.347000
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 7	686900	691578	941943	125-22670	Operator Reported Not Drilled	401	Northern-F	40.271968	-80.345277
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 8	686902	691581	941947	125-22671	Operator Reported Not Drilled	401	Northern-F	40.277579	-80.346027
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 8H	710286	718671	990071	125-23716	Operator Reported Not Drilled	401	Northern-F	40.277245	-80.349638
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 8H	710286	729928	1012400	125-24145	Active	4	Northern-F	40.277228	-80.349864
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 8H	710286	710078	975141	125-23278	Operator Reported Not Drilled	401	Northern-F	40.277190	-80.349583
RANGE RESOURCES APPALACHIA LLC	OHIO VALLEY LBC UNIT 9	686699	691394	941659	125-22662	Operator Reported Not Drilled	401	Northern-F	40.279940	-80.351389
RANGE RESOURCES APPALACHIA LLC	ORTON 1	682436	688254	935869	125-22532	Active	4	Northern-F	40.270495	-80.339027
RANGE RESOURCES APPALACHIA LLC	ORTON 2	682439	688256	935870	125-22533	Active	4	Northern-F	40.270523	-80.332805
RANGE RESOURCES APPALACHIA LLC	ORTON 4	691945	695539	949401	125-22854	Operator Reported Not Drilled	401	Northern-F	40.266412	-80.339166
RANGE RESOURCES APPALACHIA LLC	ORTON 4	682444	688260	935874	125-22535	Operator Reported Not Drilled	401	Northern-F	40.265607	-80.340527
RANGE RESOURCES APPALACHIA LLC	ORTON 5	682449	688262	935878	125-22536	Inactive/Plugged Well	361	Northern-F	40.261190	-80.345278

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	ORTON 6	682453	688269	935890	125-22537	Active	4	Northern-F	40.260079	-80.338722
RANGE RESOURCES APPALACHIA LLC	ORTON 8H	712474	711888	978485	125-23357	Active	4	Northern-F	40.260051	-80.337499
RANGE RESOURCES APPALACHIA LLC	ORTON 9H	712474	711889	978486	125-23358	Active	4	Northern-F	40.260023	-80.337527
RANGE RESOURCES APPALACHIA LLC	POLLANA UNIT 1H	746684	750408	1073038	125-24715	Active	4	Northern-F	40.305250	-80.360975
RANGE RESOURCES APPALACHIA LLC	POLLANA UNIT 2H	746684	740398	1039667/1039779	125-24415	Active	4	Northern-F	40.305203	-80.360844
RANGE RESOURCES APPALACHIA LLC	POLLANA UNIT 3H	746684	750395	1073017	125-24711	Active	4	Northern-F	40.305325	-80.360925
RANGE RESOURCES APPALACHIA LLC	POLLANA UNIT 4H	746684	740402	1039683/1039778	125-24416	Active	4	Northern-F	40.305275	-80.360797
RANGE RESOURCES APPALACHIA LLC	POLLANA UNIT 5H	746684	750397	1073020	125-24712	Active	4	Northern-F	40.305397	-80.360878
RANGE RESOURCES APPALACHIA LLC	POLLANA UNIT 6H	746684	740406	1039697	125-24417	Active	4	Northern-F	40.305350	-80.360750
CHESAPEAKE APPALACHIA LLC	RAYMOND MARGARIA 1H	732213	728868	1010584	125-24072	Operator Reported Not Drilled	401	Northern-F	40.284944	-80.431611
CHESAPEAKE APPALACHIA LLC	RAYMOND MARGARIA 3H	732213	728876	1010594	125-24074	Operator Reported Not Drilled	401	Northern-F	40.284944	-80.431667
RANGE RESOURCES APPALACHIA LLC	ROMANETTI UNIT 7	686688	691383	941589	125-22659	Operator Reported Not Drilled	401	Northern-F	40.262440	-80.358528
RANGE RESOURCES APPALACHIA LLC	ROMANETTI UNIT 1	664792	675020	910396	125-22277	Inactive/Plugged Well	361	Northern-F	40.258773	-80.359889
RANGE RESOURCES APPALACHIA LLC	ROMANETTI UNIT 2	665394	675453	911374	125-22283	Inactive/Plugged Well	361	Northern-F	40.252329	-80.353278

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	ROMANETTI UNIT 3	676287	683503	927355	125-22435	Operator Reported Not Drilled	401	Northern-F	40.252107	-80.352611
RANGE RESOURCES APPALACHIA LLC	ROMANETTI UNIT 4	676261	683484	927318	125-22432	Operator Reported Not Drilled	401	Northern-F	40.257829	-80.352833
RANGE RESOURCES APPALACHIA LLC	ROMANETTI UNIT 4	679343	685807	931369	125-22453	Operator Reported Not Drilled	401	Northern-F	40.257523	-80.354778
RANGE RESOURCES APPALACHIA LLC	ROMANETTI UNIT 5	682617	688379	936058	125-22548	Inactive/Plugged Well	361	Northern-F	40.256194	-80.348444
RANGE RESOURCES APPALACHIA LLC	ROMANETTI UNIT 6	687098	691734	942250	125-22681	Operator Reported Not Drilled	401	Northern-F	40.254996	-80.357028
RANGE RESOURCES APPALACHIA LLC	RUKAVINA UNIT 1H	726803	724434	1002307	125-23925	Active	4	Northern-F	40.265528	-80.362750
RANGE RESOURCES APPALACHIA LLC	RUKAVINA UNIT 2H	726803	724481	1002376	125-23928	Active	4	Northern-F	40.265472	-80.362722
RANGE RESOURCES APPALACHIA LLC	RUKAVINA UNIT 3H	726803	724471	1002359	125-23929	Active	4	Northern-F	40.265333	-80.362611
RANGE RESOURCES APPALACHIA LLC	RUKAVINA UNIT 4H	726803	724479	1002374	125-23930	Active	4	Northern-F	40.265444	-80.362694
RANGE RESOURCES APPALACHIA LLC	RUKAVINA UNIT 5H	726803	724472	1002360	125-23931	Active	4	Northern-F	40.265389	-80.362667
RANGE RESOURCES APPALACHIA LLC	STEWART NANCY UNIT 1	685591	690523	940042	125-22619	Active	4	Northern-F	40.284884	-80.351527
RANGE RESOURCES APPALACHIA LLC	STEWART NANCY UNIT 10	686784	691472	941756	125-22665	Operator Reported Not Drilled	401	Northern-F	40.290662	-80.357528
RANGE RESOURCES APPALACHIA LLC	STEWART NANCY UNIT 2	686689	691384	941599	125-22660	Operator Reported Not Drilled	401	Northern-F	40.290940	-80.352889

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	STEWART NANCY UNIT 3	686690	691386	941606	125-22661	Operator Reported Not Drilled	401	Northern-F	40.287634	-80.354889
RANGE RESOURCES APPALACHIA LLC	STEWART NANCY UNIT 4	686049	690907	940713	125-22641	Active	4	Northern-F	40.284690	-80.346527
RANGE RESOURCES APPALACHIA LLC	STEWART NANCY UNIT 5	687097	691732	942248	125-22680	Operator Reported Not Drilled	401	Northern-F	40.287745	-80.350027
RANGE RESOURCES APPALACHIA LLC	STEWART NANCY UNIT 6	687241	691833	942418	125-22688	Active	4	Northern-F	40.283301	-80.343305
RANGE RESOURCES APPALACHIA LLC	STEWART NANCY UNIT 7	686904	691583	941949	125-22672	Operator Reported Not Drilled	401	Northern-F	40.287106	-80.341416
RANGE RESOURCES APPALACHIA LLC	STEWART NANCY UNIT 8	686899	691577	941942	125-22669	Active	4	Northern-F	40.288273	-80.345444
RANGE RESOURCES APPALACHIA LLC	STEWART NANCY UNIT 9	687242	691834	942419	125-22689	Operator Reported Not Drilled	401	Northern-F	40.294495	-80.357833
EQUITABLE RESOURCES EXPLORATION	W KENNETH SMITH 510	230506	232483	188876	125-20109	Inactive/Plugged Well	361	Northern-F	40.279222	-80.387389
EQT PRODUCTION CO	A BURNS 779	229460	231437	187830	125-01031	Active	4	Southern	40.0665	-80.199861
PRESTON OIL CO	A O VANKIRK 761	230573	232550	188943	125-20668	Inactive/Plugged Well	361	Southern	40.11673	-80.230572
PRESTON OIL CO	A O VANKIRK 789	230574	232551	188944	125-20669	Inactive/Plugged Well	361	Southern	40.11503	-80.232903
PRESTON OIL CO	A O VANKIRK 797	230577	232554	188947	125-20672	Inactive/Plugged Well	361	Southern	40.11528	-80.231031
PRESTON OIL CO	A O VANKIRK 800	230580	232557	188950	125-20692	Inactive/Plugged Well	361	Southern	40.11393	-80.234814
PRESTON OIL CO	A O VANKIRK U790	230586	232563	188956	125-20705	Inactive/Plugged Well	361	Southern	40.10971	-80.235472

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
PRESTON OIL CO	A O VANKIRK U799	230587	232564	188957	125-20706	Inactive/Plugged Well	361	Southern	40.11185	-80.236183
PRESTON OIL CO	A O VANKIRK U810	230588	232565	188958	125-20707	Inactive/Plugged Well	361	Southern	40.11097	-80.234072
CARNEGIE NATURAL GAS CO	ADDISON HUPP 682	228934	230911	187304	125-00281	Inactive/Plugged Well	361	Southern	40.06487	-80.217786
CARNEGIE NATURAL GAS CO	ANNA M HALLAM 652	228838	230815	187208	125-00077	Inactive/Plugged Well	361	Southern	40.05432	-80.234886
T & F EXPLORATION LP	BAKER 1	713556	712797	980074	125-23403	Active	4	Southern	40.07721	-80.216285
T & F EXPLORATION LP	BAKER 2	713551	712792	980061	125-23402	Active	4	Southern	40.08033	-80.218871
RANGE RESOURCES APPALACHIA LLC	BAKER R&M 1A	714826	713893	981907	125-23471	Plugged Well	361	Southern	40.0803	-80.222329
RANGE RESOURCES APPALACHIA LLC	BASH-SALTZER UNIT 1H	765526	768682	1115207	125-27106	Active	4	Southern	40.13397	-80.240342
RANGE RESOURCES APPALACHIA LLC	BEDILLION-DAY UNIT 1H	704393	705320	967102	125-23152	Proposed But Never Materialized	401	Southern	40.11666	-80.228135
RANGE RESOURCES APPALACHIA LLC	BEDILLION-DAY UNIT 1H	704396	716014	985344	125-23609	Active	4	Southern	40.11666	-80.228135
RANGE RESOURCES APPALACHIA LLC	BEDILLION-DAY UNIT 2H	704396	705322	967104	125-23153	Active	4	Southern	40.11672	-80.228135
RANGE RESOURCES APPALACHIA LLC	BEDILLION-DAY UNIT 4H	704396	705399	967227	125-23156	Active	4	Southern	40.11675	-80.228135
RANGE RESOURCES APPALACHIA LLC	BEDILLION-DAY UNIT 5H	704396	722947	999093	125-23843	Operator Reported Not Drilled	401	Southern	40.11697	-80.228361
RANGE RESOURCES APPALACHIA LLC	BEDILLION-DAY UNIT 6H	704396	722946	999077	125-23844	Operator Reported Not Drilled	401	Southern	40.11692	-80.228306

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	BEDILLION-DAY UNIT 7H	704396	722945	999074	125-23845	Operator Reported Not Drilled	401	Southern	40.11692	-80.228361
RANGE RESOURCES APPALACHIA LLC	BEDILLION-DAY UNIT 8H	704396	722944	999073	125-23842	Operator Reported Not Drilled	401	Southern	40.11697	-80.228333
AMWELL ENTERPRISES INC	BLACKERT 1	697023	699405	956751	125-22982	Active	4	Southern	40.07291	-80.211024
CNX GAS CO LLC	BURT NV11	720688	719110	990916	125-23758	Operator Reported Not Drilled	401	Southern	40.12976	-80.204629
EQT PRODUCTION CO	C B FRAZEE 636	229450	231427	187820	125-01021	Active	4	Southern	40.05803	-80.209444
RICE DRILLING B LLC	CAPTAIN PLANET 1H	743245	737643	1033356	125-24366	Active	4	Southern	40.07752	-80.184042
RICE DRILLING B LLC	CAPTAIN PLANET 2H	743245	743385	1046428	125-24489	Operator Reported Not Drilled	401	Southern	40.07746	-80.184022
RICE DRILLING B LLC	CAPTAIN PLANET 3H	743245	743388	1046436	125-24490	Operator Reported Not Drilled	401	Southern	40.07741	-80.184
RICE DRILLING B LLC	CAPTAIN PLANET 4H	743245	743593	1046788	125-24494	Active	4	Southern	40.07736	-80.183981
RICE DRILLING B LLC	CAPTAIN PLANET G1	743245	746707	1060122	125-24611	Operator Reported Not Drilled	401	Southern	40.07747	-80.184097
RICE DRILLING B LLC	CAPTAIN PLANET G2	743245	746708	1060125	125-24612	Operator Reported Not Drilled	401	Southern	40.07742	-80.184075
RICE DRILLING B LLC	CAPTAIN PLANET G3	743245	744924	1049714 & 1049715	125-24525	Operator Reported Not Drilled	401	Southern	40.07737	-80.18405

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
CNX GAS CO LLC	COLLINS NV31	721738	720057	992978	125-23790	Operator Reported Not Drilled	401	Southern	40.08856	-80.198567
CNX GAS CO LLC	COLLINS NV31	718827	717427	987795	125-23694	Operator Reported Not Drilled	401	Southern	40.08847	-80.199973
CNX GAS CO LLC	CONRHEIN NV35	707126	707468	970761	125-23207	Active	4	Southern	40.08749	-80.260367
CNX GAS CO LLC	CONSOL NV36	708159	708298	972220	125-23236	Active	4	Southern	40.09936	-80.269725
CNX GAS CO LLC	CONSOL NV42	708194	708327	972256	125-23235	Active	4	Southern	40.07723	-80.259597
CNX GAS CO LLC	CONSOL NV43	708165	708303	972226	125-23237	Active	4	Southern	40.07672	-80.257547
RANGE RESOURCES APPALACHIA LLC	DAY L & L UNIT 1H	731848	731116	1014677	125-24207	Active	4	Southern	40.07581	-80.2457
RANGE RESOURCES APPALACHIA LLC	DAY L & L UNIT 3H	731848	730634	1013743	125-24175	Active	4	Southern	40.07577	-80.245747
RANGE RESOURCES APPALACHIA LLC	DAY L&L UNIT 2H	731848	728559	1010137	125-24046	Active	4	Southern	40.07586	-80.245667
RANGE RESOURCES APPALACHIA LLC	DAY L&L UNIT 4H	731848	728568	1010147	125-24045	Active	4	Southern	40.07589	-80.245611
CNX GAS CO LLC	DAY NV17	716063	714959	983680	125-23547	Operator Reported Not Drilled	401	Southern	40.1168	-80.222277
CNX GAS CO LLC	DAY NV17	732257	728912	1010668	125-24085	Proposed But Never Materialized	6	Southern	40.11668	-80.222503
CNX GAS CO LLC	DAY NV21	716095	714988	983739	125-23548	Operator Reported Not Drilled	401	Southern	40.11596	-80.221068

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
CNX GAS CO LLC	DAY NV21	732293	728952	1010726	125-24086	Proposed But Never Materialized	6	Southern	40.11594	-80.221294
RANGE RESOURCES APPALACHIA LLC	DAY UNIT 1H	705981	706608	969156 & 1059522	125-23185	Active	4	Southern	40.12261	-80.216111
RANGE RESOURCES APPALACHIA LLC	DAY UNIT 1H	699870	701633	960538	125-23038	Operator Reported Not Drilled	401	Southern	40.11433	-80.213051
RANGE RESOURCES APPALACHIA LLC	DAY UNIT 2H	705981	707386	970629 & 1059524	125-23205	Active	4	Southern	40.12264	-80.216083
RANGE RESOURCES APPALACHIA LLC	DAY UNIT 2H	699871	701634	960539	125-23039	Operator Reported Not Drilled	401	Southern	40.11919	-80.212579
RANGE RESOURCES APPALACHIA LLC	DAY UNIT 3H	705981	720391	993654	125-23796	Active	4	Southern	40.12272	-80.215917
RANGE RESOURCES APPALACHIA LLC	DAY UNIT 4H	705981	722343	997853	125-23828	Active	4	Southern	40.12275	-80.215917
RANGE RESOURCES APPALACHIA LLC	DAY UNIT 5H	705981	720390	993653	125-23795	Active	4	Southern	40.12269	-80.215944
RANGE RESOURCES APPALACHIA LLC	DAY UNIT 6H	705981	722333	997836	125-23829	Active	4	Southern	40.12267	-80.216028
RANGE RESOURCES APPALACHIA LLC	DAY UNIT 7H-A	705981	720388	993651	125-23794	Active	4	Southern	40.12264	-80.216
RANGE RESOURCES APPALACHIA LLC	DAY UNIT 8H	705981	720392	993655	125-23797	Active	4	Southern	40.12269	-80.215972
PHILIP R & ROBERT GENE CONKLIN	DEBLASIO 1	230374	232351	188744	125-01947	Inactive/DEP Plugged	522	Southern	40.09291	-80.278378
CNX GAS CO LLC	ECKELS NV44	720694	719114	990924	125-23756	Operator Reported Not Drilled	401	Southern	40.07463	-80.2314
CNX GAS CO LLC	EIGHTY FOUR MINING COMPANY NV20	735447	731471	1015426	125-24218	Proposed But Never Materialized	6	Southern	40.10723	-80.198703

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
CNX GAS CO LLC	EIGHTY-FOUR NV20	714690	713778	981748	125-23462	Proposed But Never Materialized	401	Southern	40.10726	-80.198476
EQT PRODUCTION CO	F I MONINGER 590034	706137	706740	969410	125-23192	Active	4	Southern	40.07269	-80.197551
EQT PRODUCTION CO	F I MONINGER 772	229459	231436	187829	125-01030	Active	4	Southern	40.07197	-80.198556
EQT PRODUCTION CO	F WILEY 556	229446	231423	187816	125-01017	Active	4	Southern	40.05636	-80.207194
RANGE RESOURCES APPALACHIA LLC	FARABEE MATTHEW UNIT 1H	734028	730389	1013284	125-24165	Active	4	Southern	40.06336	-80.204303
RANGE RESOURCES APPALACHIA LLC	FARABEE MATTHEW UNIT 2H	734028	730391	1013289	125-24164	Active	4	Southern	40.06334	-80.204236
PHILIP R & ROBERT GENE CONKLIN	FARRABEE 13	230372	232349	188742	125-01945	Abandoned/DEP Orphan List	521	Southern	40.13279	-80.215262
PHILIP R & ROBERT GENE CONKLIN	FARRABEE 2	230371	232348	188741	125-01944	Abandoned/DEP Orphan List	521	Southern	40.13334	-80.215798
RANGE RESOURCES APPALACHIA LLC	FOLLY HOLLOW FARM UNIT 1H	738059	733469	1018943	125-24286	Operator Reported Not Drilled	401	Southern	40.11371	-80.267822
RANGE RESOURCES APPALACHIA LLC	FOLLY HOLLOW FARM UNIT 2H	738059	733627	1019168	125-24287	Operator Reported Not Drilled	401	Southern	40.11375	-80.267767
RANGE RESOURCES APPALACHIA LLC	FOLLY HOLLOW FARM UNIT 3H	738059	740204	1039231 & 1050692	125-24409	Active	4	Southern	40.11379	-80.267758
RANGE RESOURCES APPALACHIA LLC	FOLLY HOLLOW FARM UNIT 4H	738059	740212	1039245 & 1050690	125-24410	Active	4	Southern	40.11384	-80.267675
RANGE RESOURCES APPALACHIA LLC	FOLLY HOLLOW FARM UNIT 6H	738059	740215	1050689 & 1039248	125-24411	Active	4	Southern	40.11392	-80.267761
RANGE RESOURCES APPALACHIA LLC	FOLLY HOLLOW FARM UNIT 8H	746489	740222	1061407 & 1050688	125-24412	Active	4	Southern	40.09721	-80.267847

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	FOLLY HOLLOW FARM UNIT 9H	738059	740232	1063302 & 1050686	125-24413	Proposed But Never Materialized	4	Southern	40.11379	-80.267994
CNX GAS CO LLC	FOLLY NV27	731630	728384	1009823	125-24037	Active	4	Southern	40.1046	-80.271011
CNX GAS CO LLC	FOLLY NV27	715843	714786	983416	125-23528	Operator Reported Not Drilled	401	Southern	40.10463	-80.270786
CNX GAS CO LLC	FOLLY NV28	715851	714796	983431	125-23527	Operator Reported Not Drilled	401	Southern	40.10638	-80.257175
CNX GAS CO LLC	FOLLY NV28	732088	728756	1010436	125-24052	Proposed But Never Materialized	6	Southern	40.10636	-80.2574
EQT PRODUCTION CO	G B SARGENT 723	229456	231433	187826	125-01027	Active	4	Southern	40.07536	-80.203806
EIGHTY FOUR MINING CO	G F AND N K TIBBENS 5051	663779	674267	908997	125-22272	Inactive/Plugged Well	361	Southern	40.10934	-80.188323
EQT PRODUCTION CO	G I GLOSSER 743	229457	231434	187827	125-01028	Active	4	Southern	40.08056	-80.207528
LEATHERWOOD INC	G L WALKER (FMLY NASER ROY AND BETTY) 1	465863	495090	373602	125-01986	Active	4	Southern	40.12294	-80.227333
DUNN MAR OIL & GAS CO	G L WALKER 5	228880	230857	187250	125-00171	Inactive/Plugged Well	361	Southern	40.12088	-80.228119
CARNEGIE NATURAL GAS CO	GEORGE C POWELL & AGNES Y POWELL 1008	229022	230999	187392	125-00440	Inactive/Plugged Well	361	Southern	40.08892	-80.193575
Unavailable	GRAY 1	230320	232297	188690	125-01893	Inactive/DEP Plugged	522	Southern	40.11734	-80.262472
CNX GAS CO LLC	GUY NV25	723781	721800	996752	125-23826	Operator Reported Not Drilled	401	Southern	40.12118	-80.269231

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	HAINES GAYLORD UNIT 1H	738844	751330	1075399	125-24763	Operator Reported Not Drilled	401	Southern	40.05925	-80.255833
RANGE RESOURCES APPALACHIA LLC	HAINES GAYLORD UNIT 2H	738844	751331	1075400	125-24764	Operator Reported Not Drilled	401	Southern	40.05936	-80.255864
RANGE RESOURCES APPALACHIA LLC	HAINES GAYLORD UNIT 2H	738844	739339	1037038	125-24392	Operator Reported Not Drilled	401	Southern	40.05936	-80.255864
RANGE RESOURCES APPALACHIA LLC	HAINES GAYLORD UNIT 3H	738844	751333	1075405 & 1075403	125-24765	Operator Reported Not Drilled	401	Southern	40.05938	-80.255758
RANGE RESOURCES APPALACHIA LLC	HAINES GAYLORD UNIT 3H	738844	739343	1037042	125-24393	Operator Reported Not Drilled	401	Southern	40.05938	-80.255758
RANGE RESOURCES APPALACHIA LLC	HAINES GAYLORD UNIT 3H	738844	734078	1020122	125-24294	Operator Reported Not Drilled	401	Southern	40.05935	-80.255669
RANGE RESOURCES APPALACHIA LLC	HAINES GAYLORD UNIT 4H	738844	734083	1020128	125-24295	Proposed But Never Materialized	401	Southern	40.05934	-80.2556
RANGE RESOURCES APPALACHIA LLC	HAINES GAYLORD UNIT 4H	738844	751339	1075413	125-24766	Proposed But Never Materialized	401	Southern	40.05939	-80.255653
RANGE RESOURCES APPALACHIA LLC	HAINES GAYLORD UNIT 4H	738844	739345	1037046	125-24394	Proposed But Never Materialized	401	Southern	40.05939	-80.255653
RANGE RESOURCES APPALACHIA LLC	HAINES GAYLORD UNIT 5H	738844	734089	1020141	125-24296	Proposed But Never Materialized	401	Southern	40.05933	-80.255531
RANGE RESOURCES APPALACHIA LLC	HAINES GAYLORD UNIT 5H	738844	740882	1040708 & 1042059	125-24428	Proposed But Never Materialized	401	Southern	40.05929	-80.255622

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	HAINES GAYLORD UNIT 5H	738844	751366	1075492	125-24767	Proposed But Never Materialized	401	Southern	40.05929	-80.255622
RANGE RESOURCES APPALACHIA LLC	HAINES GAYLORD UNIT 6H	738844	735195	1022311	125-24321	Proposed But Never Materialized	6	Southern	40.0593	-80.255539
CNX GAS CO LLC	HAINES NV51	712512	711921	978536	125-23354	Active	4	Southern	40.05986	-80.256436
CNX GAS CO LLC	HARTLEY NV33	711452	711068	976953	125-23324	Regulatory Inactive Status	523	Southern	40.07754	-80.214054
LEATHERWOOD INC	HAZLETT 1	229801	231778	188171	125-01373	Active	4	Southern	40.12778	-80.220361
LEATHERWOOD INC	HAZLETT 2	229802	231779	188172	125-01374	Active	4	Southern	40.12664	-80.222833
CNX GAS CO LLC	HORENCY NV16	721736	720056	992976	125-23788	Operator Reported Not Drilled	401	Southern	40.12216	-80.240283
RICE DRILLING B LLC	HULK 1H	734164	731322	1015103	125-24214	Active	4	Southern	40.08831	-80.185894
RICE DRILLING B LLC	HULK 1V	734164	731134	1014720	125-24210	Regulatory Inactive Status	523	Southern	40.08811	-80.186139
RICE DRILLING B LLC	HULK 2H	734164	731323	1015107	125-24212	Active	4	Southern	40.08824	-80.185858
RICE DRILLING B LLC	HULK 3H	734164	744363	1048259	125-24509	Operator Reported Not Drilled	401	Southern	40.08826	-80.185953
RICE DRILLING B LLC	HULK 3H	734164	731325	1015109	125-24213	Operator Reported Not Drilled	401	Southern	40.08826	-80.185953
RICE DRILLING B LLC	HULK 4H	734164	743613	1046836	125-24495	Operator Reported Not Drilled	401	Southern	40.0882	-80.185903

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RICE DRILLING B LLC	HULK 4H	734164	762115	1100432	125-26985	Active	4	Southern	40.08841	-80.185667
RICE DRILLING B LLC	HULK 5H	734164	748879	1064965	125-24667	Operator Reported Not Drilled	401	Southern	40.08822	-80.186
RICE DRILLING B LLC	HULK 6H	734164	762116	1100435	125-26986	Active	4	Southern	40.08849	-80.185572
RICE DRILLING B LLC	HULK 7H	734164	748888	1064986	125-24668	Operator Reported Not Drilled	401	Southern	40.08812	-80.186
RICE DRILLING B LLC	HULK 8H	734164	762118	1100436	125-26987	Active	4	Southern	40.08853	-80.185525
RICE DRILLING B LLC	HULK 9H	734164	748890	1064990	125-24669	Operator Reported Not Drilled	401	Southern	40.08852	-80.185658
RICE DRILLING B LLC	HULK G1	734164	747693	1062419	125-24634	Operator Reported Not Drilled	401	Southern	40.08848	-80.185706
RICE DRILLING B LLC	HULK G3	734164	747695	1062428	125-24635	Operator Reported Not Drilled	401	Southern	40.08844	-80.185753
RICE DRILLING B LLC	HULK G4	734164	747697	1062430	125-24636	Operator Reported Not Drilled	401	Southern	40.08816	-80.185953
RICE DRILLING B LLC	HULK G5	734164	747699	1062435	125-24637	Operator Reported Not Drilled	401	Southern	40.08839	-80.1858
CNX GAS CO LLC	HUTCHINSON NV50	732075	728746	1010422	125-24053	Operator Reported Not Drilled	401	Southern	40.05457	-80.236961
CNX GAS CO LLC	HUTCHINSON NV50	716079	714974	983718	125-23544	Operator Reported Not Drilled	401	Southern	40.0546	-80.236736

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
LEATHERWOOD INC	IAMS FMLY 1 KENNETH MANKEY 10	230370	232347	188740	125-01943	Inactive/DEP Plugged	522	Southern	40.09291	-80.278378
EQT PRODUCTION CO	J C BAYNE 665	229452	231429	187822	125-01023	Active	4	Southern	40.06119	-80.224528
LEATHERWOOD INC	J C CRAFT 603510	229770	231747	188140	125-01341	Active	4	Southern	40.13343	-80.227444
EQT PRODUCTION CO	J D BEDDOW 590033	717108	715890	985127	125-23600	Proposed But Never Materialized	6	Southern	40.06794	-80.193467
EQT PRODUCTION CO	J D BEDDOW 590035	713375	712607	979643	125-23396	Proposed But Never Materialized	6	Southern	40.06928	-80.198995
CARNEGIE NATURAL GAS CO	J L PHILLIPS 2	228894	230871	187264	125-00196	Inactive/Plugged Well	361	Southern	40.06547	-80.192675
EIGHTY FOUR MINING CO	J W MONINGER 4079	653432	666251	892439	125-22208	Inactive/Plugged Well	361	Southern	40.11225	-80.18255
EQT PRODUCTION CO	JAMES COX 543	229445	231422	187815	125-01016	Active	4	Southern	40.05213	-80.208881
PETROTHERM IND CORP	JAMES WAYNE (DUANE) HINERMAN 1	230547	232524	188917	125-20150	Active	4	Southern	40.11008	-80.244611
MANUFACTURERS LIGHT & HEAT CO	JESSE MCAFEE 3409	228991	230968	187361	125-00382	Inactive/Plugged Well	361	Southern	40.11218	-80.186506
COLUMBIA GAS TRANS LLC	JESSE MCATEE 2	669271	678210	916955	125-02140	Abandoned/DEP Abandoned List	524	Southern	40.11196	-80.186123
DEVON PETRO CORP	JESSE MCATTEE 1	669206	678190	916931	125-02139	Active	4	Southern	40.11362	-80.187553
DUNN MAR OIL & GAS CO	JOHN HUPP 1	228882	230859	187252	125-00182	Inactive/Plugged Well	361	Southern	40.06821	-80.2178
ONEXXX PROD & EXPLORATION CORP	KENIMOND #2 W-87	230177	232154	188547	125-01750	Active	4	Southern	40.0735	-80.207583
EIGHTY FOUR MINING CO	KENNETH E & ARMANDA E HULL 4076	618554	639177	774401	125-22089	Inactive/Plugged Well	361	Southern	40.11764	-80.183078

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
PRESTON OIL CO	L SNYDER U443	229064	231041	187434	125-00580	Inactive/Plugged Well	361	Southern	40.13348	-80.242539
CNX GAS CO LLC	LEECH NV45	718329	716994	987077	125-23670	Operator Reported Not Drilled	401	Southern	40.06797	-80.222794
EIGHTY FOUR MINING CO	LEWIS ARMSTRONG 4082	688296	692624	943861	125-22734	Inactive/Plugged Well	361	Southern	40.10996	-80.182586
UNKNOWN OPR	M & H ONAPIUK 5252	712295	711740	978216	125-02225	Abandoned	525	Southern	40.1028	-80.181156
COLUMBIA GAS TRANS LLC	M F WHITEHILL 4	693636	696848	951579	125-02160	Active	4	Southern	40.10701	-80.190442
DUNN MAR OIL & GAS CO	M M HUPP & PEARL HUPP 1	230434	232411	188804	125-20037	Inactive/Plugged Well	361	Southern	40.06817	-80.219658
LEATHERWOOD INC	MANKEY (FMLY ERNEST ALEXAS) 1	484354	513140	392861	125-01994	Inactive/DEP Plugged	522	Southern	40.08577	-80.255628
EQUITABLE RESOURCES EXPLORATION	MARION C JOHNSON 769	229074	231051	187444	125-00619	Inactive/Plugged Well	361	Southern	40.11751	-80.228508
DJW ENTERPRISES INC	MARY J SIMS 1	230660	232637	189030	125-20942	Active	4	Southern	40.09056	-80.180806
DJW ENTERPRISES INC	MARY JANE SIMS 2	230719	232696	189089	125-21067	Active	4	Southern	40.09514	-80.185264
DJW ENTERPRISES INC	MERLE & ANNABELLE HULL 1	230713	232690	189083	125-21061	Active	4	Southern	40.11356	-80.187861
RICE DRILLING B LLC	MOJO 1H	738553	745401	1050634	125-24542	Active	4	Southern	40.08853	-80.212194
RICE DRILLING B LLC	MOJO 2H-A	738553	736611	1078498	125-24348	Active	4	Southern	40.08875	-80.212667
RICE DRILLING B LLC	MOJO 3H	738553	745633	1051011	125-24565	Active	4	Southern	40.08878	-80.212725
RICE DRILLING B LLC	MOJO 4H	738553	745631	1051009	125-24566	Active	4	Southern	40.08881	-80.212786

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RICE DRILLING B LLC	MOJO G2	738553	747479	1061785	125-24629	Operator Reported Not Drilled	401	Southern	40.08863	-80.212425
RICE DRILLING B LLC	MOJO G3	738553	747477	1061781	125-24630	Operator Reported Not Drilled	401	Southern	40.08866	-80.212486
RICE DRILLING B LLC	MOJO G4	738553	747475	1061776	125-24631	Active	4	Southern	40.08869	-80.212544
RICE DRILLING B LLC	MOJO IV	738553	733855	1019689	125-24289	Active/Regulatory Inactive Status	523	Southern	40.08847	-80.2125
UNKNOWN OPR	MOWL 1	553386	569821	565912	125-02058	Inactive/DEP Plugged	522	Southern	40.11748	-80.195948
EQT PRODUCTION CO	N MCCOLLOUGH 615	229449	231426	187819	125-01020	Active	4	Southern	40.06711	-80.197472
ELMS BROS & CO LTD	NO NAME OG WELL	230052	232029	188422	125-01624	Active	4	Southern	40.06258	-80.214472
DJW ENTERPRISES INC	PEARL MILES 1	230711	232688	189081	125-21059	Active	4	Southern	40.10278	-80.181361
RANGE RESOURCES APPALACHIA LLC	PHELAN UNIT 10H	737718	733150	1018464	125-24273	Inactive/Plugged Well	361	Southern	40.09084	-80.245631
RANGE RESOURCES APPALACHIA LLC	PHELAN UNIT 1H	720356	718802	990429	125-23729	Operator Reported Not Drilled	401	Southern	40.08964	-80.24333
RANGE RESOURCES APPALACHIA LLC	PHELAN UNIT 2H	720356	719774	992408	125-23784	Operator Reported Not Drilled	401	Southern	40.08958	-80.2435
RANGE RESOURCES APPALACHIA LLC	PHELAN UNIT 4H	737730	733157	1018471 & 1059580	125-24274	Active	4	Southern	40.09088	-80.245839
RANGE RESOURCES APPALACHIA LLC	PHELAN UNIT 5H	737718	733156	1018469	125-24275	Operator Reported Not Drilled	401	Southern	40.09102	-80.246253
RANGE RESOURCES APPALACHIA LLC	PHELAN UNIT 6H	737718	733154	1018468	125-24276	Inactive/Plugged Well	361	Southern	40.09085	-80.2457

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	PHELAN UNIT 7H	737718	733151	1018465	125-24272	Operator Reported Not Drilled	401	Southern	40.09081	-80.245639
RANGE RESOURCES APPALACHIA LLC	PHELAN UNIT 7H	737718	734178	1020330	125-24298	Inactive/Plugged Well	361	Southern	40.09081	-80.245639
LEATHERWOOD INC	PIEDMONT 4	687630	692163	942932	125-02157	Active	4	Southern	40.08254	-80.262065
CNX GAS CO LLC	POST NV15	720335	718790	990386	125-23725	Operator Reported Not Drilled	401	Southern	40.12736	-80.253217
CNX GAS CO LLC	RESERVE NV22	718464	717105	987276	125-23675	Active	4	Southern	40.1037	-80.235769
CNX GAS CO LLC	RESERVE NV30	718463	717104	1036568 & 987274 & 1036567 & 1036569 & 1036566	125-23674	Operator Reported Not Drilled	401	Southern	40.10306	-80.234631
EQT PRODUCTION CO	S DEUNN 528	229444	231421	187814	125-01015	Active	4	Southern	40.05159	-80.211
EQT PRODUCTION CO	S E REESE 1007	229470	231447	187840	125-01041	Active	4	Southern	40.08175	-80.202661
EQT PRODUCTION CO	S E REESE 1009	229471	231448	187841	125-01042	Active	4	Southern	40.08368	-80.18775
EQT PRODUCTION CO	S E REESE 787	229461	231438	187831	125-01032	Active	4	Southern	40.08664	-80.190417
EQT PRODUCTION CO	S G MCCOLLOUGH 577	229448	231425	187818	125-01019	Active	4	Southern	40.06328	-80.201253
CNX GAS CO LLC	SEIRSDALE NV34	720501	718934	990620	125-23737	Operator Reported Not Drilled	401	Southern	40.08504	-80.223383

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
CNX GAS CO LLC	SHANKS NV12	716068	714963	983690	125-23545	Operator Reported Not Drilled	401	Southern	40.12687	-80.213015
CNX GAS CO LLC	SHANKS NV12	731628	728378	1009813	125-24038	Active	4	Southern	40.12685	-80.213242
CNX GAS CO LLC	SHANKS NV18	732261	728918	1010675	125-24084	Active	4	Southern	40.12606	-80.212122
CNX GAS CO LLC	SHANKS NV18	715846	714790	983423	125-23526	Operator Reported Not Drilled	401	Southern	40.12609	-80.211896
CNX GAS CO LLC	SHRADER NV52	715962	714887	983566	125-23536	Operator Reported Not Drilled	401	Southern	40.06505	-80.263748
CNX GAS CO LLC	SHRADER NV52	732263	728920	1010677	125-24081	Operator Reported Not Drilled	401	Southern	40.06502	-80.263972
RANGE RESOURCES APPALACHIA LLC	SIERZEGA UNIT 11H	725270	725419	1004138	125-23958	Active	4	Southern	40.07847	-80.224472
RANGE RESOURCES APPALACHIA LLC	SIERZEGA UNIT 12H	725270	725432	1004154	125-23959	Active	4	Southern	40.07844	-80.224444
RANGE RESOURCES APPALACHIA LLC	SIERZEGA UNIT 13H	725270	725444	1004169	125-23960	Plugged Well	361	Southern	40.0785	-80.224389
RANGE RESOURCES APPALACHIA LLC	SIERZEGA UNIT 14H	725270	725421	1004140	125-23961	Plugged Well	361	Southern	40.07853	-80.224417
RANGE RESOURCES APPALACHIA LLC	SIERZEGA UNIT 2H	725270	723203	999708	125-23852	Active	4	Southern	40.07839	-80.224583
RANGE RESOURCES APPALACHIA LLC	SIERZEGA UNIT 3H	725270	723209	999721	125-23851	Active	4	Southern	40.07836	-80.224556
RANGE RESOURCES APPALACHIA LLC	SIERZEGA UNIT 4H	725270	723208	999715	125-23850	Plugged Well	361	Southern	40.07839	-80.224528
RANGE RESOURCES APPALACHIA LLC	SIERZEGA UNIT 5H	725270	723206	999712	125-23849	Active	4	Southern	40.07842	-80.224556

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	SIERZEGA UNIT 6H	725270	727994	1009089	125-24024	Active	4	Southern	40.07853	-80.224333
RANGE RESOURCES APPALACHIA LLC	SIERZEGA UNIT 7H	725270	728011	1009112	125-24023	Active	4	Southern	40.07856	-80.224361
RANGE RESOURCES APPALACHIA LLC	SIERZEGA UNIT 8H	725270	724829	1003026	125-23937	Active	4	Southern	40.07825	-80.22475
RANGE RESOURCES APPALACHIA LLC	SIERZEGA UNIT 9H	725270	724841	1003045	125-23938	Active	4	Southern	40.07831	-80.224694
EIGHTY FOUR MINING CO	SOL MILES 1 5065	680227	686469	932731	125-22476	Inactive/Plugged Well	361	Southern	40.10489	-80.185714
CNX GAS CO LLC	SPINNENWEBER NV49	715143	714176	982420	125-23488	Operator Reported Not Drilled	401	Southern	40.05212	-80.22663
CNX GAS CO LLC	SPINNENWEBER NV49	732259	728916	1010673	125-24083	Operator Reported Not Drilled	401	Southern	40.05209	-80.226856
CNX GAS CO LLC	STEIN NV41	719184	717733	988316	125-23698	Proposed But Never Materialized	401	Southern	40.08362	-80.275037
EQT PRODUCTION CO	T J HORN 902	229465	231442	187835	125-01036	Active	4	Southern	40.07397	-80.200164
PRESTON OIL CO	T M BEBOUT 768	230575	232552	188945	125-20670	Inactive/Plugged Well	361	Southern	40.11825	-80.231408
BETTY & THOMAS MCCOMBS	THOMAS & BETTY MCCOMBS 1	662224	673066	906872	125-02134	Active	4	Southern	40.11432	-80.185752
BETTY & THOMAS MCCOMBS	THOMAS & BETTY MCCOMBS 2	662226	674041	908580	125-02135	Active	4	Southern	40.11114	-80.186972
PHILIP R & ROBERT GENE CONKLIN	TREXEL/MENTZER 11	230373	232350	188743	125-01946	Abandoned/DEP Orphan List	521	Southern	40.13114	-80.219376
CARNEGIE NATURAL GAS CO	W C & A H HORN 923	228893	230870	187263	125-00195	Inactive/Plugged Well	361	Southern	40.07568	-80.212867
EQT PRODUCTION CO	W C HORN 901	229464	231441	187834	125-01035	Active	4	Southern	40.08017	-80.209964

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
EQT PRODUCTION CO	W S BOOTHE 759	229458	231435	187828	125-01029	Active	4	Southern	40.07714	-80.203806
PETROTHERM IND CORP	W T ZIMMERMAN-NOW R VANCE ANDREW ET 2	230540	232517	188910	125-20143	Inactive/Plugged Well	361	Southern	40.11021	-80.239069
LEATHERWOOD INC	WALKER FARM 2	465866	495092	373603	125-01987	Active	4	Southern	40.11967	-80.2265
EQUITABLE RESOURCES EXPLORATION	WILLIAM B BAKER 518	230559	232536	188929	125-20162	Inactive/Plugged Well	361	Southern	40.09281	-80.223911
RICE DRILLING B LLC	X-MAN 1	746922	721706	996577	125-23823	Active	4	Southern	40.09936	-80.179578
RICE DRILLING B LLC	X-MAN 10H	746922	754800	1082686	125-24825	Active	4	Southern	40.09934	-80.179408
RICE DRILLING B LLC	X-MAN 1H	746922	725917	1005060	125-23967	Active	4	Southern	40.09939	-80.179634
RICE DRILLING B LLC	X-MAN 2	723726	721757	996663	125-23825	Operator Reported Not Drilled	401	Southern	40.08169	-80.186717
RICE DRILLING B LLC	X-MAN 2H	746922	754953	1083044	125-24832	Active	4	Southern	40.09938	-80.179325
RICE DRILLING B LLC	X-MAN 2H	746922	736615	1025010	125-24347	Operator Reported Not Drilled	401	Southern	40.09939	-80.179667
RICE DRILLING B LLC	X-MAN 3H	746922	749075	1065521	125-24674	Active	4	Southern	40.09939	-80.179394
RICE DRILLING B LLC	X-MAN 5H	746922	749077	1065534	125-24675	Active	4	Southern	40.09944	-80.179672
RICE DRILLING B LLC	X-MAN 7H	746922	749081	1065542	125-24676	Active	4	Southern	40.09935	-80.179481
RICE DRILLING B LLC	X-MAN G1	746922	749073	1065518	125-24673	Operator Reported Not Drilled	401	Southern	40.09943	-80.179603
RICE DRILLING B LLC	X-MAN G5	746922	749140	1065663	125-24677	Active	4	Southern	40.09939	-80.179689

Table C23 Well Inventory Summary
Southwestern Pennsylvania (Washington County)

Organization	Farm Name	Site ID	Primary ID	Sub Facility ID	API Number	Site Status	Sub Facility #	Search Area	Latitude	Longitude
RANGE RESOURCES APPALACHIA LLC	YEAGER UNIT 1H	718618	735027	1021966 & 1071810 & 1105140	125-24314	Active	523	Southern	40.09133	-80.227842
RANGE RESOURCES APPALACHIA LLC	YEAGER UNIT 1H	718618	717258	987532	125-23687	Operator Reported Not Drilled	401	Southern	40.09139	-80.227607
RANGE RESOURCES APPALACHIA LLC	YEAGER UNIT 1H	718618	724197	1001839	125-23911	Operator Reported Not Drilled	401	Southern	40.09136	-80.227833
RANGE RESOURCES APPALACHIA LLC	YEAGER UNIT 2H	718618	719764	992380	125-23783	Operator Reported Not Drilled	401	Southern	40.09128	-80.227806
RANGE RESOURCES APPALACHIA LLC	YEAGER UNIT 2H	718618	732097	1016535	125-24240	Operator Reported Not Drilled	401	Southern	40.09129	-80.227797
RANGE RESOURCES APPALACHIA LLC	YEAGER UNIT 2H	718618	735031	1021986 & 1105141	125-24315	Active	523	Southern	40.09129	-80.227797
RANGE RESOURCES APPALACHIA LLC	YEAGER UNIT 7H	718618	721768	996685	125-23824	Active	4	Southern	40.09153	-80.228111
CNX GAS CO LLC	YOST NV32	719392	717930	988682	125-23700	Active	4	Southern	40.07362	-80.199279
PETROTHERM IND CORP	ZIMMERMAN (NOW A E LOWERY & R VANCE 1	230533	232510	188903	125-20136	Inactive/Plugged Well	361	Southern	40.11104	-80.238311

Source: http://www.pasda.psu.edu/uci/MetadataDisplay.aspx?entry=PASDA&file=OilGasLocations2014_01.xml&dataset=283
Last accessed in September 2013.

Key:

API = American Petroleum Industry.
DEP = Department of Environmental Protection.
ID = Identification.

Table C24 Number of Permitted Oil and Gas Wells in Southwestern Pennsylvania, Northern Area

Search Area	Search Area Radius (miles)	EPA HF Study Samples	Total Number of Oil and Gas Wells	Oil and Gas Wells within 1 Mile of EPA HF Study Sampling Points
C	1	SWPAGW08	26	26
D	1	SWPAGW01 SWPAGW02 SWPASW01	27	27
E	1	SWPAGW04 SWPASW02	16	16
F	3	SWPAGW03 SWPAGW05 SWPAGW06 SWPAGW07 SWPAGW09	119	39

Source: PADEP database, filtered to SPUD date before 5/20/13 and populated fields only

Table C25 Southwestern Pennsylvania, Northern Area, Locations of Impoundments and Reserve Pits

EPA Sample	Operator	Nearest Well Pad to Impoundment/Reserve Pit	Approximate Distance from Sampling Point to Impoundment or Reserve Pit	Visible in Google Earth Aerial Imagery	
				Impoundment	Reserve Pit
SWPAGW01	Range	Clingerman-Thomas Unit	2 mi SW	10/08 – 8/12	
		Painter Unit	2.4 mi E		7/10 – 9/12
		Paxton Isaac/Johnson Charles/A&D Ferguson Dev Units	3 mi ENE	10/08 – 8/12	
		Best Unit	3.4 mi SW	7/10 – 9/10	
		Ward Unit (reserve pit only)	3.8 mi SW		7/10 – 9/10
		Durkacs Unit	4 mi ENE	7/10 – 8/12	
		Engel Unit	4.25 mi NE	7/10 – 8/12	7/10 – 9/10
SWPAGW02	Range	Clingerman-Thomas Unit	2 mi SW	10/08 – 8/12	
		Painter Unit (reserve pit only)	2.5 mi E		7/10 – 9/10
		Paxton Isaac/Johnson Charles/A&D Ferguson Dev Units	3 mi ENE	10/08 – 8/12	7/10 – 9/10
		Ward Unit (reserve pit only)	3.4 mi SW		
		Best Unit	3.6 mi SW	7/10 – 9/10	
		Durkacs Unit	4 mi ENE	7/10 – 8/12	7/10 – 9/10
		Engel Unit	4.25 mi NE	7/10 – 8/12	
SWPAGW03	Range	Stewart Nancy Unit	0.5 mi SW	10/08 - 8/12	
		Lehman Unit	2 mi W	10/08 – 8/12	
		Carns Donald (unnamed pad 0.5 mi to N)	3.4 mi NW		5/12 – 8/12
		Best Unit	4 mi S	7/10 – 9/10	
		Ward Unit	4.4 mi SSE		7/10 – 9/10
SWPAGW04	Range	Cowden Unit (3H, 4H, 5H, 6H (Carter Impoundment)	0.3 mi N	7/10 – 8/12	7/10 – 9/10
		Cowden Unit (1H, 2H)	0.75 mi NE	10/8 – 8/12	
		Engel Unit	4 mi SE	7/10 – 8/12	7/10 – 9/10
		Durkacs Unit	4.25 SE	7/10 – 8/12	
SWPAGW05	Range	Stewart Nancy Unit	0.75 mi to NE	10/08 - 8/12	
		Lehman Unit	1.75 mi NW	10/08 – 8/12	
		Best Unit	3.3 mi SE	7/10 – 9/10	
		Ward Unit	3.8 mi SE		7/10-9/10
		Carns Donald	3.9 mi NNW		5/12 – 8/132

Table C25 Southwestern Pennsylvania, Northern Area, Locations of Impoundments and Reserve Pits

EPA Sample	Operator	Nearest Well Pad to Impoundment/Reserve Pit	Approximate Distance from Sampling Point to Impoundment or Reserve Pit	Visible in Google Earth Aerial Imagery	
				Impoundment	Reserve Pit
SWPAGW06	Range	Lehman Unit	1.5 mi NE	10/08 – 8/12	
		Margaria Raymond Unit	2 mi WNW	5/12 – 8/12	
		Margaria Paul Unit (2 impoundments)	2.75 mi W	5/12 – 8/12	
		Guy Avolio (3 impoundments and one reserve pit)	3.5 mi WSW	9/10 – 8/12	9/10
		Black William	3.8 mi SE		7/10 – 9/10
		Rush John Unit	4 mi S	5/12 – 8/12	9/10
		Bon-De Inc. Unit	4 mi SW	9/10 – 8/12	
		Kearns Unit	4.3 mi SSW	9/10 – 8/12	
		Best Unit	4.4 mi SE	7/10 – 9/10	
		Ward Unit	5.2 mi SE		7/10 – 9/10
SWPAGW07	Range	Lehman Unit	1.5 mi NE	10/08 – 8/12	
		Margaria Raymond Unit	2 mi WNW	5/12 – 8/12	
		Margaria Paul Unit (2 impoundments)	2.75 W	5/12 – 8/12	
		Guy Avolio (3 impoundments and one reserve pit)	3.5 mi SW	9/10 – 8/12	9/10
		Black William	3.8 mi SE		7/10 – 9/10
		Rush John Unit	4 mi S	5/12 – 8/12	9/10
		Bon-De Inc. Unit	4 mi SW	9/10 – 8/12	
		Kearns Unit	4.3 mi SSW	9/10 – 8/12	
		Best Unit	4.4 mi SE	7/10 – 9/10	
		Ward Unit	5.2 mi SE		7/10 – 9/10
SWPAGW08	Range	Best Unit Lowery William Unit	0.1 mi S	7/10 – 9/10	
		Ward Unit	0.9 mi NW1.0 mi SE	7/10 – 8/12	7/10 – 9/10
		Clingerman-Thomas	1.5 mi NE		7/10 – 9/10
		Bednarski Unit	2 mi SW	10/08 – 8/12	
		Black William	2.1 WSW	7/10 – 8/12	
					7/10 – 9/10

Table C25 Southwestern Pennsylvania, Northern Area, Locations of Impoundments and Reserve Pits

EPA Sample	Operator	Nearest Well Pad to Impoundment/Reserve Pit	Approximate Distance from Sampling Point to Impoundment or Reserve Pit	Visible in Google Earth Aerial Imagery	
				Impoundment	Reserve Pit
SWPAGW09	Range	Lehman Unit	1.5 mi NE	10/08 – 8/12	
		Margaria Raymond Unit	2 mi WNW	5/12 – 8/12	
		Margaria Paul Unit (2 impoundments)	2.75 mi W	5/12 – 8/12	
		Guy Avolio (3 impoundments and one reserve pit)	3.5 mi SW	9/10 – 8/12	9/10
		Rush John Unit	4 mi S	5/12 – 8/12	9/10
		Bon-De Inc. Unit	4 mi SW	9/10 – 8/12	
		Kearns Unit	4.3 mi SSW	9/10 – 8/12	
		Best Unit	4.4 mi SE	7/10 – 9/10	
		Ward Unit	5.2 mi SE		7/10 – 9/10
SWPASW01	Range	Clingerman-Thomas	2 mi NW	10/08 – 8/12	
		Painter Unit	2.5 mi E		7/10 – 9/10
		Paxton Isaac/Johnson Charles/A&D Ferguson Dev Units	3 mi ENE	10/08 – 8/12	7/10 – 9/10
		Ward Unit	3.4 mi SW		
		Best	3.6 mi SW	7/10 – 9/10	
		Durkacs Unit	4 mi ENE	7/10 – 8/12	7/10 – 9/10
		Engel Unit (impoundment and reserve pit)	4.25 mi NE	7/10 – 8/12	
SWPASW02	Range	Cowden Unit (3H, 4H, 5H, 6H (Carter Impoundment) (impoundment and reserve pit)	0.3 mi N	7/10 – 8/12	7/10 – 9/10
		Cowden Unit (1H, 2H)	0.75 mi NE	10/8 – 8/12	
		Engel Unit (impoundment and reserve pit)	4 mi SE	7/10 – 8/12	7/10 – 9/10
		Durkacs Unit	4.25 mi SE	7/10 – 8/12	

Source: Well Units and EPA sample locations from EPA ORD Database

Table C26 Notice of Violations Summary, Southwestern Pennsylvania, Northern Area

Well Name[a]	API Number	Number of Inspections	Date of Violation	Violations Identified by PADEP Inspector	Corrected[b]	Comment	Location (Township)	Latitude	Longitude	Operator	Search Area
ANNA B JOHNSON 1	125-21461	2	01/05/90	1. Failure to bond well, replace or maintain bond. 2. Failure to install, in a permanent manner, the permit number on a completed well.	Resolution not recorded	Active	Hopewell	40.2338250	-80.3581820	JM BEST INC	C
BEST UNIT 1H	125-23277	6	NA	None	NA	Active	Hopewell	40.2328290	-80.3380270	RANGE RESOURCES APPALACHIA LLC	C
BEST UNIT 2H	125-23283	5	NA	None	NA	Active	Hopewell	40.2328010	-80.3379720	RANGE RESOURCES APPALACHIA LLC	C
BEST UNIT 3H	125-23282	6	NA	None	NA	Active	Hopewell	40.2328010	-80.3379160	RANGE RESOURCES APPALACHIA LLC	C
BEST UNIT 4H	125-23284	5	NA	None	NA	Active	Hopewell	40.2328010	-80.3378600	RANGE RESOURCES APPALACHIA LLC	C
BEST UNIT 5H	125-23370	5	NA	None	NA	Active	Hopewell	40.2327740	-80.3377770	RANGE RESOURCES APPALACHIA LLC	C
BEST UNIT 6H	125-23368	3	NA	None	NA	Active	Hopewell	40.2327740	-80.3376940	RANGE RESOURCES APPALACHIA LLC	C
BEST UNIT 7H-A	125-23369	2	NA	None	NA	Active	Hopewell	40.2327740	-80.3376380	RANGE RESOURCES APPALACHIA LLC	C
HAROLD L WARD 1	125-21460	3	NA	None	NA	Active	Canton	40.2288810	-80.3268980	JM BEST INC	C
HUNTER 1	125-21446	1	NA	None	NA	Active	Hopewell	40.2308080	-80.3413480	JM BEST INC	C
LBROS UNIT 1H	125-23308	2	NA	None	NA	Active	Mount Pleasant	40.2441620	-80.3416940	RANGE RESOURCES APPALACHIA LLC	C
LBROS UNIT 2H	125-23367	2	NA	None	NA	Active	Mount Pleasant	40.2444400	-80.3416380	RANGE RESOURCES APPALACHIA LLC	C
LBROS UNIT 3H	125-23696	1	NA	None	NA	Active	Mount Pleasant	40.2441620	-80.3415830	RANGE RESOURCES APPALACHIA LLC	C
LBROS UNIT 4H	125-23695	1	NA	None	NA	Active/Regulatory Inactive Status	Mount Pleasant	40.2441350	-80.3416940	RANGE RESOURCES APPALACHIA LLC	C
LBROS UNIT 5H	125-23705	1	NA	None	NA	Active	Mount Pleasant	40.2441350	-80.3416380	RANGE RESOURCES APPALACHIA LLC	C
LOWRY WILLIAM UNIT 3H	125-23169	6	02/25/10	1. There is a potential for polluting substance(s) reaching Waters of the Commonwealth and may require a permit. 2. Stream discharge of industrial waste, includes drill cuttings, oil, brine, and/or silt.	Yes ($49,500)	Active	Hopewell	40.2438010	-80.3471110	RANGE RESOURCES APPALACHIA LLC	C
LOWRY WILLIAM UNIT 4H	125-23326	1	NA	None	NA	Operator Reported Not Drilled	Hopewell	40.2437730	-80.3470830	RANGE RESOURCES APPALACHIA LLC	C
ODONNELL JOSEPH UNIT 1H	125-24939	5	NA	None	NA	Active	Hopewell	40.2321170	-80.3515110	RANGE RESOURCES APPALACHIA LLC	C
ODONNELL JOSEPH UNIT 2H	125-24940	5	NA	None	NA	Active	Hopewell	40.2321940	-80.3514670	RANGE RESOURCES APPALACHIA LLC	C
ODONNELL JOSEPH UNIT 3H	125-24941	2	NA	None	NA	Active	Hopewell	40.2322250	-80.3512920	RANGE RESOURCES APPALACHIA LLC	C
ODONNELL JOSEPH UNIT 4H	125-24942	3	NA	None	NA	Active	Hopewell	40.2321500	-80.3513360	RANGE RESOURCES APPALACHIA LLC	C
WARD HAROLD UNIT 3H	125-24119	10	02/25/10	Compliance database record: 1. Stream discharge of industrial waste, includes drill cuttings, oil, brine, and/or salt. 2. Discharge of pollutional material to waters of Commonwealth.	Yes ($49,500)	Active	Canton	40.2295000	-80.3232780	RANGE RESOURCES APPALACHIA LLC	C
WARD HAROLD UNIT 4H	125-23975	4	NA	None	NA	Active	Canton	40.2292780	-80.3232780	RANGE RESOURCES APPALACHIA LLC	C
WARD HAROLD UNIT 5H	125-24329	4	NA	None	NA	Active	Canton	40.2294470	-80.3232810	RANGE RESOURCES APPALACHIA LLC	C
WARD HAROLD UNIT 6H	125-23974	3	NA	None	NA	Active	Canton	40.2293890	-80.3232780	RANGE RESOURCES APPALACHIA LLC	C

Table C26 Notice of Violations Summary, Southwestern Pennsylvania, Northern Area

Well Name[a]	API Number	Number of Inspections	Date of Violation	Violations Identified by PADEP Inspector	Corrected[b]	Comment	Location (Township)	Latitude	Longitude	Operator	Search Area
WARD HAROLD UNIT 7H	125-23976	4	NA	None	NA	Active	Canton	40.2293330	-80.3233060	RANGE RESOURCES APPALACHIA LLC	C
WARD HAROLD UNIT 8H	125-24070	8	NA	None	NA	Active	Canton	40.2292780	-80.3233060	RANGE RESOURCES APPALACHIA LLC	C
ALEXANDER 1	125-02162	28	NA	None	NA	Inactive/Plugged	Mount Pleasant	40.2829950	-80.3130540	RANGE RESOURCES APPALACHIA LLC	D
ALEXANDER UNIT 1H	125-22366	11	NA	No violations noted; however, two complaint inspections are still pending (dated 6/3/2009 and 6/9/2009).	NA	Shows up as Alexander Unit 1 on eFACTS (based on permit #)/inactive, plugged	Mount Pleasant	40.2879440	-80.3141670	RANGE RESOURCES APPALACHIA LLC	D
ALEXANDER UNIT 2	125-22447	9	03/03/08	1. Stream discharge of industrial waste, includes drill cuttings, oil, brine, and/or salt. 2. Discharge of pollutional material to waters of Commonwealth.	Yes ($21,200)	Active	Mount Pleasant	40.2833010	-80.3101370	RANGE RESOURCES APPALACHIA LLC	D
BEAUMARIAGE UNIT 1H	125-23280	2	NA	None	NA	Active	Mount Pleasant	40.2703010	-80.3083320	RANGE RESOURCES APPALACHIA LLC	D
BEAUMARIAGE UNIT 2H	125-23591	2	NA	None	NA	Active	Mount Pleasant	40.2703290	-80.3083870	RANGE RESOURCES APPALACHIA LLC	D
DEISEROTH 1	125-22088	12	NA	None	NA	Active	Mount Pleasant	40.2800230	-80.2919980	RANGE RESOURCES APPALACHIA LLC	D
DEISEROTH 2	125-22238	5	NA	None	NA	Active	Mount Pleasant	40.2844670	-80.2918590	RANGE RESOURCES APPALACHIA LLC	D
DEISEROTH 3	125-22629	2	NA	None	NA	Active	Mount Pleasant	40.2789120	-80.2969420	RANGE RESOURCES APPALACHIA LLC	D
GULLA UNIT 1	125-22212	16	05/25/10	O&G Act 223-General. Used only when a specific O&G Act code cannot be used.	Yes	Inactive/Plugged	Mount Pleasant	40.2758610	-80.3078890	RANGE RESOURCES APPALACHIA LLC	D
			08/10/06	1. Failure to restore site within 9 months of completion of drilling or plugging. 2. Inadequate containment of oil tank.	Yes						
GULLA UNIT 10H	125-22941	2	NA	None	NA	Active	Mount Pleasant	40.2740000	-80.3183610	RANGE RESOURCES APPALACHIA LLC	D
GULLA UNIT 3	125-22261	12	01/10/08	1. Failure to implement Encroachment Plan. 2. Failure to minimize accelerated erosion, implement E&S plan, maintain E&S controls. Failure to stabilize site until total site restoration under O&G Act Section 206(c)(d).	Yes	Active	Mount Pleasant	40.2727220	-80.3143890	RANGE RESOURCES APPALACHIA LLC	D
			10/19/07	Failure to restore site within 9 months of completion of drilling or plugging	Yes ($21,200)						
			08/10/06	Failure to minimize accelerated erosion, implement E&S plan, maintain E&S controls. Failure to stabilize site until total site restoration under O&G Act Section 206(c)(d).	Yes						
GULLA UNIT 5H	125-22259	11	03/24/08	1. Failure to restore site within 9 months of completion of drilling or plugging. 2. Failure to minimize accelerated erosion, implement E&S plan, maintain E&S controls. Failure to stabilize site until total site restoration under O&G Act Section 206(c)(d).	Yes ($21,200)	Plugged	Mount Pleasant	40.2831340	-80.3029430	RANGE RESOURCES APPALACHIA LLC	D
GULLA UNIT 6	125-22300	6	01/10/08	1. Failure to implement Encroachment Plan. 2. Failure to minimize accelerated erosion, implement E&S plan, maintain E&S controls. Failure to stabilize site until total site restoration under O&G Act Section 206(c)(d).	Yes	Active	Mount Pleasant	40.2724400	-80.3131930	RANGE RESOURCES APPALACHIA LLC	D
			10/19/07	Failure to restore site within 9 months of completion of drilling or plugging	Yes ($21,200)						
GULLA UNIT 9	125-22639	2	NA	None	NA	Active	Mount Pleasant	40.2724120	-80.3086370	RANGE RESOURCES APPALACHIA LLC	D
MCBURNEY 2	125-22563	1	NA	None	NA	Active	Mount Pleasant	40.2883280	-80.3056370	DORSO LP	D
MCBURNEY 3	125-22562	1	NA	None	NA	Active	Mount Pleasant	40.2856060	-80.3075540	DORSO LP	D
MITCHELL JAMES UNIT 1	125-22798	1	NA	None	NA	Active	Mount Pleasant	40.2764950	-80.3013310	RANGE RESOURCES APPALACHIA LLC	D

Table C26 Notice of Violations Summary, Southwestern Pennsylvania, Northern Area

Well Name[a]	API Number	Number of Inspections	Date of Violation	Violations Identified by PADEP Inspector	Corrected[b]	Comment	Location (Township)	Latitude	Longitude	Operator	Search Area
MITCHELL JAMES UNIT 2H	125-22799	3	NA	None	NA	Shows up as MITCHELL JAMES UNIT 2 on eFACTS (based on permit #)/inactive	Mount Pleasant	40.2718290	-80.2982200	RANGE RESOURCES APPALACHIA LLC	D
MITCHELL JAMES UNIT 4H	125-22801	5	NA	None	NA	Active	Mount Pleasant	40.2696060	-80.3017760	RANGE RESOURCES APPALACHIA LLC	D
PEACOCK 1	125-22856	1	NA	None	NA	Operator Reported Not Drilled	Mount Pleasant	40.2857730	-80.2983590	RANGE RESOURCES APPALACHIA LLC	D
PEACOCK 3	125-22864	0	NA	None	NA	Active	Mount Pleasant	40.2897170	-80.2980810	RANGE RESOURCES APPALACHIA LLC	D
PEACOCK UNIT 1H	125-22900	1	NA	None	NA	Active	Mount Pleasant	40.2838010	-80.2977480	RANGE RESOURCES APPALACHIA LLC	D
RENZ 2	125-22205	8	05/10/06	1. Failure to restore site within 9 months of completion of drilling or plugging. 2. Failure to submit completion report within 30 days of completion of well.	Yes	Active	Mount Pleasant	40.2769120	-80.2863030	RANGE RESOURCES APPALACHIA LLC	D
COWDEN UNIT 1H	125-23023	7	NA	None	NA	Active	Mount Pleasant	40.3301060	-80.2817470	RANGE RESOURCES APPALACHIA LLC	E
COWDEN UNIT 2H	125-23304	2	NA	None	NA	Active	Mount Pleasant	40.3301060	-80.2816920	RANGE RESOURCES APPALACHIA LLC	E
COWDEN UNIT 2H	125-23031	1	NA	None	NA	Operator Reported Not Drilled	Mount Pleasant	40.3270220	-80.2836360	RANGE RESOURCES APPALACHIA LLC	E
COWDEN UNIT 3	125-23022	2	NA	None	NA	Operator Reported Not Drilled	Mount Pleasant	40.3334670	-80.2839420	RANGE RESOURCES APPALACHIA LLC	E
COWDEN UNIT 3H	125-23693	8	NA	None	NA	Active	Mount Pleasant	40.3281330	-80.2958870	RANGE RESOURCES APPALACHIA LLC	E
COWDEN UNIT 4H	125-23780	11	NA	None	NA	Active	Mount Pleasant	40.3280830	-80.2959440	RANGE RESOURCES APPALACHIA LLC	E
COWDEN UNIT 5H	125-23781	13	NA	None	NA	Active	Mount Pleasant	40.3280830	-80.2960560	RANGE RESOURCES APPALACHIA LLC	E
COWDEN UNIT 6H	125-23782	9	NA	None	NA	Active	Mount Pleasant	40.3280830	-80.2960000	RANGE RESOURCES APPALACHIA LLC	E
DRUGMAND UNIT 1H	125-23888	6	NA	None	NA	Active	Mount Pleasant	40.3203060	-80.3023330	RANGE RESOURCES APPALACHIA LLC	E
DRUGMAND UNIT 2H	125-23889	4	NA	None	NA	Active	Mount Pleasant	40.3203610	-80.3023060	RANGE RESOURCES APPALACHIA LLC	E
DRUGMAND UNIT 3H	125-23853	6	NA	None	NA	Active	Mount Pleasant	40.3203890	-80.3022780	RANGE RESOURCES APPALACHIA LLC	E
DRUGMAND UNIT 4H	125-23890	6	NA	None	NA	Active	Mount Pleasant	40.3204440	-80.3022220	RANGE RESOURCES APPALACHIA LLC	E
DRUGMAND UNIT 5H	125-23891	7	NA	None	NA	Active	Mount Pleasant	40.3203890	-80.3022220	RANGE RESOURCES APPALACHIA LLC	E
DRUGMAND UNIT 6H	125-23892	8	NA	None	NA	Active	Mount Pleasant	40.3204720	-80.3021670	RANGE RESOURCES APPALACHIA LLC	E
DRUGMAND UNIT 7H	125-23893	5	NA	None	NA	Active	Mount Pleasant	40.3202780	-80.3023060	RANGE RESOURCES APPALACHIA LLC	E
DRUGMAND UNIT 8H	125-23894	4	NA	None	NA	Active	Mount Pleasant	40.3203330	-80.3022780	RANGE RESOURCES APPALACHIA LLC	E
CARNS UNIT 2	125-22709	2	NA	None	NA	Active	Cross Creek	40.2805790	-80.3799730	RANGE RESOURCES APPALACHIA LLC	F
CHRISTMAN UNIT 1	125-22252	8	NA	None	NA	Active	Cross Creek	40.2689120	-80.3711390	RANGE RESOURCES APPALACHIA LLC	F
CHRISTMAN UNIT 2	125-22264	6	04/30/08	1. Discharge of pollutional material to Waters of Commonwealth. 2. Failure to minimize accelerated erosion, implement E&S controls. Failure to stabilize site until total site restoration under O&G Act Section 206(c)(d).	Yes ($21,200)	Active	Cross Creek	40.2653890	-80.3662220	RANGE RESOURCES APPALACHIA LLC	F
CHRISTMAN UNIT 5	125-22431	1	NA	None	NA	Inactive/Plugged	Cross Creek	40.2709400	-80.3637220	RANGE RESOURCES APPALACHIA LLC	F

Table C26 Notice of Violations Summary, Southwestern Pennsylvania, Northern Area

Well Name[a]	API Number	Number of Inspections	Date of Violation	Violations Identified by PADEP Inspector	Corrected[b]	Comment	Location (Township)	Latitude	Longitude	Operator	Search Area
CHRISTMAN UNIT 6	125-22434	1	NA	None	NA	Inactive/Plugged	Mount Pleasant	40.2660510	-80.3588330	RANGE RESOURCES APPALACHIA LLC	F
COSTANZO UNIT 1H	125-23803	4	NA	None	NA	Active	Mount Pleasant	40.2667780	-80.3547780	RANGE RESOURCES APPALACHIA LLC	F
COSTANZO UNIT 2H	125-23804	3	NA	None	NA	Active	Mount Pleasant	40.2668330	-80.3547780	RANGE RESOURCES APPALACHIA LLC	F
COWDEN 40	125-23161	6	03/24/10	Failure to restore site within 9 months of completion of drilling or plugging.	Yes ($37,500)	Active	Cross Creek	40.2804670	-80.3611670	ATLAS RESOURCES LLC	F
COWDEN 41	125-23537	9	06/02/10	Compliance database record: Failure to restore site within 9 months of completion of drilling or plugging.	Yes ($37,500)	Active	Cross Creek	40.2811340	-80.3659450	ATLAS RESOURCES LLC	F
COWDEN 41	125-23171	7	06/02/10	Failure to restore site within 9 months of completion of drilling or plugging.	Yes ($37,500)	Operator Reported Not Drilled	Cross Creek	40.2794120	-80.3686950	ATLAS RESOURCES LLC	F
COWDEN 46	125-22957	6	03/30/09	There is a potential for polluting substance(s) reaching Waters of the Commonwealth and may require a permit.	Yes	Active/Regulatory Inactive Status	Cross Creek	40.2721340	-80.3841950	ATLAS RESOURCES LLC	F
COWDEN 47	125-22958	1	NA	None	NA	Operator Reported Not Drilled	Cross Creek	40.2693840	-80.3851950	ATLAS RESOURCES LLC	F
COWDEN 47H	125-23271	5	04/01/10	Discharge of pollutional material to Waters of Commonwealth.	Yes ($17,500)	Active	Cross Creek	40.2693840	-80.3851950	ATLAS RESOURCES LLC	F
COWDEN 48	125-23270	6	10/01/08	1. There is a potential for polluting substance(s) reaching Waters of Commenwealth and may require a permit. 2. Failure to minimize accelerated erosion, implement E&S plan, maintain E&S controls. Failure to stabilize site until total site restoaration under O&G Act Section 206(c)(d).	Yes ($58,000)	Active	Cross Creek	40.2689680	-80.3904730	ATLAS RESOURCES LLC	F
COWDEN 48	125-22959	1	NA	None	NA	Operator Reported Not Drilled	Cross Creek	40.2689680	-80.3904730	ATLAS RESOURCES LLC	F
COWDEN 48H	125-23429	10	11/12/09	1. There is a potential for polluting substance(s) reaching Waters of Commenwealth and may require a permit. 2. Failure to take all necessary measures to prevent spill. Inadequate diking, potential pollution.	Yes ($45,000)	Active/Regulatory Inactive Status	Cross Creek	40.2689680	-80.3904730	ATLAS RESOURCES LLC	F
COWDEN 50	125-23070	5	NA	None	NA	Active/Regulatory Inactive Status	Cross Creek	40.2704120	-80.3981680	CHEVRON APPALACHIA LLC	F
COWDEN 51	125-22960	5	10/29/08	1. Failure to minimize accelerated erosion, implement E&S plan, maintain E&S controls. Failue to stablize site until total site restoration under O&G Act Section 206(c)(d). 2. Drilling within 100 feet of surface water or wetland without variance.	Yes ($58,000)	Active/Regulatory Inactive Status	Cross Creek	40.2747450	-80.3912790	ATLAS RESOURCES LLC	F
COWDEN 53	125-22961	5	10/29/08	Failure to minimize accelerated erosion, implement E&S plan, maintain E&S controls. Failue to stablize site until total site restoration under O&G Act Section 206(c)(d).	Yes ($58,000)	Active/Regulatory Inactive Status	Cross Creek	40.2700790	-80.4020850	ATLAS RESOURCES LLC	F
COWDEN 75	125-23376	5	03/24/10	Failure to restore site within 9 months of completion of drilling or plugging.	Yes ($37,500)	Active/Regulatory Inactive Status	Cross Creek	40.2694120	-80.3850010	ATLAS RESOURCES LLC	F
COWDEN 76	125-23515	9	06/02/10	Compliance database record: 1. Failure to restore site within 9 months of completion of drilling or plugging. 2. Failure to achieve permanent stabilization of earth disturbance activity.	Yes ($37,500)	Active	Mount Pleasant	40.2691340	-80.3903900	ATLAS RESOURCES LLC	F
COWDEN 76	125-23377	8	06/02/10	1. Failure to achieve permanent stabilization of earth disturbance activity. 2. Failure to restore site within 9 months of completion of drilling or plugging.	Yes ($37,500)	Operator Reported Not Drilled	Mount Pleasant	40.2689680	-80.3902790	ATLAS RESOURCES LLC	F
OHIO VALLEY LBC UNIT 1	125-22420	2	NA	None	NA	Inactive/Plugged	Mount Pleasant	40.2680510	-80.3476380	RANGE RESOURCES APPALACHIA LLC	F
OHIO VALLEY LBC UNIT 11H	125-24148	3	NA	None	NA	Active	Mount Pleasant	40.2770830	-80.3497640	RANGE RESOURCES APPALACHIA LLC	F
OHIO VALLEY LBC UNIT 12H	125-24147	3	NA	None	NA	Active	Mount Pleasant	40.2771310	-80.3497970	RANGE RESOURCES APPALACHIA LLC	F
OHIO VALLEY LBC UNIT 14H	125-24146	3	NA	None	NA	Active	Mount Pleasant	40.2770470	-80.3496970	RANGE RESOURCES APPALACHIA LLC	F
OHIO VALLEY LBC UNIT 15H	125-24149	4	NA	None	NA	Active	Mount Pleasant	40.2771810	-80.3498310	RANGE RESOURCES APPALACHIA LLC	F

Table C26 Notice of Violations Summary, Southwestern Pennsylvania, Northern Area

Well Name[a]	API Number	Number of Inspections	Date of Violation	Violations Identified by PADEP Inspector	Corrected[b]	Comment	Location (Township)	Latitude	Longitude	Operator	Search Area
OHIO VALLEY LBC UNIT 16H	125-24144	5	NA	None	NA	Active	Mount Pleasant	40.2770330	-80.3497310	RANGE RESOURCES APPALACHIA LLC	F
OHIO VALLEY LBC UNIT 2A	125-22414	5	NA	None	NA	Inactive/Plugged	Mount Pleasant	40.2751340	-80.3429440	RANGE RESOURCES APPALACHIA LLC	F
OHIO VALLEY LBC UNIT 3	125-22415	3	NA	None	NA	Inactive/Plugged	Mount Pleasant	40.2766900	-80.3543060	RANGE RESOURCES APPALACHIA LLC	F
OHIO VALLEY LBC UNIT 4	125-22433	4	NA	None	NA	Inactive/Plugged	Mount Pleasant	40.2712180	-80.3535000	RANGE RESOURCES APPALACHIA LLC	F
OHIO VALLEY LBC UNIT 6	125-22495	3	NA	None	NA	Inactive/Plugged	Mount Pleasant	40.2743560	-80.3488610	RANGE RESOURCES APPALACHIA LLC	F
OHIO VALLEY LBC UNIT 7	125-22670	2	NA	None	NA	Operator Reported Not Drilled	Mount Pleasant	40.2719680	-80.3452770	RANGE RESOURCES APPALACHIA LLC	F
OHIO VALLEY LBC UNIT 8	125-22671	3	NA	None	NA	Operator Reported Not Drilled	Mount Pleasant	40.2775790	-80.3460270	RANGE RESOURCES APPALACHIA LLC	F
OHIO VALLEY LBC UNIT 8H	125-24145	6	06/20/11	1. Failure to properly store, transport, process, or dispose of a residual waste. 2. Failure to properly control or dispose of industrial or residual waste to prevent pollution of the Waters of the Commonwealth.	Yes	Active	Mount Pleasant	40.2772280	-80.3498640	RANGE RESOURCES APPALACHIA LLC	F
OHIO VALLEY LBC UNIT 9	125-22662	2	NA	None	NA	Operator Reported Not Drilled	Mount Pleasant	40.2799400	-80.3513890	RANGE RESOURCES APPALACHIA LLC	F
RUKAVINA UNIT 1H	125-23925	4	NA	None	NA	Active	Cross Creek	40.2655280	-80.3627500	RANGE RESOURCES APPALACHIA LLC	F
RUKAVINA UNIT 2H	125-23928	5	NA	None	NA	Active	Cross Creek	40.2654720	-80.3627220	RANGE RESOURCES APPALACHIA LLC	F
RUKAVINA UNIT 3H	125-23929	5	NA	None	NA	Active	Cross Creek	40.2653330	-80.3626110	RANGE RESOURCES APPALACHIA LLC	F
RUKAVINA UNIT 4H	125-23930	5	NA	None	NA	Active	Cross Creek	40.2654440	-80.3626940	RANGE RESOURCES APPALACHIA LLC	F
RUKAVINA UNIT 5H	125-23931	5	NA	None	NA	Active	Cross Creek	40.2653890	-80.3626670	RANGE RESOURCES APPALACHIA LLC	F
STEWART NANCY UNIT 1	125-22619	2	NA	None	NA	Active	Mount Pleasant	40.2848840	-80.3515270	RANGE RESOURCES APPALACHIA LLC	F
STEWART NANCY UNIT 4	125-22641	3	NA	None	NA	Active	Mount Pleasant	40.2846900	-80.3465270	RANGE RESOURCES APPALACHIA LLC	F
STEWART NANCY UNIT 6	125-22688	4	06/28/11	eFACTS database record: 1. Unlawful management of residual solid waste. Compliance database record: 1. Failure to properly control or dispose of industrial waste or residual waste to prevent pollution of the waters of the Commonwealth.	Yes ($59,000)	Active	Mount Pleasant	40.2833010	-80.3433050	RANGE RESOURCES APPALACHIA LLC	F
STEWART NANCY UNIT 8	125-22669	7	NA	None	NA	Active	Mount Pleasant	40.2882730	-80.3454440	RANGE RESOURCES APPALACHIA LLC	F
BEST IMPOUNDMENT DAM	95-7-60915-2[c]	8	03/17/10	1. Failure of storage operator to maintain and/or submit required information, such as maps, well records, integrity testing information, pressure data. 2. Impoundment not structurally sound, impermeable, 3rd party protected, greater than 20 inches of seasonal high ground water table.	Yes ($49,500)	Active	Hopewell	40.2321410	-80.3411830	RANGE RESOURCES APPALACHIA LLC	C
CARTER IMPOUNDMENT DAM	95-7-60915-8[c]	16	03/21/11	1. Failur to properly store, transport, process or dispose of a residual waste. 2. Failure to properly control or dispose of industrial or residual waste to prevent pollution of the waters of the Commonwealth.	Yes ($59,000)	Active	Mount Pleasant	40.3296430	-80.2990320	RANGE RESOURCES APPALACHIA LLC	E

Table C26 Notice of Violations Summary, Southwestern Pennsylvania, Northern Area

Well Name[a]	API Number	Number of Inspections	Date of Violation	Violations Identified by PADEP Inspector	Corrected[b]	Comment	Location (Township)	Latitude	Longitude	Operator	Search Area

Source: Pennsylvania DEP website eFACTS at http://www.ahs.dep.pa.gov/eFACTSWeb/criteria_site.aspx (Last accessed: January 2014)

Notes:

[a] - This table does not include wells that are reported as "proposed but never materialized" or "operator reported not drilled", if there were no inspections performed at the proposed well sites.

[b] - Dollar amount shown indicates fine assessed.

[c] - Centralized impoundment dam permit number.

Key:

API = American Petroleum Institute

eFACTS = Pennsylvania Environmental Facility Application Compliance Tracking System

E&S = Erosion and Sedimentation

NA - Not applicable

O&G = Oil & Gas

PADEP = Pennsylvania Department of Environmental Protection

SWPA = Southwest Pennsylvania

Table C27 Notice of Violations. Identified Potential Candidate Causes and Distances from EPA Sampling Points Southwest Pennsylvania, Northern Area

					EPA Sampling Point		EPA Sampling Point		EPA Sampling Point		EPA Sampling Point	
Well	API Number	Latitude	Longitude	Search Area	ID	Distance (miles)	ID	Distance (miles)	ID	Distance (miles)	ID	Distance (miles)
LOWRY WILLIAM UNIT 3H	125-23169	40.2438010	-80.3471100	C	SWPAGW08	0.8	SWPAGW05	2.4	SWPAGW01	3.1	SWPAGW02	3.2
ALEXANDER UNIT 2	125-22447	40.2833000	-80.3101370	D	SWPASW01	0.6	SWPAGW02	0.6	SWPAGW01	0.8	SWPAGW03	1.8
CHRISTMAN UNIT 2	125-22264	40.2653880	-80.3662220	F	SWPAGW05	1.0	SWPAGW07	1.8	SWPAGW06	1.9	SWPAGW09	1.9
COWDEN 47H	125-23271	40.2693840	-80.3851950	F	SWPAGW07	0.8	SWPAGW06	0.9	SWPAGW09	0.9	SWPAGW05	1.6
Ohio Valley LBC Unit 8H	125-24145	40.2772280	-80.3498640	F	SWPAGW05	0.4	SWPAGW03	0.9				
BEST IMPOUNDMENT DAM	95-7-60915-2[a]	40.2321410	-80.3411830	C	SWPAGW08	0.1						
CARTER IMPOUNDMENT DAM	95-7-60915-8[a]	40.3296430	-80.2990320	E	SWPAGW04	0.3	SWPASW02	0.4				

Notes:

[a] - Centralized impoundment dam permit number.

Table C28 **Environmental Database Review Summary, Southwestern Pensylvannia, Southern Area**

Database	Name of Facility	Site Location and Address	Distance from Nearest Sampling Point	Potential Candidate Cause		Groundwater Wells
				Yes/No	Justification	
RCRA-SQG, US HIST AUTO STAT, FINDS, MANIFEST	NADALIN AUTO BODY	1280 Banetown Rd. Washington, PA 15301	1.68 mi. NNW of SWPAGW13	Yes	Site included due to potential for contamination.	16 Federal USGS Wells 1 Federal FRDS Public Water Supply System 173 State Wells
RCRA-CESQG, FINDS	DEANS WATER SVC	1007 Amity Ridge Rd. Amity, PA 15311	1.84 mi. SE of SWPAGW11	No	Handled lead waste. Lead is generally not mobile in subsurface soils, therefore not a likely source of contamination due to distance from the nearest sampling point.	
4 ERNS	Private Residence	1085 McAdams Rd. Washington, PA 15301	0.6 mi. S of SWPAGW10	Yes	ERNS - On 3/10/11 a caller stated that a retaining pond with frac water has overflowed, releasing the water onto the ground, and it is flowing toward the private residence and a drinking water well. ERNS - On 3/10/11, a caller stated that there was a tanker in the street, and when the caller came by the area there was some white cloth material in the road, a crew was trying to contain the chemicals that were coming out of the truck, the material was running out into the road and where the cattle are, and into the field nearby. ERNS - On 4/29/11 Range Resources reportedly dumped 25 trucks of frac water in a pond with a leaking liner. The site address is near the Yeager impoundment. ERNS - On 10/13/11 a caller reported a strong odor from the nearby pond	
2 ERNS, SPILL	Private Residence	121 Headley Rd. Washington, PA 15301	0.69 mi. ESE of SWPASW03	Yes	ERNS - On 6/4/11 a caller reported that the frac pond was overflowing into the stream on the property. The caller stated that there were rainbow, rusty, and black sheens, with heavy sediments as well. It was also reported that there was a strong odor as well. Discharge to the stream was also noted in May. ERNS - On 6/4/11, a caller reported that there is a fracing pond with a runoff pond and it has been trenched into a creek. Caller stated that top soil, silt, and some kind of foamy oil material was going into the north fork of Bane Creek from the runoff pond. Caller also stated there are gas pipelines below the fracing pond and they did not mitigate it. Spilled material: unknown oil Medium affected: Water - North Fork of Bane Creek (Tributary: Monongahela River)	
LUST, UST	AMWELL TWP ROAD DEPT	1473 Amity Ridge Rd. Washington, PA 15301	1.17 mi. ENE of SWPAGW13	Yes	Two leaking USTs, one gasoline and one diesel. Site included due to potential for contamination.	
UST	LONE PINE 1 STOP	1748 Amity Ridge Rd. Washington, PA 15301	2.61 mi. ESE of SWPAGW12	No	Not a likely source of contamination due to distance from nearest sampling point.	
RCRA Non-Gen/NLR	MARKWEST TUPTA-DAY COMPRESSOR	200 Johnson Rd. Washington, PA 15301	1.48 mi. NNE of SWPAGW13	Yes	Methanol waste handling. Site included due to potential for contamination.	
TSCA	SPARTECH POLYCOM	470 Johnson Road Washington, PA 15301	1.64 mi. NNE of SWPAGW13	No	Toxic material importer (Carbon Black, Cristobalite, and Kieselguhr); no releases recorded, therefore not a likely source of contamination.	
ICIS, FINDS	AMWELL TOWNSHIP MUNICIPAL AUTHORITY	1172 Amity Ridge Rd. Amity, PA 15311	1.54 mi. ESE of SWPAGW11	No	Administrative order violations from a government entity. Not a likely source of contamination due to distance from nearest sampling point.	
ICIS, FINDS	AMWELL TOWNSHIP MUNICIPAL AUTHORITY	885 Amity Ridge Rd. Amity, PA 15311	2.38 mi. SSE of SWPAGW11	No	Administrative order violations from a government entity. Not a likely source of contamination due to distance from nearest sampling point.	
FINDS	MARK WEST BAKER COMPRESSOR STATION	151 Baker Station Rd. Washington, PA 15301	0.68 mi. SE of SWPAGW11	Yes	Compressor station; site included due to potential for contamination.	
FINDS, NPDES	ROGERS SR STP	3050 Bedillion Rd. Washington, PA 15301	1.13 mi. WSW of SWPAGW11	No	In database for NPDES program. No violations recorded.	
FINDS, NPDES	LANE SR STP	2925 Bedillion Rd. Washington, PA 15301	1.3 mi. WSW of SWPAGW11	No	In database for NPDES program. No violations recorded.	
FINDS	TRINITY SOUTH EL SCH	2500 S. Main Street Washington, PA 15301	1.62 mi. NE of SWPAGW13	No	Elementary school; no violations cited. Not a likely source of contamination due to distance from nearest sampling point.	
FINDS, NPDES	DAY SR STP	39 Sturge Rd. Amity, PA 15311	1.34 mi. SSW of SWPAGW11	No	In database for NPDES program. No violations recorded.	
FINDS, NPDES	HATFIELD SR STP	35 Sturge Hollow Rd. Amity, PA 15311	1.36 mi. SSW of SWPAGW11	No	In database for NPDES program. No violations recorded.	
FINDS, NPDES	MORRIS ELISABETH	559 Waynesburg Rd. Washington, PA 15301	2.58 mi. NNE of SWPAGW13	No	In database for NPDES program. No violations recorded. Not a likely source of contamination due to distance from nearest sampling point.	
FINDS, NPDES	WINTERS SR STP	124 Mowl Rd. Washington Boro, PA 15301	2.88 mi. NE of SWPAGW13	No	In database for NPDES program. No violations recorded. Not a likely source of contamination due to distance from nearest sampling point.	
FINDS	GLEN MEADOW MHP	1 Laurie Lane Washington, PA 15301	2.8 mi. N of SWPAGW13	No	Mobile home park that participates in the Safe Drinking Water Program. Not a likely source of contamination due to distance from nearest sampling point.	

Table C28 **Environmental Database Review Summary, Southwestern Pensylvannia, Southern Area**

Database	Name of Facility	Site Location and Address	Distance from Nearest Sampling Point	Potential Candidate Cause		Groundwater Wells
				Yes/No	Justification	
MANIFEST	RANGE RESOURCES	1153 McAdams Rd. Washington, PA 15301	0.13 mi. S of SWPAGW13	Yes	Metal drums, barrels, and kegs reported. Site included due to potential for contamination.	
US MINES	LONE PINE	Brush Run Rd. Amwell Twp., PA	>3.1 mi. SE of SWPAGW12	Yes	Abandoned mine. Location determined from 1982 USGS topographic map. Not a likely source of contamination due to distance from nearest sampling point.	
US MINES	LONE PINE NORTH	Brush Run Rd. Amwell Twp., PA	>3.1 mi. SE of SWPAGW12	Yes	Abandoned mine. Location determined from 1982 USGS topographic map. Not a likely source of contamination due to distance from nearest sampling point.	
US HIST AUTO STAT	NADALIN AUTO BODY	1260 Banetown Rd. Washington, PA 15301	1.7 mi. NNW of SWPAGW13	Yes	Site in historical directory as a potential gas station/filling station/service station site. Site included due to potential for contamination.	
US HIST AUTO STAT	SUNOCO FLEET FUEL CARD	841 Amity Ridge Rd. Amity, PA 15311	2.6 mi. SE of SWPAGW11	No	Site in historical directory as a potential gas station/filling station/service station site. Not a likely source of contamination due to distance from nearest sampling point.	
US HIST AUTO STAT	LONE PINE EXXON	1748 Amity Ridge Rd. Washington, PA 15301	1.6 mi. NE of SWPAGW13	Yes	Site in historical directory as a potential gas station/filling station/service station site. Site included due to potential for contamination.	
US HIST AUTO STAT	RON SMITHS AUTO REPAIR	20 Big Block Blvd. Washington, PA 15301	2.9 mi. NE of SWPAGW13	No	Site in historical directory as a potential gas station/filling station/service station site. Not a likely source of contamination due to distance from nearest sampling point.	
US HIST CLEANERS	ALL PRO CARPET & UPHOLSTERY CLEANERS	660 Old Post Rd. Prosperity, PA 15329	1.3 mi. SW of SWPAGW11	Yes	Site included due to potential for contamination.	
Orphan CERCLIS-NFRAP	FALCONI RTE 18	Route 18 Washington, PA 15301	>3 mi. W of SWPAGW13	No	Brownfield site. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan CERCLIS-NFRAP	MARTIN, WILLIAM H LANDFILL	North Main St. Ext Washington, PA 15301	NI	Yes	Site included due to potential for contamination.	
Orphan LUST	PPL ELIMSPORT SUBSTA	Route 54 Washington, PA	NI	Yes	Leaking UST, cleanup completed, stored media unknown. Site included due to potential for contamination.	
Orphan LUST	WASHINGTON OPR CTR	Route 19 Washington, PA	>1 mi. NE of SWPAGW13	Yes	UST containing petroleum, cleanup completed. Site included due to potential for contamination.	
Orphan FINDS, RCRA-NLR	COURTNEY CONTRACTING CORP	RD 2 Box 239 Route 136 Washington, PA 15301	>5.3 mi. SE of SWPAGW08	No	Hazardous waste transport; no violations recorded. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan FINDS, RCRA-CESQG MANIFEST	CESSNA AUTO BODY	1515 Route 136	6.7 mi. NE of SWPAGW13	No	Not a likely source of contamination due to distance from nearest sampling point.	
Orphan FINDS, RCRA-CESQG	WASHINGTON ARMORY	78 Maiden St.	5.3 mi. NNW of SWPAGW-13	No	Not a likely source of contamination due to distance from nearest sampling point.	
Orphan FINDS, RCRA-CESQG, MANIFEST	KENNY'S BODY SHOP	3445 Route 40 West	4 mi. NE of SWPAGW13	No	Not a likely source of contamination due to distance from nearest sampling point.	
Orphan FINDS	WASTE MANAGEMENT OF PA INC.	Washington Hauling	>7mi. NW of SWPAGW13	No	Not a likely source of contamination due to distance from nearest sampling point.	
Orphan FINDS	WASHINGTON ENGR & CONSTR	P.O. Box 1203	NI	Yes	Violation for not submitting a discharge monitoring report for discharging gasoline-contaminated water from a remediation system. Site included due to potential for contamination.	
Orphan MANIFEST	COLUMBIA GAS TRANSMISSION	Route 40 Redd Farm M&R Station	>5.9 mi. S of SWPAGW08	No	Columbia Gas shipped or received a non-listed ignitable waste. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan FINDS	WASHINGTON PENN PLASTIC CO INC	V-bat Plastics Div	>6 mi. E of SWPAGW13	No	In database for NPDES program. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan ICIS	WHEELING PITTSBURGH STEEL CORP	Allenport Plant-Allenport Boro	>20 mi. E of SWPAGW12	No	Not a likely source of contamination due to distance from nearest sampling point.	
Orphan RMP	ALLEGHENY LUDLUM CORPORATION - WAS	Woodland and Griffith Avenues	>6 mi. N of SWPAGW13	No	Hydrogen fluoride/hydrofluoric acid gas release. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan RMP	WASHINGTON STEEL - WASHINGTON PLAN	Woodland and Griffith Avenues	>6 mi. N of SWPAGW13	No	Hydrogen fluoride/hydrofluoric acid gas release. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan FINDS, RMP	WASHINGTON - EAST WASHINGOTN JOINT A	102 Arden Station Road	>8 mi. N of SWPAGW13	No	Sewage Treatment Facility. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan FINDS	WASHINGTON COUNTY	Washington County Airport	>4.0 mi. NW of SWPAGW14	No	Listed on national emissions inventory database associated with airports and flying fields. Not a likely source of contamination due to distance from nearest sampling point.	
Orphan UST	PITT OHIO TERM	Route 136 N	>6 mi. NE of SWPAGW13	No	Diesel UST. Not a likely source of contamination due to distance from nearest sampling point.	

Table C28 Environmental Database Review Summary, Southwestern Pensylvannia, Southern Area

Database	Name of Facility	Site Location and Address	Distance from Nearest Sampling Point	Potential Candidate Cause		Groundwater Wells
				Yes/No	Justification	

Primary Source: Environmental records search report by Environmental Data Resources, Inc. (EDR) / EDR Inquiry Number: 3589255.2s
EDR Search Radius: 3 miles with EDR Center of Search: Latitude 40.0915000 - 40° 5' 29.40'', Longitude 80.2281000 - 80° 13' 41.16''

Other Sources: Pennsylvania eFacts website, EPA envirofacts website, and http://mines.findthedata.org/d/s/Pennsylvania. Last accessed in January 2014.

Notes:
ORPHAN SITE: A site of potential environmental interest that appear in the records search but due to incomplete location information (i.e., address and coordinates) is unmappable and not included in the records search report provided by EDR Inc.

Key:

ENE = East-northeast.
ESE = East-southeast.
FRDS = Federal Reporting Data System.
mi = Mile.
NI = No information.
N = North.
NE = Northeast.
NNE = North-northeast.
NNW = North-northwest.
NW = Northwest.
NPDES = National Pollutant Discharge Elimination System.
PA = Pennsylvania.
S = South.
SE = Southeast.
SSE = South-southeast.
SSW = South-southwest.
USGS = United States Geological Survey.
UST = Underground storage tank.
W = West.
WSW = West-southwest.

Databases:
AST: Aboveground Storage Tank Listing. The data come from the Department of Health & Consolidated Laboratories' AST Data (Facility & Owner Address of the Tanks Currently Recorded in North Dakota).
CERCLIS-NFRAP: Federal CERCLIS (Comprehensive Environmental Response, Compensation, and Liability Information System) NFRAP (No Further Remedial Action Planned) site list
ERNS: The Emergency Response Notification System records and stores information on reported releases of oil and hazardous substances. The source of this database is the U.S. EPA.
FINDS: Facility Index System/Facility Registry System
ICIS: Integrated Compliance Information System. ICIS supports the information needs of the national enforcement and compliance program as well as the unique needs of the National Pollutant Discharge Elimination System (NPDES) program.
LUST: The Leaking Underground Storage Tank Incident Reports contain an inventory of reported leaking underground storage tank incidents. The data come from the Department of Environmental Resources' List of Confirmed Releases.
MANIFEST - Hazardous waste manifest information
NPDES: National Pollutant Discharge Elimination System Permit Listing
RCRA-CESQG - Federal RCRA (Resource Conservation and Recovery Act) Conditionally Exempt Small Quantity Generator List. Conditionally exempt small quantity generators (CESQGs)generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month). RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA).
RCRA NonGen / NLR: RCRA) Non-Generators do not presently generate hazardous waste.
RCRA SQG: RCRA small quantity generators (SQGs generate between 100 kg and 1,000 kg of hazardous waste per month.). RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA).
RMP = Risk Management Plans.
SPILLS: Records of Emergency Release Reports
TIER 2: Listing of Tier 2 information.

TSCA: Database of Toxic Substances Control Act manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site. The United States Environmental Protection Agency has no current plan to update and/or re-issue this database.

Hist Auto Stat: EDR's database of listings of potential gas station/filling station/service station sites that were available to EDR researchers.
US HIST CLEANERS: EDR's database of listings of drycleaner facility locations that were available to EDR researchers.
US MINES: Mines Master Index File. The source of this database is the Dept. of Labor, Mine Safety and Health Administration
UST: The Underground Storage Tank database contains registered USTs. USTs are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA). The data come from the Department of Environmental Resources' Regulated Underground Storage Tank Listing.

Table C29 Number of Permitted Oil and Gas Wells in Southwestern Pennsylvania, Southern Area

Search Area	Search Area Radius (miles)	EPA HF Study Samples	Total Number of Oil and Gas Wells	Oil and Gas Wells within 1 Mile of EPA HF Study Sampling Points
Southern	3	SWPAGW10 SWPAGW11 SWPAGW12 SWPAGW13 SWPAGW14 SWPAGW15 SWPAGW16 SWPAGW17 SWPASW03	152	33

Source: PADEP database, filtered to SPUD date before 5/20/13 and populated fields only

Table C30 Southwestern Pennsylvania, Southern Area, Locations of Impoundments and Reserve Pits

EPA Sample	Operator	Nearest Well Pad to Impoundment/Reserve Pit	Approximate Distance from Sampling Point to Impoundment/Reserve Pit	Visible in Google Earth Aerial Imagery	
				Impoundment	Reserve Pit
SWPAGW10	Range	Yeager Unit	0.2 NE	7/10 – 8/12	7/10 – 9/10
	Rice	Mojo Unit	1 mi ENE	8/12	
	Rice	Hulk Unit	2.5 mi ESE	8/12	
	Rice	X-Man Unit	2.8 mi NE	7/10-9/10	
	Range	Day Unit	2.6 mi NE	7/10 – 8/12	
	Range	Bedillion-Day Unit	1.9 mi NNE	7/10 – 9/10	7/10 – 9/10
SWPAGW11	Range	Yeager Unit	0.3 mi NNE	7/10 – 8/12	7/10 – 9/10
	Rice	Mojo Unit	1 mi NE	8/12	
	Rice	Hulk Unit	2.5 mi E	8/12	
	Rice	X-Man Unit	2.8 mi NE	7/10-9/10	
	Range	Day Unit	2.8 mi NE	7/10 – 8/12	
	Range	Bedillion-Day Unit	2.1 mi NNE	7/10 – 9/10	7/10 – 9/10
SWPAGW12	Range	Yeager Unit	0.1 mi NNE	7/10 – 8/12	7/10 – 9/10
	Rice	Mojo Unit	0.9 mi ENE	8/12	
	Rice	Hulk Unit	2.4 mi ESE	8/12	
	Rice	X-Man Unit	2.9 mi NE	7/10-9/10	
	Range	Day Unit	2.6 mi NE	7/10 – 8/12	
	Range	Bedillion-Day Unit	1.9 mi NNE	7/10 – 9/10	7/10 – 9/10
SWPAGW13	Range	Yeager Unit	0.25 mi SSE	7/10 – 8/12	7/10 – 9/10
	Rice	Mojo Unit	1 mi ESE	8/12	
	Rice	Hulk Unit	2.5 mi ESE	8/12	
	Rice	X-Man Unit	2.75 ENE	7/10-9/10	
	Range	Day Unit	2.3 mi NE	7/10 – 8/12	
	Range	Bedillion-Day Unit	1.6 mi NNE	7/10 – 9/10	7/10 – 9/10

Table C30 Southwestern Pennsylvania, Southern Area, Locations of Impoundments and Reserve Pits

EPA Sample	Operator	Nearest Well Pad to Impoundment/Reserve Pit	Approximate Distance from Sampling Point to Impoundment/Reserve Pit	Visible in Google Earth Aerial Imagery	
				Impoundment	Reserve Pit
SWPAGW14	Range	Yeager Unit	0.27 mi SSE	7/10 – 8/12	7/10 – 9/10
	Rice	Mojo Unit	0.96 mi ESE	8/12	
	Rice	Hulk Unit	2.52 mi ESE	8/12	
	Rice	X-Man Unit	2.77 ENE	7/10-9/10	
	Range	Day Unit	2.3 mi NE	7/10 – 8/12	
	Range	Bedillion-Day Unit	1.65 mi NNE	7/10 – 9/10	7/10 – 9/10
SWPAGW15	Range	Yeager Unit	0.13 NE	7/10 – 8/12	7/10 – 9/10
	Rice	Mojo Unit	0.91 mi ENE	8/12	
	Rice	Hulk Unit	2.43 mi ESE	8/12	
	Rice	X-Man Unit	2.79 mi NE	7/10-9/10	
	Range	Day Unit	2.56 mi NE	7/10 – 8/12	
	Range	Bedillion-Day Unit	1.93 mi NNE	7/10 – 9/10	7/10 – 9/10
SWPAGW16	Range	Yeager Unit	0.21 mi NNE	7/10 – 8/12	7/10 – 9/10
	Rice	Mojo Unit	.97 mi NE	8/12	
	Rice	Hulk Unit	2.45 mi E	8/12	
	Rice	X-Man Unit	2.84 mi NE	7/10-9/10	
	Range	Day Unit	2.66 mi NE	7/10 – 8/12	
	Range	Bedillion-Day Unit	2 mi NNE	7/10 – 9/10	7/10 – 9/10
SWPAGW17	Range	Yeager Unit	0.58 mi NNE	7/10 – 8/12	7/10 – 9/10
	Rice	Mojo Unit	1.27 mi NE	8/12	
	Rice	Hulk Unit	2.63 mi E	8/12	
	Rice	X-Man Unit	3.16 mi NE	7/10-9/10	
	Range	Day Unit	3 mi NE	7/10 – 8/12	
	Range	Bedillion-Day Unit	2.35 mi NNE	7/10 – 9/10	7/10 – 9/10

Table C30 Southwestern Pennsylvania, Southern Area, Locations of Impoundments and Reserve Pits

EPA Sample	Operator	Nearest Well Pad to Impoundment/Reserve Pit	Approximate Distance from Sampling Point to Impoundment/Reserve Pit	Visible in Google Earth Aerial Imagery	
				Impoundment	Reserve Pit
SWPASW03	Range	Yeager Unit	0.1 mi NE	7/10 – 8/12	7/10 – 9/10
	Rice	Mojo Unit	1 mi ENE	8/12	
	Rice	Hulk Unit	2.5 mi ESE	8/12	
	Rice	X-Man Unit	2.8 mi NE	7/10-9/10	
	Range	Day Unit	2.6 mi NE	7/10 – 8/12	
	Range	Bedillion-Day Unit	1.9 mi NNE	7/10 – 9/10	7/10 – 9/10

Source: Well data and EPA sampling locations from EPA ORD database.

Table C31 Notice of Violations Summary, Southwestern Pennsylvania, Southern Area

Farm Name[a]	API Number	Number of Inspections	Date of Violation	Violations Identified by PADEP Inspector	Corrected[b]	Comment	Location (Township)	Longitude	Latitude	Operator
BAKER 1 OG WELL 1	125-23403	0	NA	NA	NA	Active	Amwell	80.2188710	40.0803340	T & F EXPLORATION LP
BAKER 2 OG WELL 2	125-23402	0	NA	NA	NA	Active	Amwell _	80.2188710	40.0803340	T & F EXPLORATION LP
BAKER R&M 1A	125-23471	1	NA	None	NA	Plugged	Amwell _	-80.2223290	40.0803030	RANGE RESOURCES APPALACHIA LLC
DAY L & L UNIT 1H	125-24207	6	NA	None	NA	Active	Amwell	-80.2457	40.075811	RANGE RESOURCES APPALACHIA LLC
DAY L & L UNIT 3H	125-24175	6	NA	None	NA	Active	Amwell	-80.245747	40.075769	RANGE RESOURCES APPALACHIA LLC
DAY L&L UNIT 2H	125-24046	5	NA	None	NA	Active	Amwell	-80.245667	40.075861	RANGE RESOURCES APPALACHIA LLC
DAY L&L UNIT 4H	125-24045	3	NA	None	NA	Active	Amwell	-80.245611	40.075889	RANGE RESOURCES APPALACHIA LLC
MOJO IV	125-24289	3	8/14/12	1. Failure to submit completion report within 30 days of completion of well. 2. Failure to submit well record within 30 days of completion of drilling.	Addressed Through Enforcement ($3,800)	Active	Amwell	-80.2125000	40.0884720	RICE DRILLING B LLC
MOJO 1H	125-24542	3	NA	None	NA	Active	Amwell	-80.2121940	40.0885280	RICE DRILLING B LLC
MOJO 2H-A	125-24348	8	NA	None	NA	Active	Amwell	-80.2126670	40.0887500	RICE DRILLING B LLC
MOJO 3H	125-24565	2	NA	None	NA	Active	Amwell	-80.2127250	40.0887810	RICE DRILLING B LLC
MOJO 4H	125-24566	3	NA	None	NA	Active	Amwell	-80.2127860	40.0888110	RICE DRILLING B LLC
MOJO G2	125-24629	1	NA	None	NA	Operator Reported Not Drilled	Amwell	80.2124250	40.0886330	RICE DRILLING B LLC
MOJO G3	125-24630	1	NA	None	NA	Operator Reported Not Drilled	Amwell _	80.2124860	40.0886640	RICE DRILLING B LLC
MOJO G4	125-24631	3	NA	None	NA	Active	Amwell _	-80.2125440	40.0886920	RICE DRILLING B LLC
MOJO Freshwater Pit	NA	NI	NA	NA	NA	ESCGP expedited	Amwell			RICE DRILLING B LLC
PHELAN UNIT 4H	125-24274	8	NA	None Compliance record indicates that on 1/29/11: Responded to 7:30 pm call about a possible well control issue at this Marcellus well. While drilling with air an unexpected amount of gas was encountered at 7525 feet. Range implemented a soft shut in. Universal pumped 726 bbls of 12.9# to 14.5# mud and the well had 0# pressure at 10:30 pm. The well will be monitored throughout the night.	NA	Active	South Franklin	-80.2458390	40.0908750	RANGE RESOURCES APPALACHIA LLC
PHELAN UNIT 6H	125-24276	1	NA	None	NA	Inactive (plugged)	South Franklin	-80.2457000	40.0908470	RANGE RESOURCES APPALACHIA LLC
PHELAN UNIT 7H	125-24298	1	NA	None	NA	Inactive (plugged)	South Franklin	-80.2456390	40.0908080	RANGE RESOURCES APPALACHIA LLC
PHELAN UNIT 10H	125-24273	1	NA	None	NA	Inactive (plugged)	South Franklin	-80.2456310	40.0908360	RANGE RESOURCES APPALACHIA LLC
RESERVE NV22 OG WELL 22	125-23675	0	NA	NA	NA	Active	Amwell	80.2357690	40.1036970	CNX GAS CO LLC
SIERZEGA UNIT 2H	125-23852	11	12/9/10	1. Failure to properly control or dispose of industrial or residual waste to prevent pollution of the Waters of the Commonwealth. 2. Failure to properly store, transport, process, or dispose of a residual waste.	Yes ($18,025) Violations immediately corrected	Active	Amwell _	-80.2245830	40.0783890	RANGE RESOURCES APPALACHIA LLC

Table C31 Notice of Violations Summary, Southwestern Pennsylvania, Southern Area

Farm Name[a]	API Number	Number of Inspections	Date of Violation	Violations Identified by PADEP Inspector	Corrected[b]	Comment	Location (Township)	Longitude	Latitude	Operator
			12/29/10	1. Failure to properly control or dispose of industrial or residual waste to prevent pollution of the Waters of the Commonwealth. 2. Failure to properly store, transport, process, or dispose of a residual waste. Compliance database record indicates this was due to: Incident- Response to Accident or Event.	Yes ($59,000)					
			1/3/11	1. Failure to properly control or dispose of industrial or residual waste to prevent pollution of the Waters of the Commonwealth. 2. Failure to properly store, transport, process, or dispose of a residual waste.	Yes ($26,250) Noted & Immediately Corrected					
			1/13/11	1. Failure to properly control or dispose of industrial or residual waste to prevent pollution of the Waters of the Commonwealth. 2. Failure to properly store, transport, process, or dispose of a residual waste. 3. Stream discharge of industrial waste, includes drill cuttings, oil, brine and/or silt.	Yes ($26,250)					
			8/30/11	Violations outstanding linked to inspection 1963840, ENF#269290 on 1/13/11	Yes ($26,250)					
SIERZEGA UNIT 3H	125-23851	7	NA	None	NA	Active	Amwell	-80.2245560	40.0783610	RANGE RESOURCES APPALACHIA LLC
SIERZEGA UNIT 4H	125-23850	5	NA	None	NA	Inactive (plugged)	Amwell	-80.2245280	40.0783890	RANGE RESOURCES APPALACHIA LLC
SIERZEGA UNIT 5H	125-23849	7	NA	None	NA	Active	Amwell	-80.2245560	40.0784170	RANGE RESOURCES APPALACHIA LLC
SIERZEGA UNIT 6H	125-24024	9	NA	None	NA	Active	Amwell	-80.2243330	40.0785280	RANGE RESOURCES APPALACHIA LLC
SIERZEGA UNIT 7H	125-24023	5	NA	None	NA	Active	Amwell	-80.2243610	40.0785560	RANGE RESOURCES APPALACHIA LLC
SIERZEGA UNIT 8H	125-23937	3	NA	None	NA	Active	Amwell	-80.2247500	40.0782500	RANGE RESOURCES APPALACHIA LLC
SIERZEGA UNIT 9H	125-23938	5	NA	None	NA	Active	Amwell	-80.2246940	40.0783060	RANGE RESOURCES APPALACHIA LLC
SIERZEGA UNIT 11H	125-23958	5	NA	None	NA	Active	Amwell	-80.2244720	40.0784720	RANGE RESOURCES APPALACHIA LLC
SIERZEGA UNIT 12H	125-23959	5	NA	None	NA	Active	Amwell	-80.2244440	40.0784440	RANGE RESOURCES APPALACHIA LLC
SIERZEGA UNIT 13H	125-23960	4	NA	None	NA	Inactive (plugged)	Amwell	-80.2243890	40.0785000	RANGE RESOURCES APPALACHIA LLC
SIERZEGA UNIT 14H	125-23961	5	NA	None	NA	Inactive (plugged)	Amwell	-80.2244170	40.0785280	RANGE RESOURCES APPALACHIA LLC
WILLIAM B BAKER 518 WELL 518	125-20162	0	NA	NA	NA	Inactive	Amwell	80.2188710	40.0803340	EQUITABLE RESOURCES EXPLORATION
YEAGER UNIT 1H	125-23911	3	NA	None	NA	Active/ Spudded on 12/23/10, but not developed.	Amwell	-80.2278330	40.0913610	RANGE RESOURCES APPALACHIA LLC
YEAGER UNIT 1H	125-24314	3	NA	None	NA	Active/ Spudded on 12/23/10, but not developed.	Amwell	-80.2278420	40.0913280	RANGE RESOURCES APPALACHIA LLC
YEAGAR UNIT 2H	125-23783	2	NA	None	NA	Regulatory Inactive Status/ Spudded on 12/23/10, but not developed	Amwell	-80.2278060	40.0912780	RANGE RESOURCES APPALACHIA LLC

Table C31 Notice of Violations Summary, Southwestern Pennsylvania, Southern Area

Farm Name[a]	API Number	Number of Inspections	Date of Violation	Violations Identified by PADEP Inspector	Corrected[b]	Comment	Location (Township)	Longitude	Latitude	Operator
YEAGAR UNIT 2H	125-24315	4	NA	None	NA	Active	Amwell	-80.2277970	40.0912860	RANGE RESOURCES APPALACHIA LLC
YEAGAR UNIT 7H	125-23824	16	3/25/10	Oil & Gas Act 223 - General. Used only when a specific O&G Act code cannot be used. Compliance database: Failed to control and dispose waste (78.54) (not in eFacts)	Yes ($49,500)	Active	Amwell	-80.228111	40.091528	RANGE RESOURCES APPALACHIA LLC
			2/8/11	1. Failure to properly control or dispose of industrial or residual waste to prevent pollution of the Waters of the Commonwealth. 2. Failure to properly store, transport, process, or dispose of a residual waste.	Yes ($18,025)					
			7/14/11	1. Stream discharge of industrial waste includes drill cuttings, oil, brine and/or silt. Compliance database record: Entered on 10/11/13 as an Admin/File Review inspection (there is no paper inspection report) for inspection done on 7/14/11; there is no CEI for this as this incident was corrected and addressed through enforcement. (CACP) Observed Deans Water Service truck discharging water into abandoned well pit area; called Range and was informed this was to determine communication possibilities. Observed second truck arrive on site.	Yes ($22,250), addressed through enforcement					
Yeager Centralized Impoundment Dam	NA	129	8/30/10	1. Failure to properly store, transport, process or dispose of a residual waste. 2. Failure to properly control or dispose of industrial or residual waste to prevent pollution of the waters of the Commonwealth.	Resolution not recorded	NA	Amwell	-80.2609940	40.0895360	RANGE RESOURCES APPALACHIA LLC

Source: Pennsylvania DEP website eFACTS at http://www.ahs.dep.pa.gov/eFACTSWeb/criteria_site.aspx - last accessed in January 2014
http://www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?%2fOil_Gas%2fOG_Compliance&rs:Command=Render - Accessed January 2014.

Notes:

[a]This table does not include wells that are reported as "proposed but never materialized" or "operator reported not drilled", if there were no inspections performed at the proposed well sites.

[b]Dollar amount shown indicates fine assessed. Fine may apply to multiple sites/facilities.

Key:

API = American Petroleum Industry.
bbl = Barrel.
CACP = Consent Assessment of Civil Penalty.
CEI = Compliance Evaluation Inspection.
DEP = Department of Environmental Protection.
NA = Not applicable.
NI = No information available.
O&G = Oil and Gas.
PA = Pennsylvania.

Table C32 Notable Notice of Violations - Identified Potential Candidate Causes and Distances (less than 2 Miles) to EPA Sampling Points, Southwestern Pennsylvania, Southern Area

Well	Latitude	Longitude	EPA Sampling Point	
			ID	Distance (miles)
Yeager Unit 7H	40.091527	-80.228111	SWPAGW10	0.3 SW
			SWPAGW11	0.5 SW
			SWPAGW12	0.3 SW
			SWPAGW13	0.1 NW
			SWPASW03	0.3 SW
Yeager Impoundment	40.089536	-80.260994	SWPAGW10	0.2 SW
			SWPAGW11	0.3 SW
			SWPAGW12	0.1 SW
			SWPAGW13	0.3 NW
			SWPASW03	0.2 SW
Sierzega Unit 2H	40.078388	-80.224583	SWPAGW10	0.7 NW
			SWPAGW11	0.6 NW
			SWPAGW12	0.7 NW
			SWPAGW13	1.0 NW
			SWPASW03	0.8 NW

Key:

EPA = Environmental Protection Agency.
ID = Identification.
NW = Northwest.
SW = Southwest.

Appendix C Figures

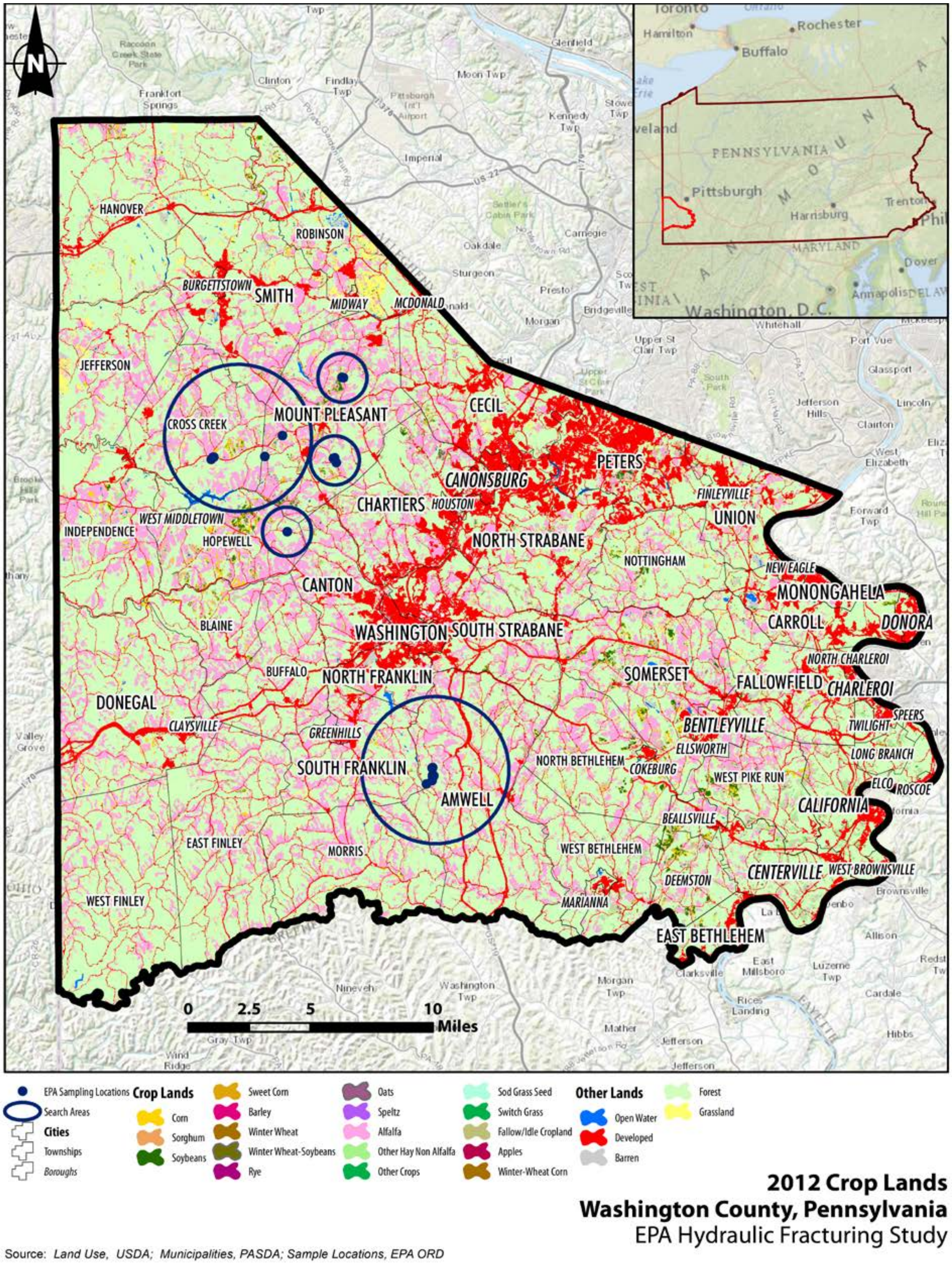

Figure C-1 2012 Crop Lands

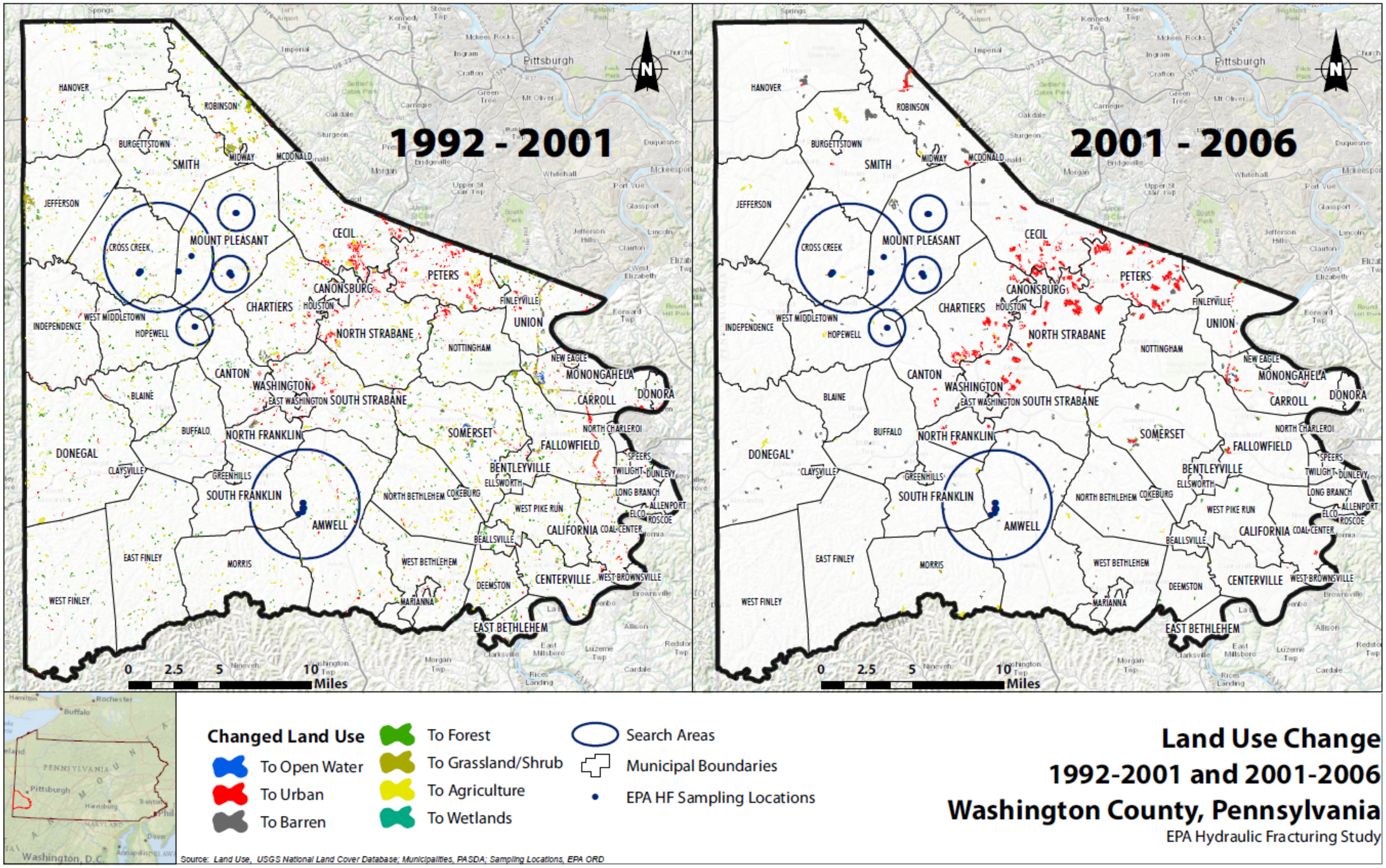

Figure C-2 Land Use Change, 1992-2001 and 2001-2006

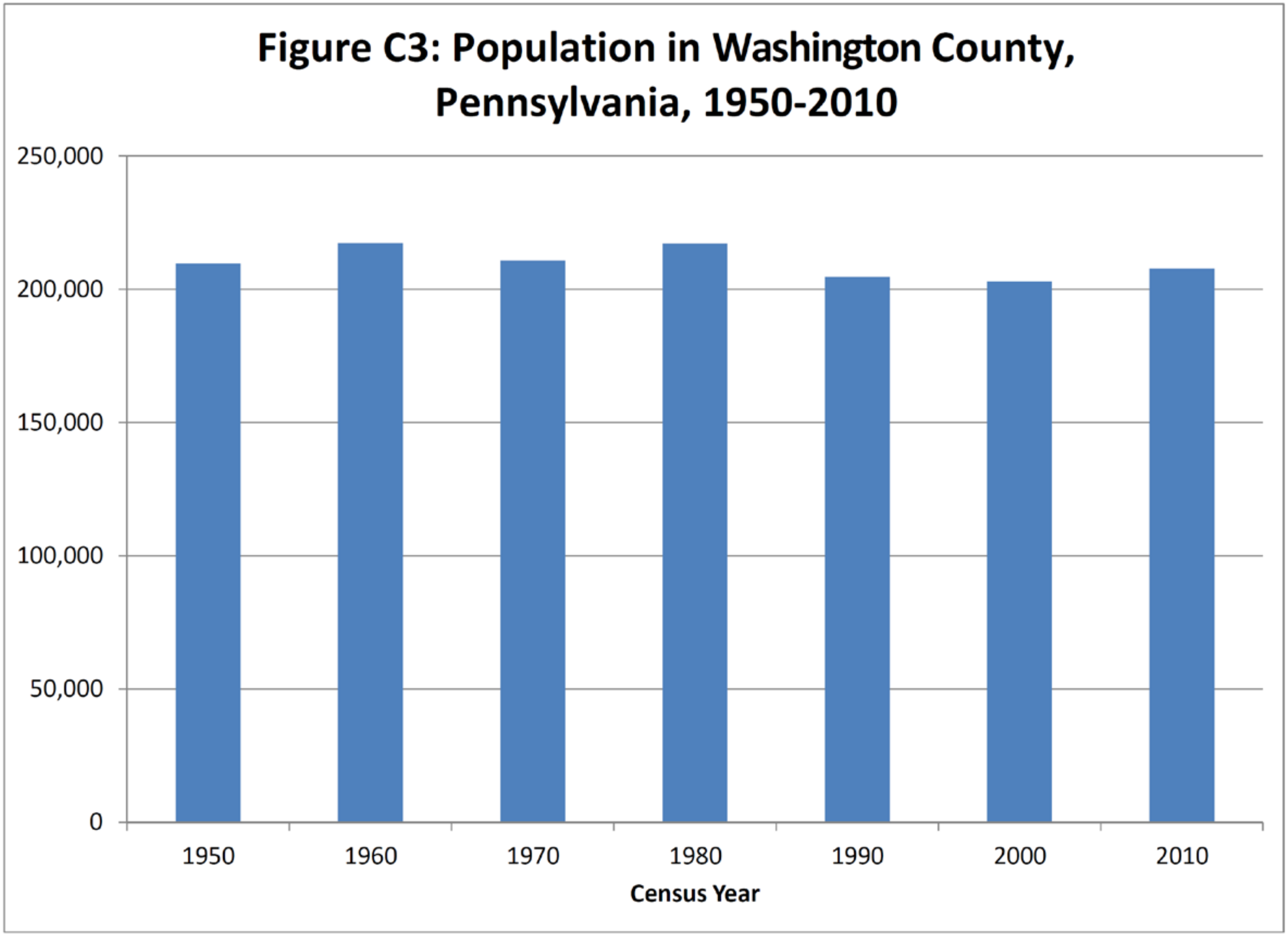
Figure C3: Population in Washington County, Pennsylvania, 1950-2010
250,000
200,000
150,000
100,000
50,000
0
1950
1960
1970
1980
1990
2000
2010
Census Year

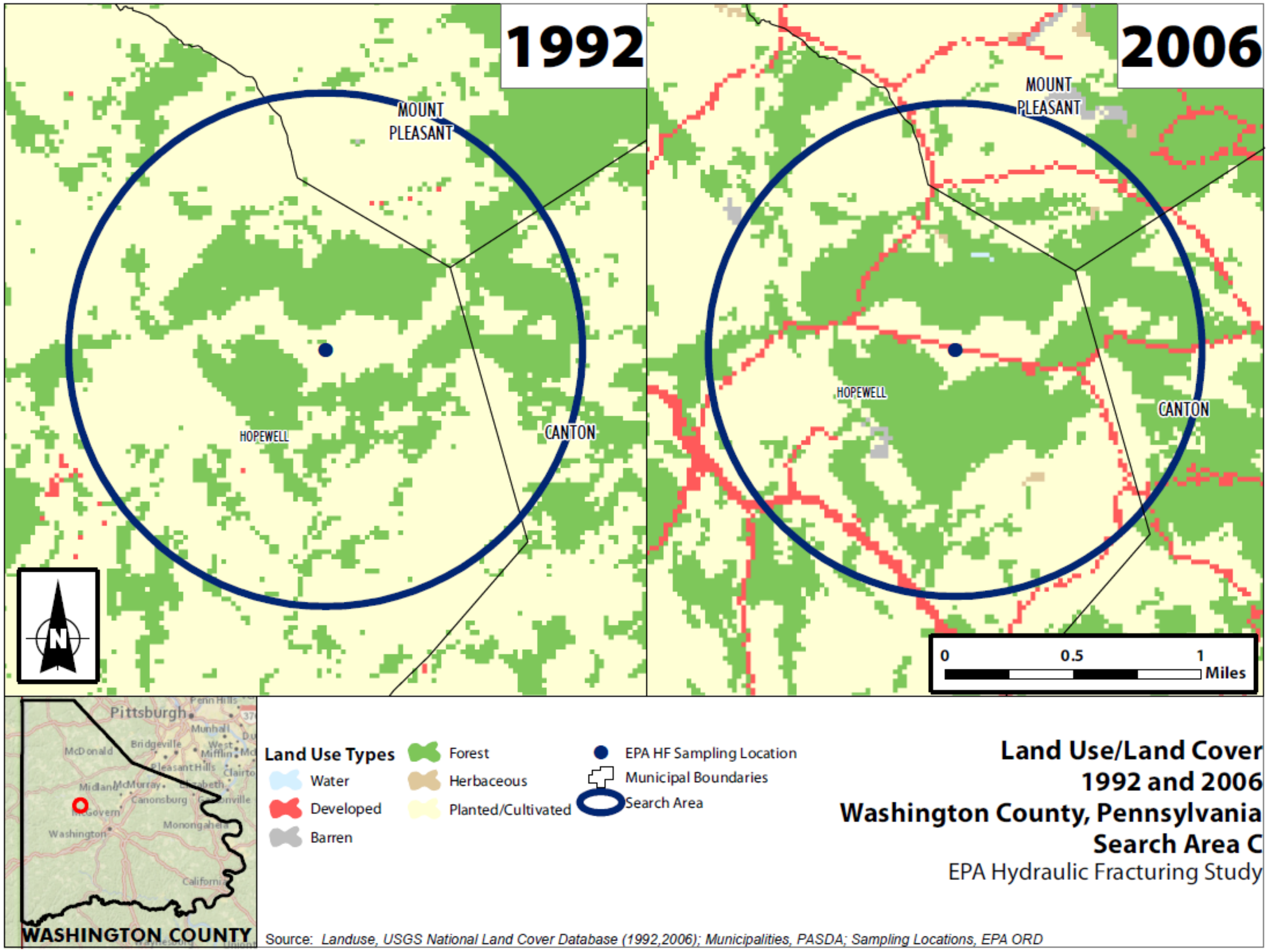

Figure C-4 Land Use/Land Cover 1992 and 2006, Search Area C

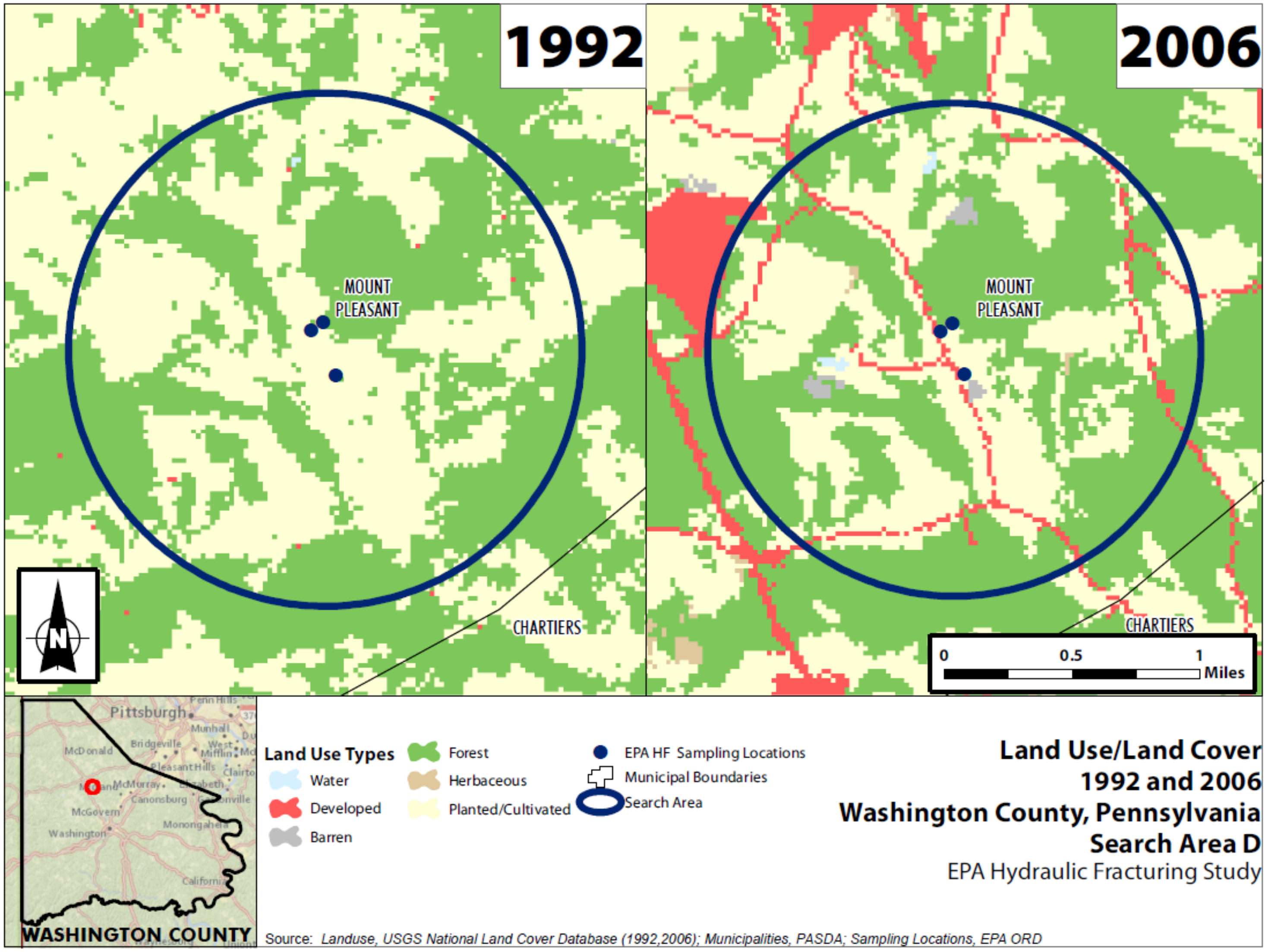

Figure C-5 Land Use/Land Cover 1992 and 2006, Search Area D

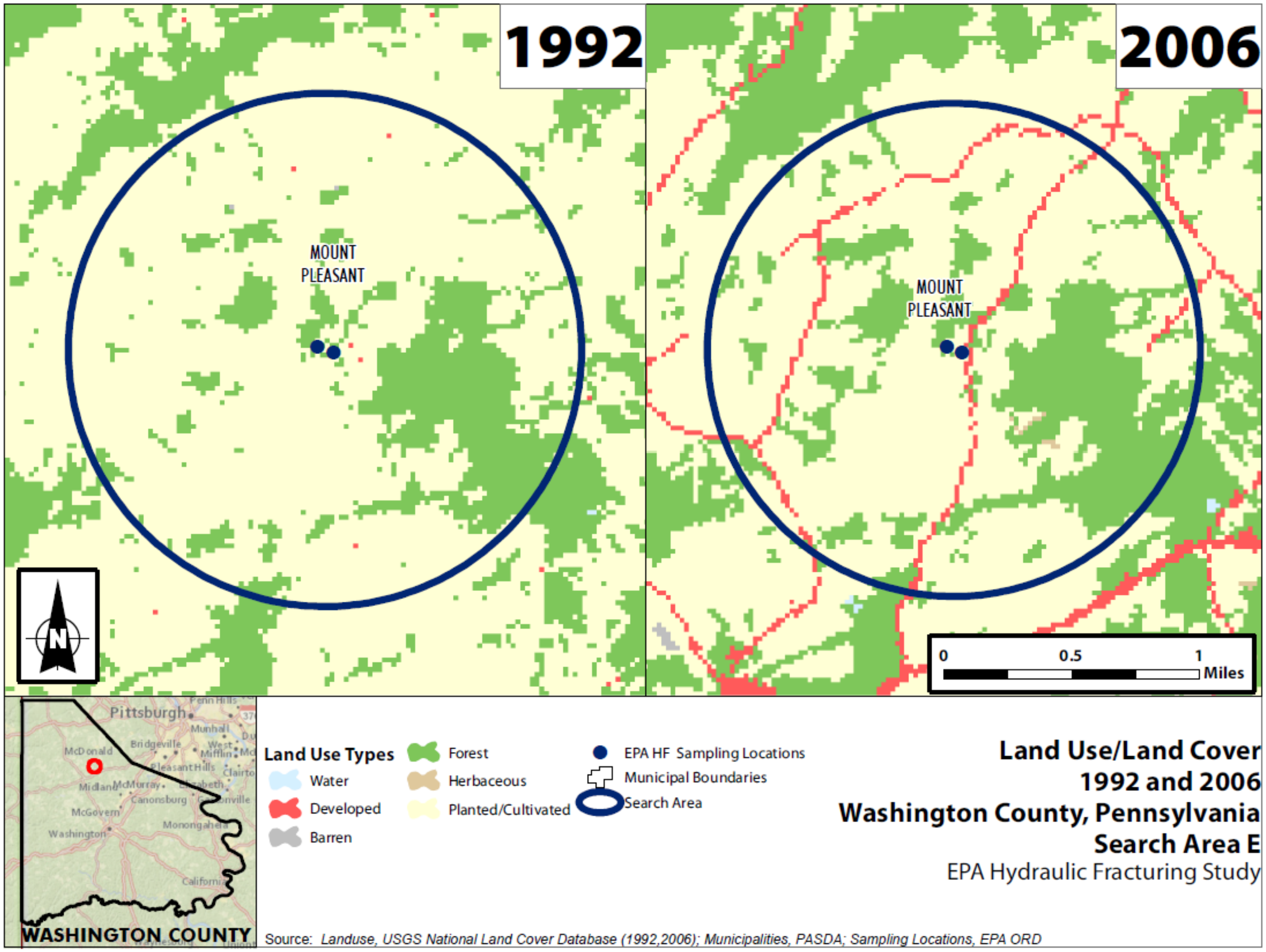

Figure C-6 Land Use/Land Cover 1992 and 2006, Search Area E

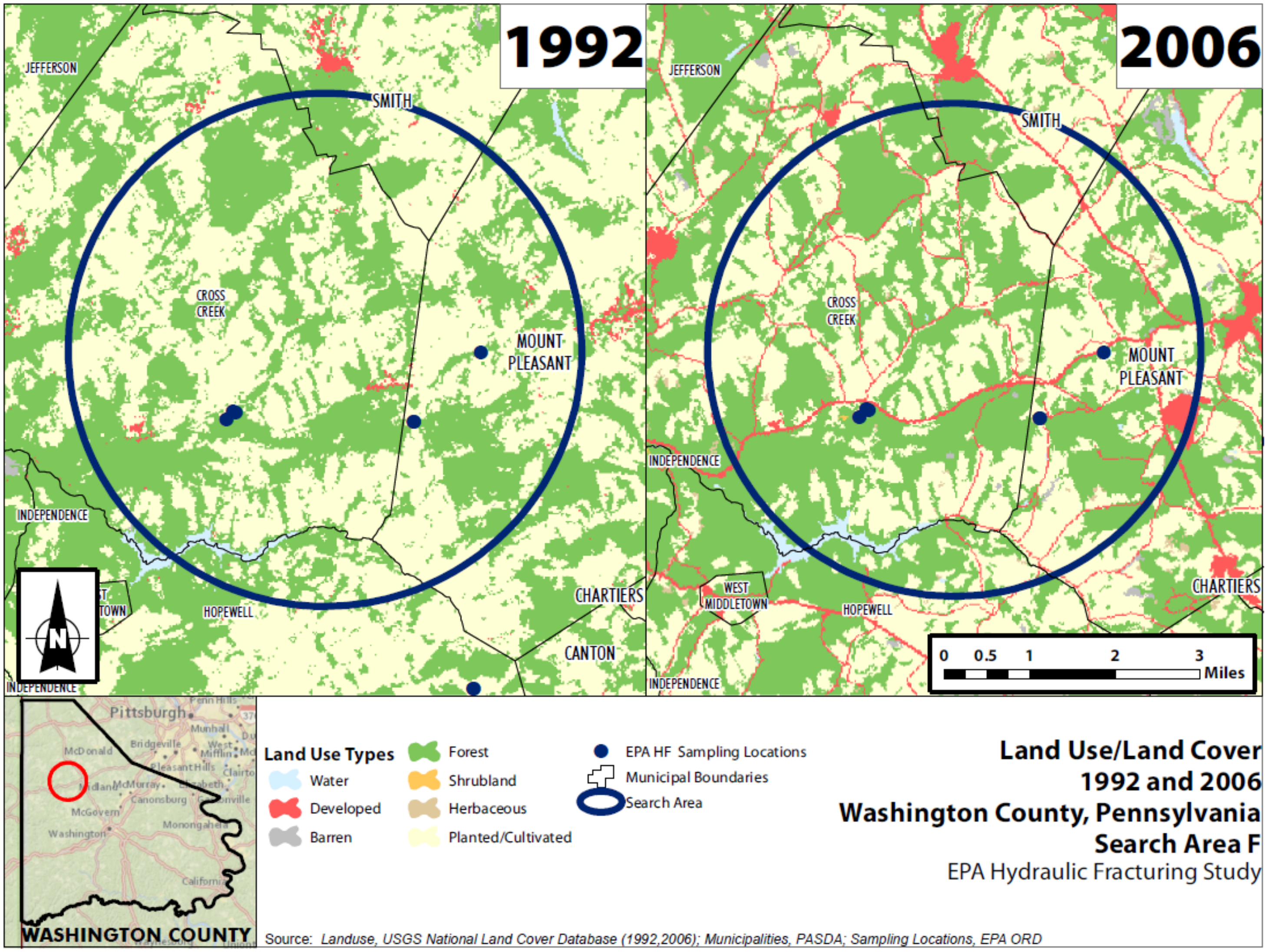

Figure C-7 Land Use/Land Cover 1992 and 2006, Search Area F

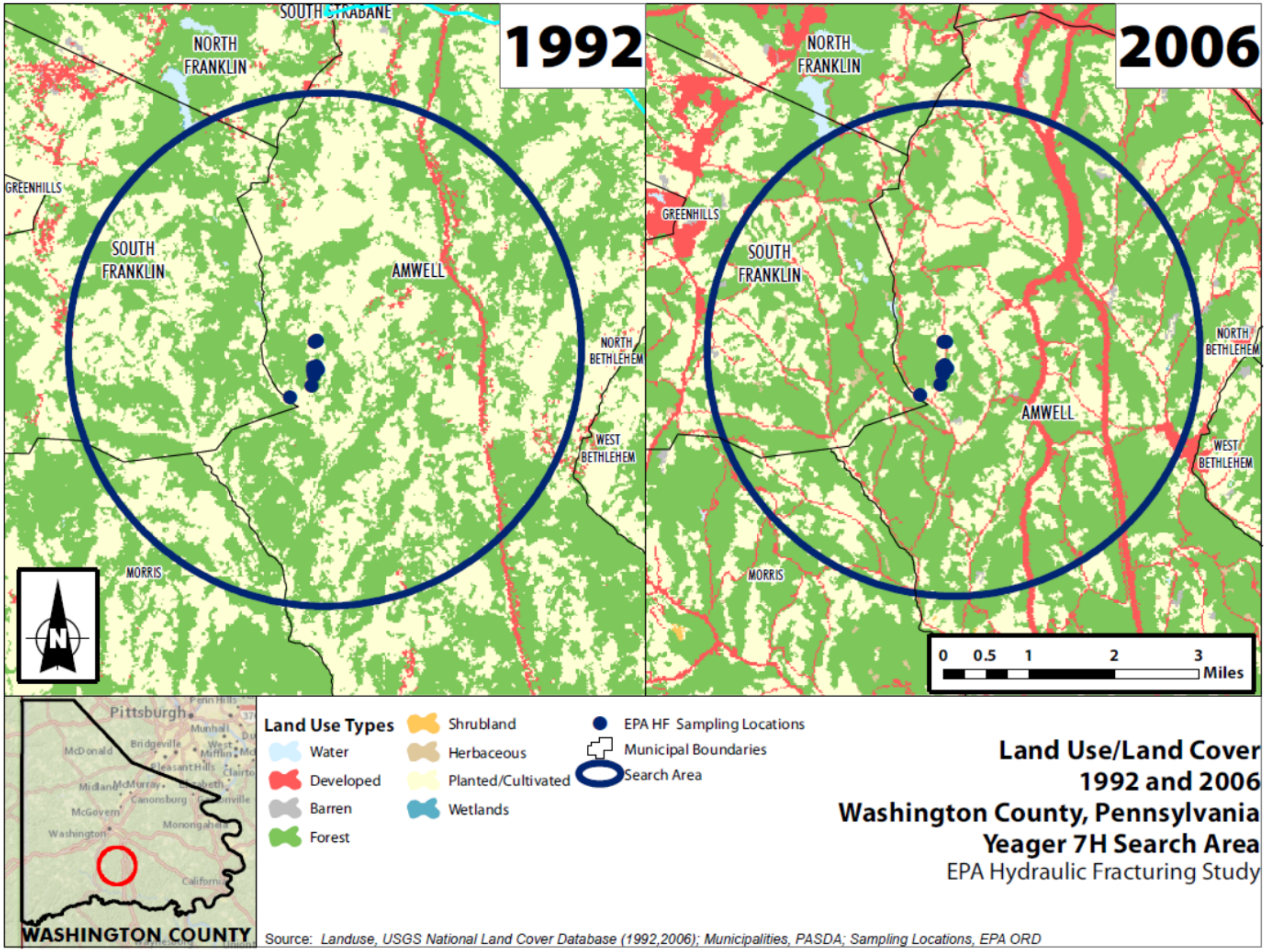

Figure C-8 Land Use/Land Cover 1992 and 2006, Search Area 7H

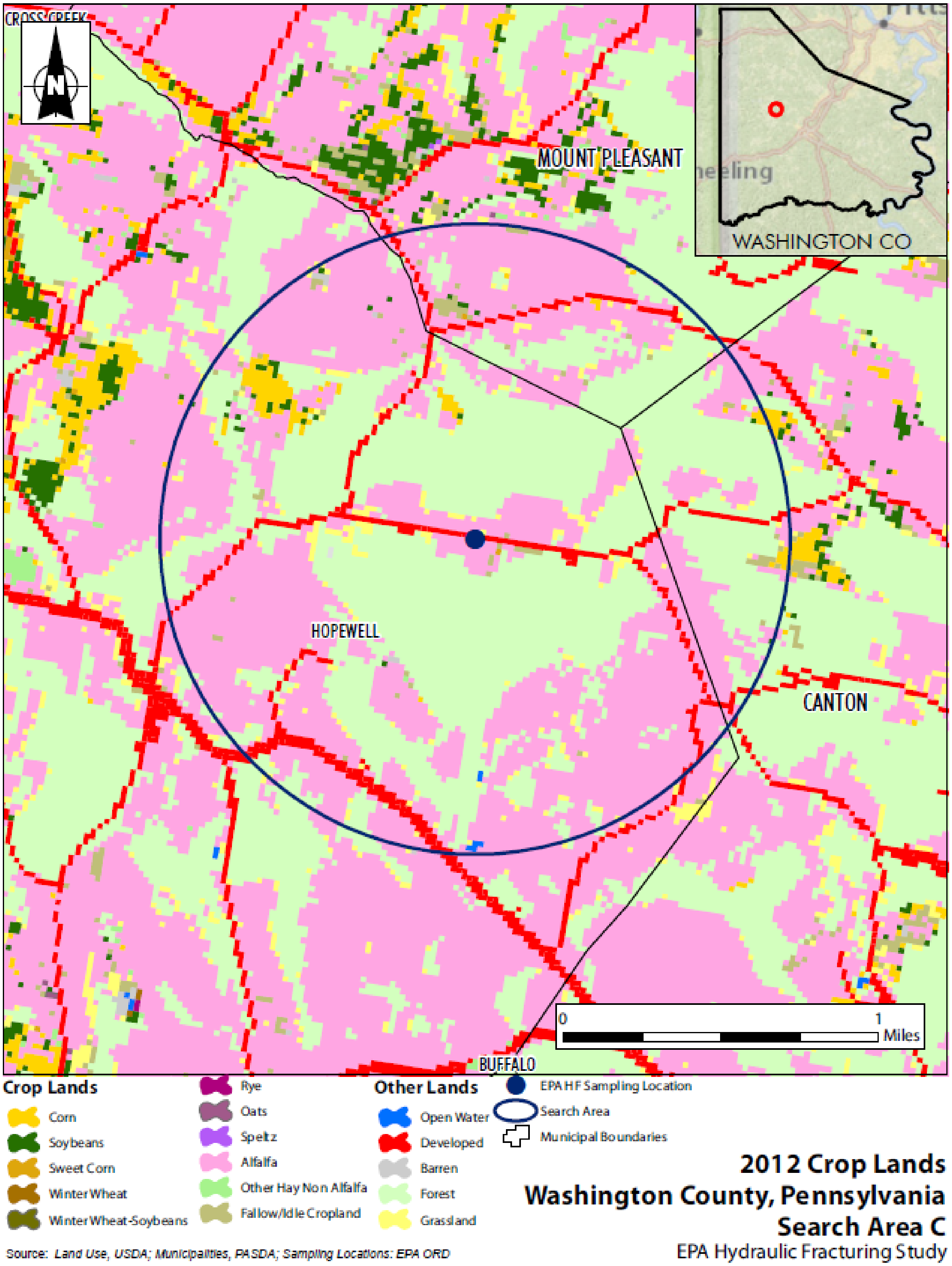

Figure C-9 2012 Crop Lands, Search Area C

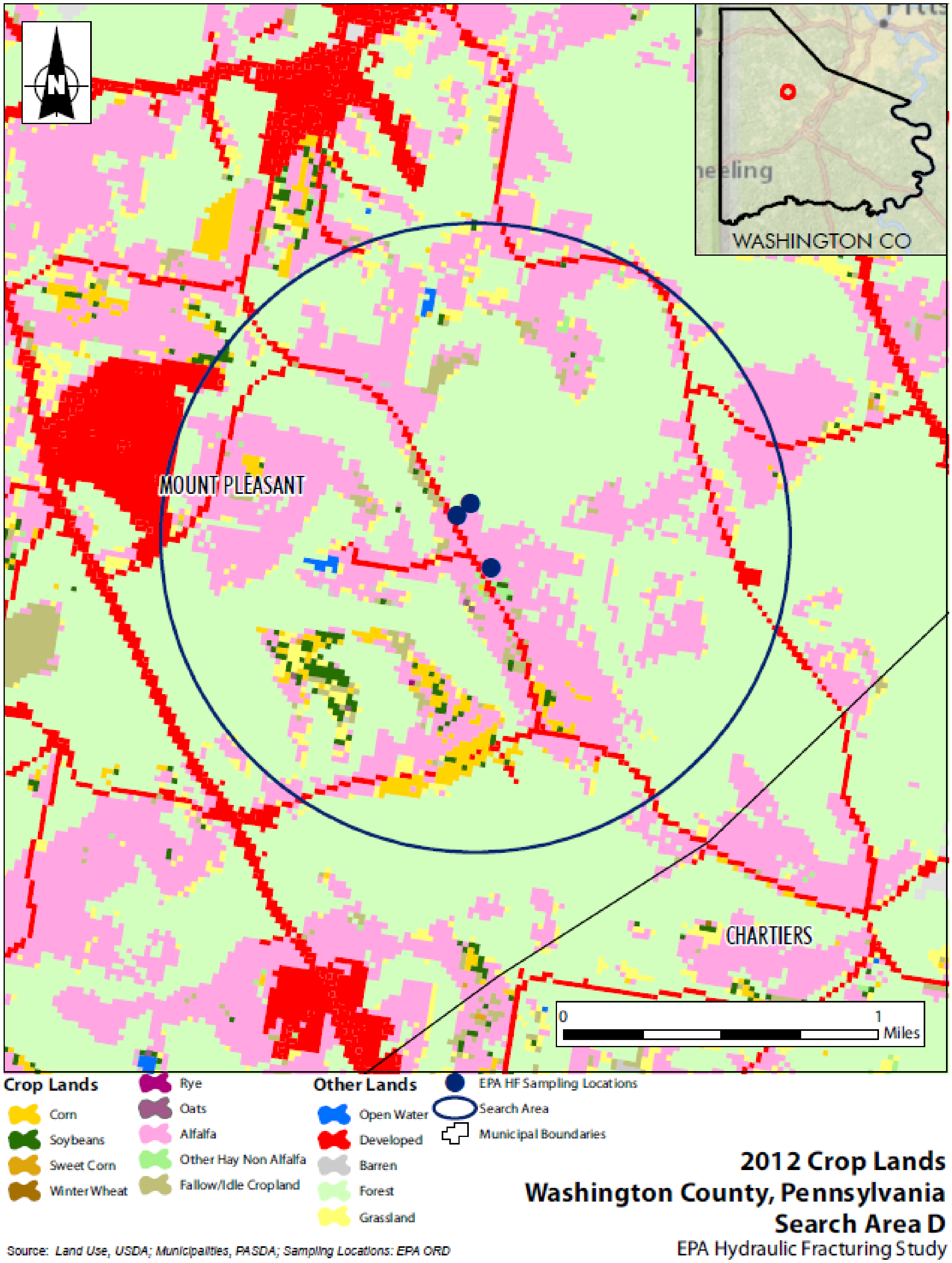

Figure C-10 2012 Crop Lands, Search Area D

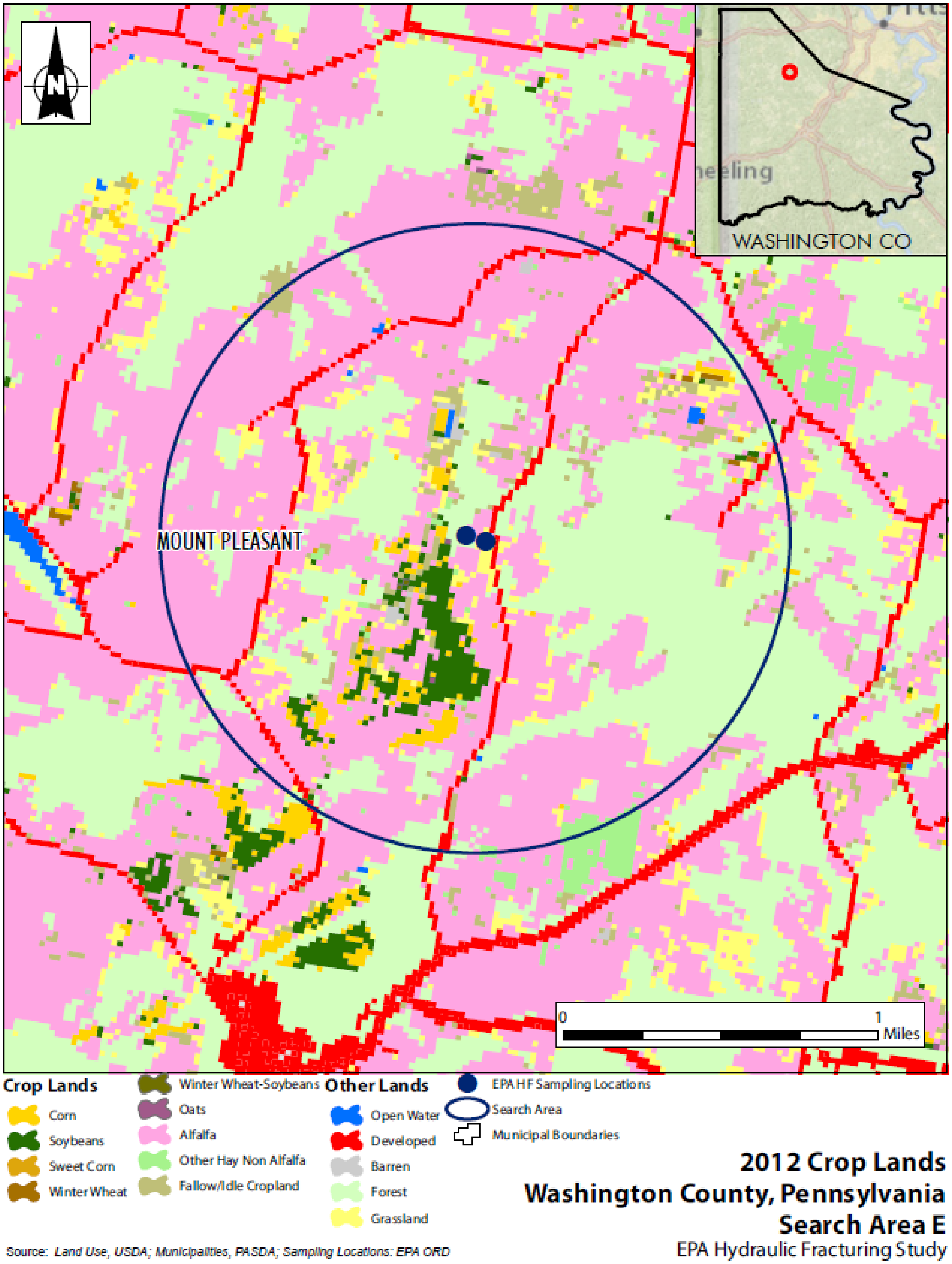

Figure C-11 2012 Crop Lands, Search Area E

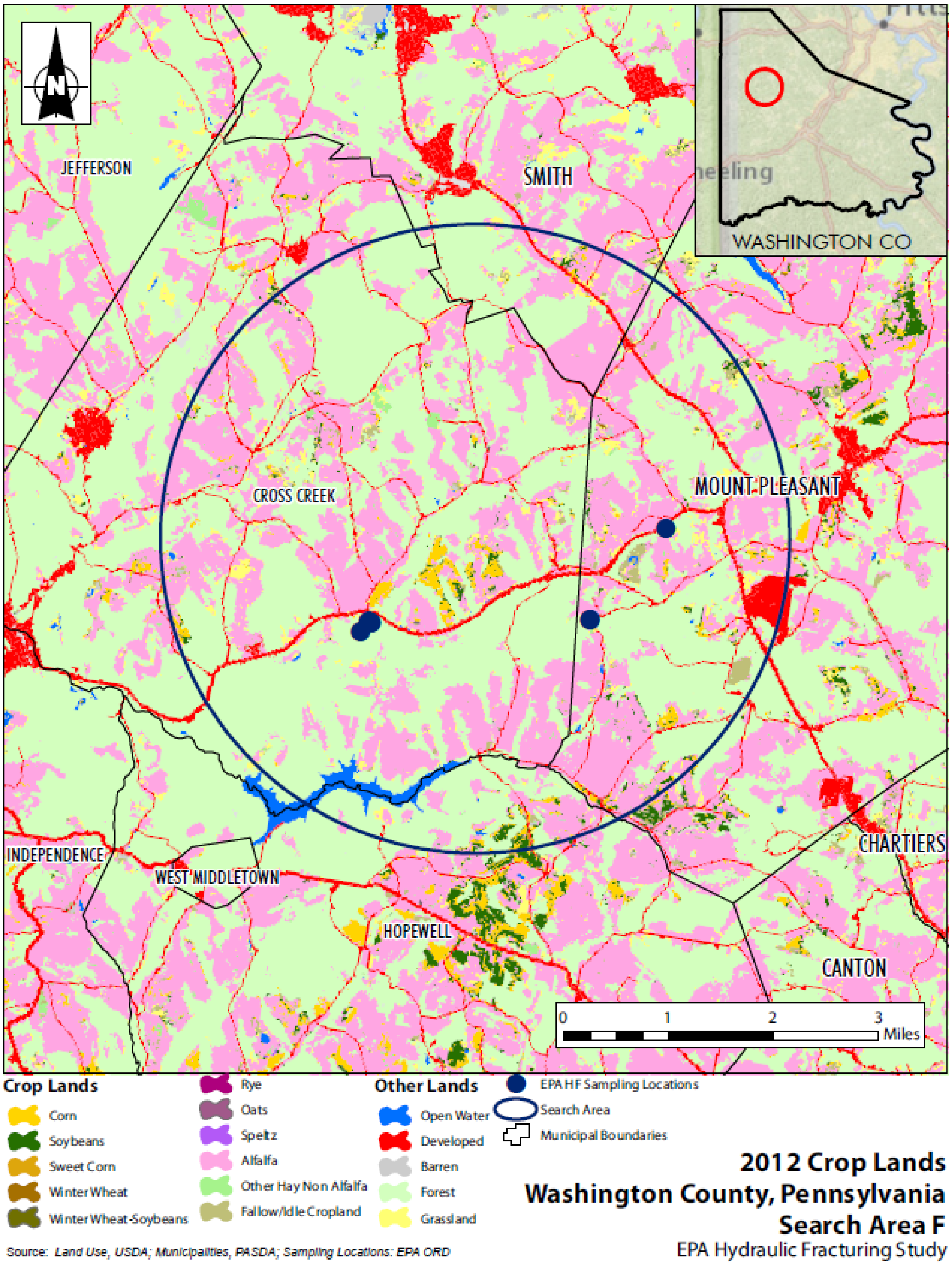

Figure C-12 2012 Crop Lands, Search Area F

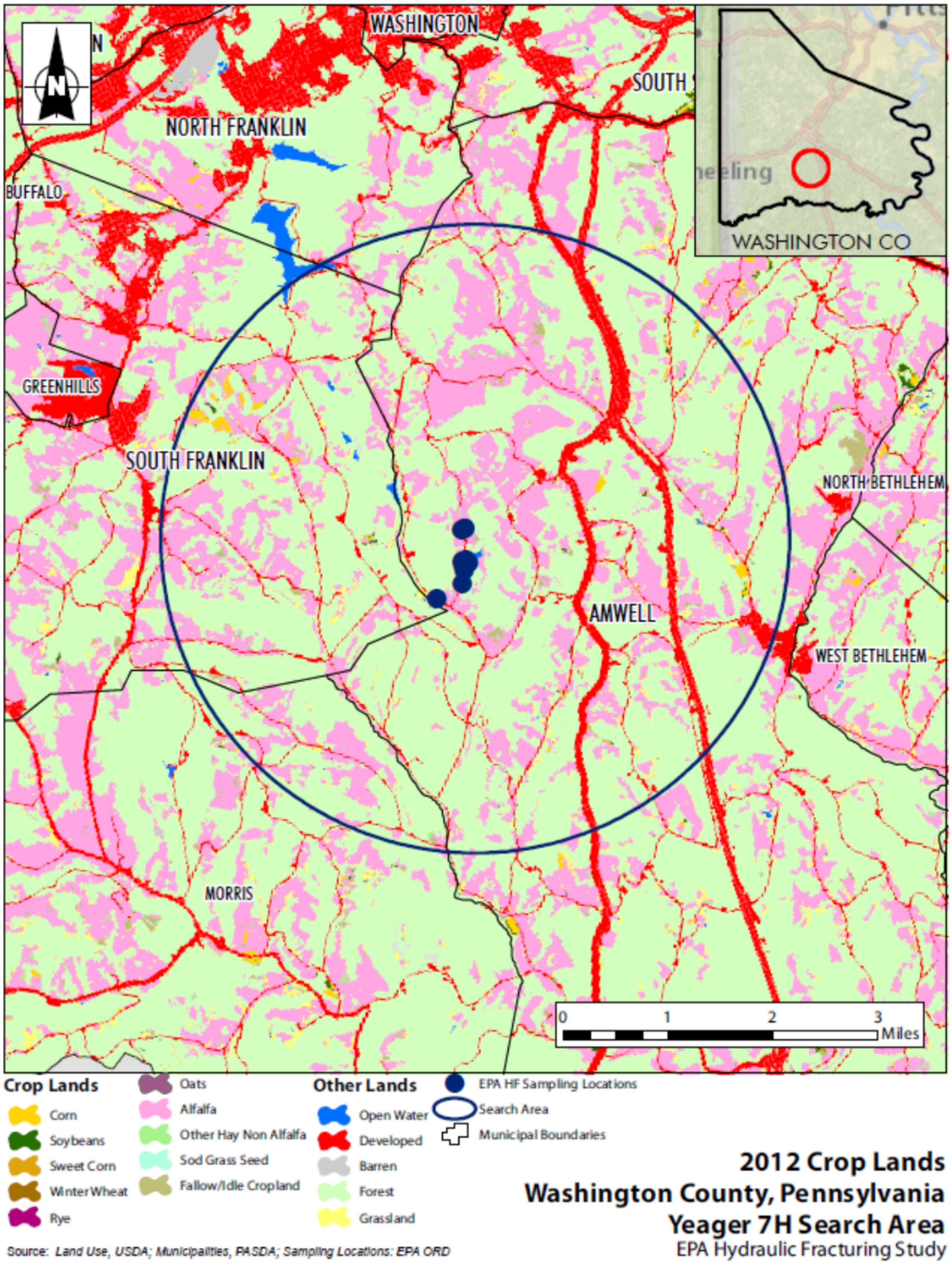

Figure C-13 2012 Crop Lands, Search Area 7H

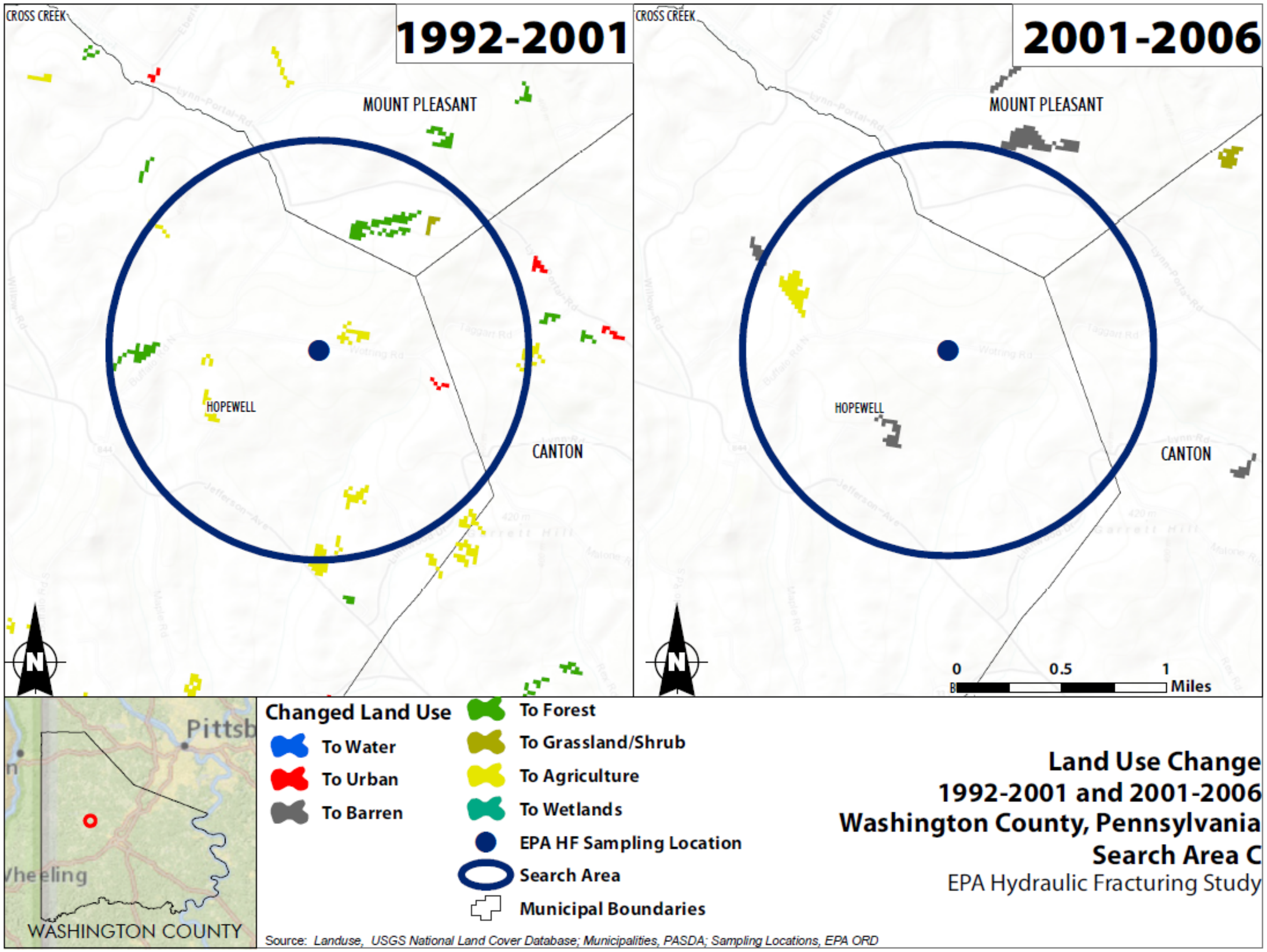

Figure C-14 Land Use Change, 1992-2001 and 2001-2006, Search Area C

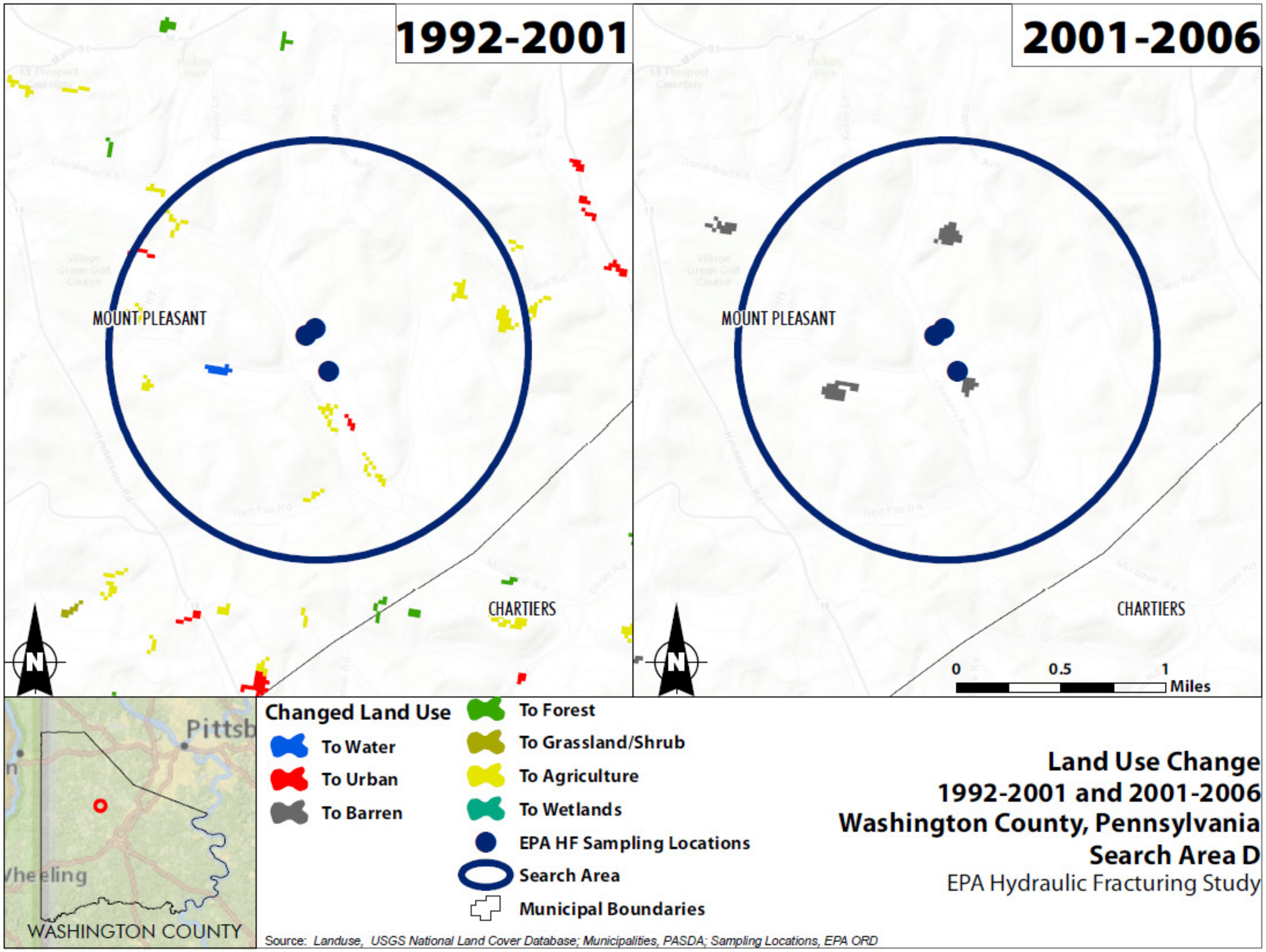

Figure C-15 Land Use Change, 1992-2001 and 2001-2006, Search Area D

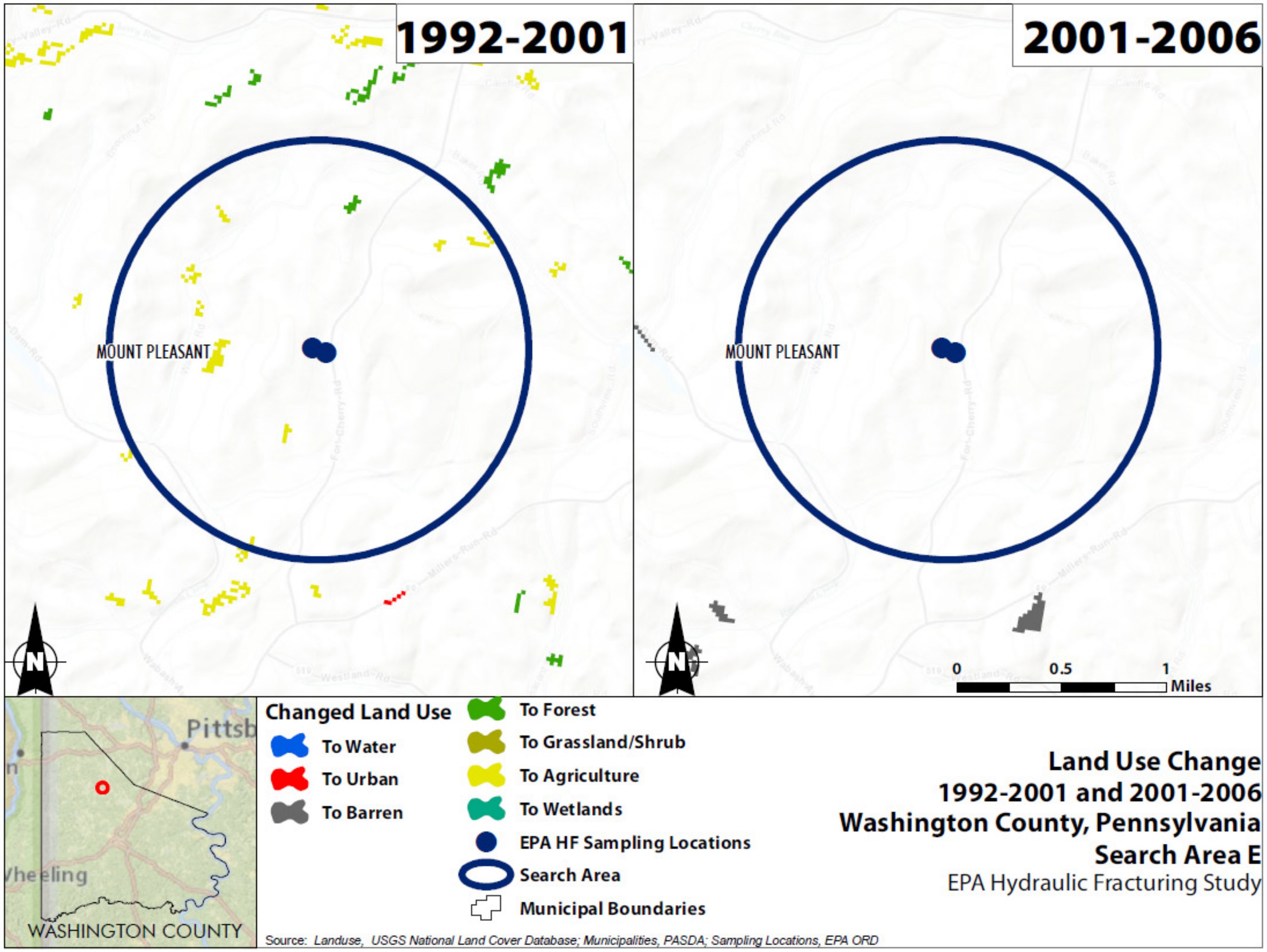

Figure C-16 Land Use Change, 1992-2001 and 2001-2006, Search Area E

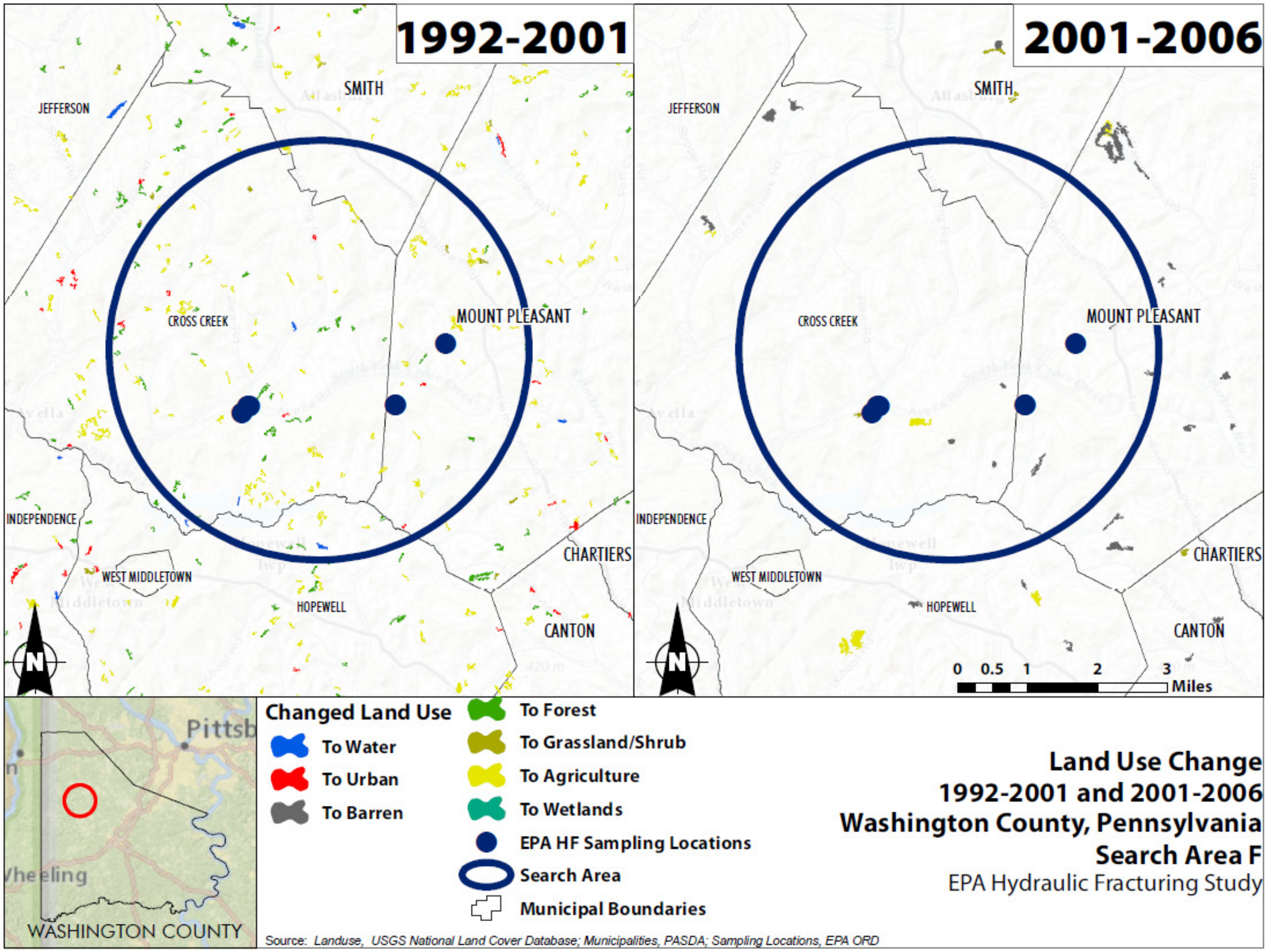

Figure C-17 2012 Crop Lands, Search Area F

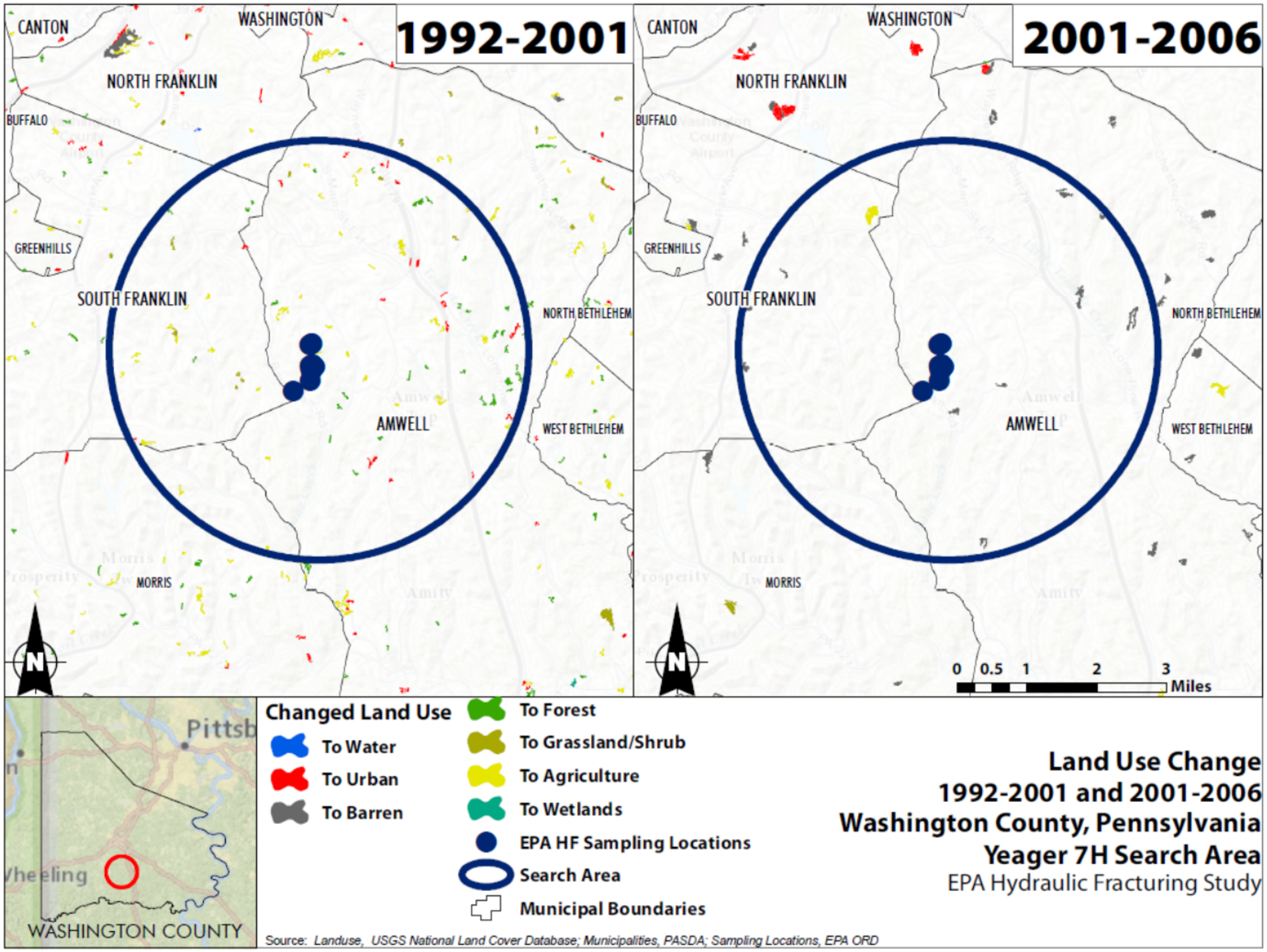

Figure C-18 Land Use Change, 1992-2001 and 2001-2006, Search Area 7H

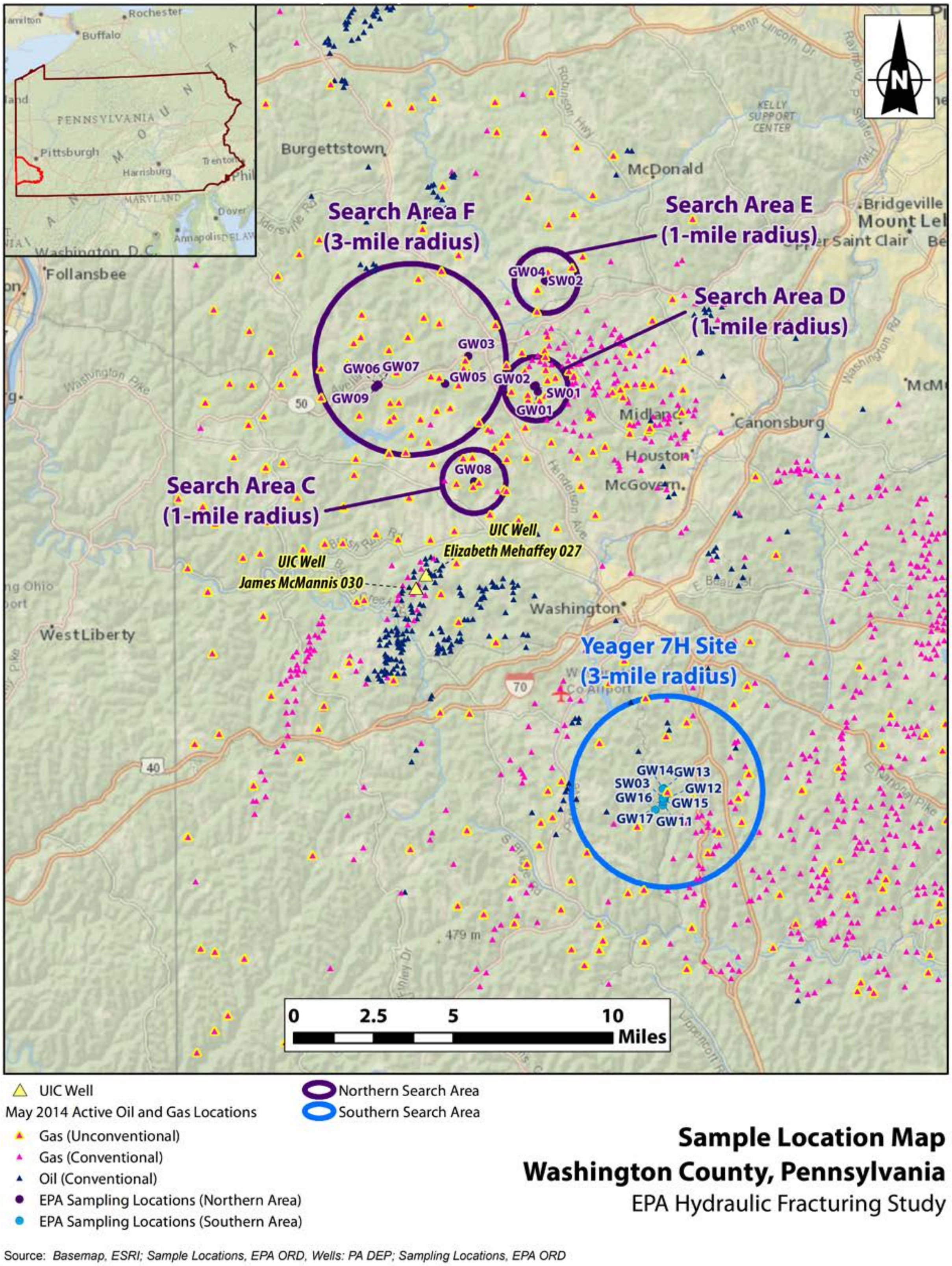

Figure C-19 Sample Location Map

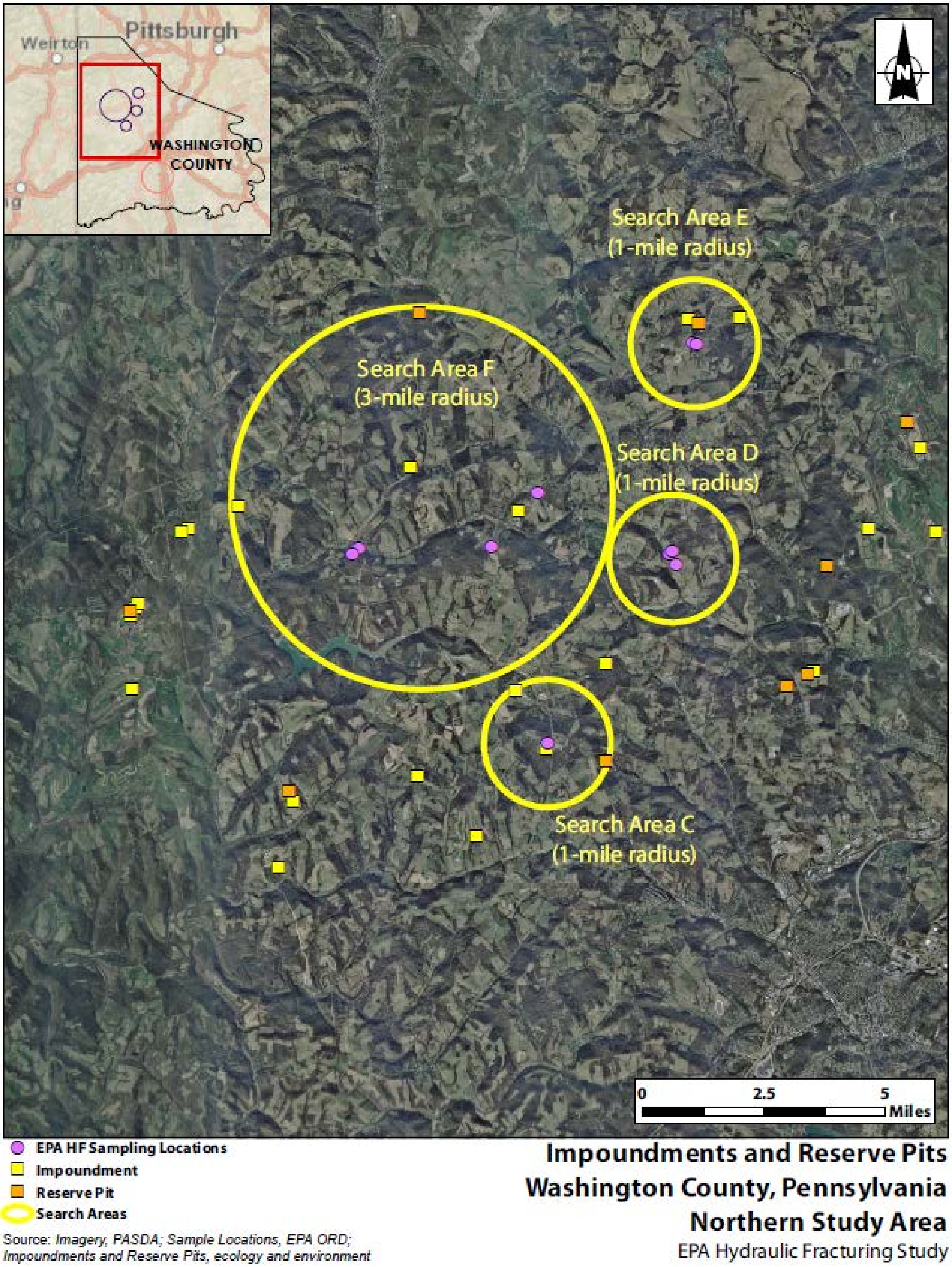

Figure C-20 Impoundments and Reserve Pits, Northern Area

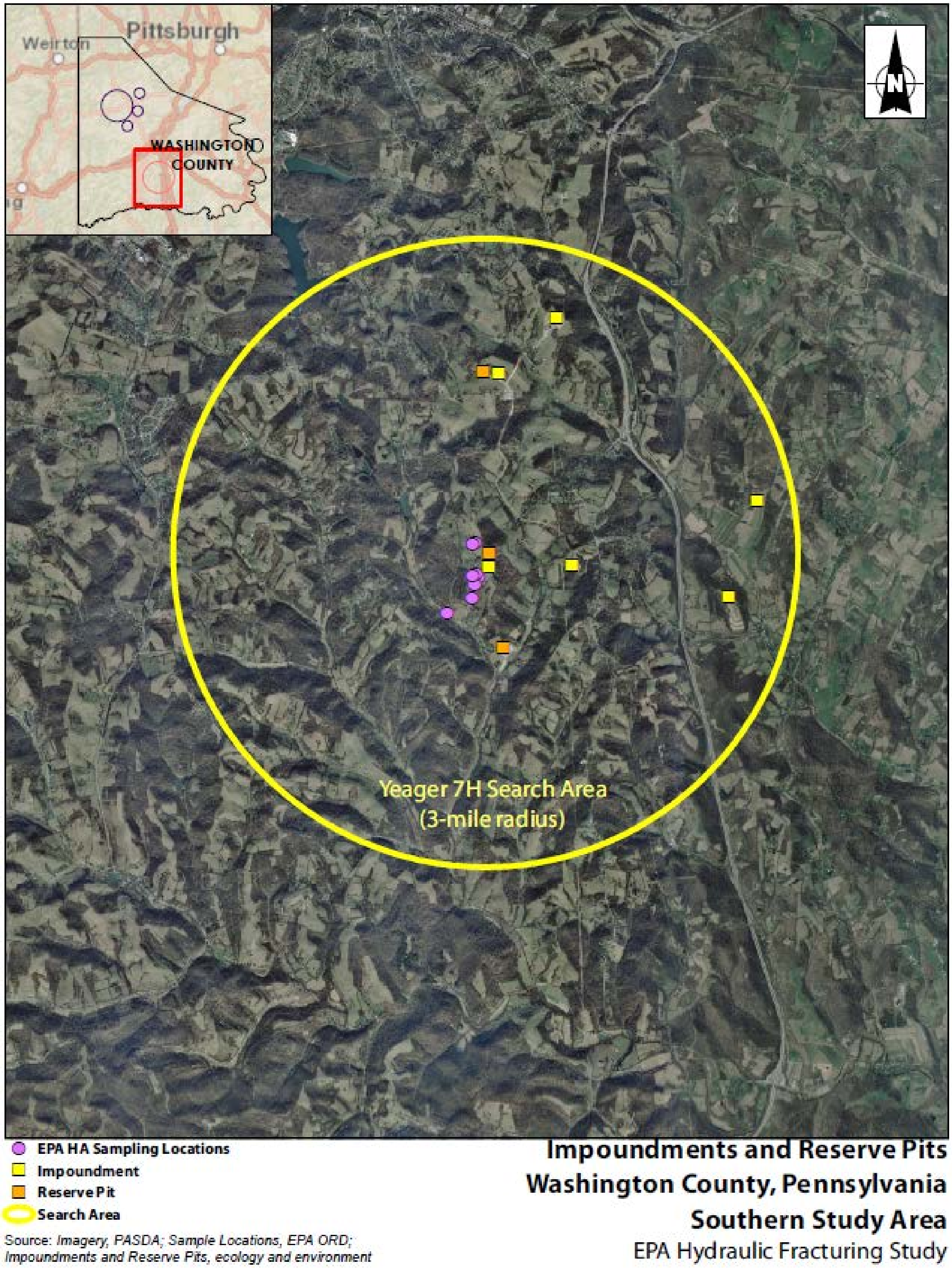

Figure C-21 Impoundments and Reserve Pits, Southern Area

Attachment 1 EDR Record Search

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Number of Days to Update: Provides confirmation that EDR is reporting records that have been updated within 90 days from the date the government agency made the information available to the public.

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL: National Priority List

National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 02/01/2013	Source: EPA
Date Data Arrived at EDR: 03/01/2013	Telephone: N/A
Date Made Active in Reports: 03/13/2013	Last EDR Contact: 05/09/2013
Number of Days to Update: 12	Next Scheduled EDR Contact: 07/22/2013
	Data Release Frequency: Quarterly

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1 Telephone 617-918-1143	EPA Region 6 Telephone: 214-655-6659
EPA Region 3 Telephone 215-814-5418	EPA Region 7 Telephone: 913-551-7247
EPA Region 4 Telephone 404-562-8033	EPA Region 8 Telephone: 303-312-6774
EPA Region 5 Telephone 312-886-6686	EPA Region 9 Telephone: 415-947-4246
EPA Region 10 Telephone 206-553-8665	

Proposed NPL: Proposed National Priority List Sites

A site that has been proposed for listing on the National Priorities List through the issuance of a proposed rule in the Federal Register. EPA then accepts public comments on the site, responds to the comments, and places on the NPL those sites that continue to meet the requirements for listing.

Date of Government Version: 02/01/2013	Source: EPA
Date Data Arrived at EDR: 03/01/2013	Telephone: N/A
Date Made Active in Reports: 03/13/2013	Last EDR Contact: 05/09/2013
Number of Days to Update: 12	Next Scheduled EDR Contact: 07/22/2013
	Data Release Frequency: Quarterly

NPL LIENS: Federal Superfund Liens

Federal Superfund Liens. Under the authority granted the USEPA by CERCLA of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner received notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/1991	Source: EPA
Date Data Arrived at EDR: 02/02/1994	Telephone: 202-564-4267
Date Made Active in Reports: 03/30/1994	Last EDR Contact: 08/15/2011
Number of Days to Update: 56	Next Scheduled EDR Contact: 11/28/2011
	Data Release Frequency: No Update Planned

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Federal Delisted NPL site list

DELISTED NPL: National Priority List Deletions

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 02/01/2013
Date Data Arrived at EDR: 03/01/2013
Date Made Active in Reports: 03/13/2013
Number of Days to Update: 12

Source: EPA
Telephone: N/A
Last EDR Contact: 05/09/2013
Next Scheduled EDR Contact: 07/22/2013
Data Release Frequency: Quarterly

Federal CERCLIS list

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System

CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 02/04/2013
Date Data Arrived at EDR: 03/01/2013
Date Made Active in Reports: 03/13/2013
Number of Days to Update: 12

Source: EPA
Telephone: 703-412-9810
Last EDR Contact: 04/05/2013
Next Scheduled EDR Contact: 06/10/2013
Data Release Frequency: Quarterly

FEDERAL FACILITY: Federal Facility Site Information listing

A listing of National Priority List (NPL) and Base Realignment and Closure (BRAC) sites found in the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) Database where EPA Federal Facilities Restoration and Reuse Office is involved in cleanup activities.

Date of Government Version: 07/31/2012
Date Data Arrived at EDR: 10/09/2012
Date Made Active in Reports: 12/20/2012
Number of Days to Update: 72

Source: Environmental Protection Agency
Telephone: 703-603-8704
Last EDR Contact: 04/10/2013
Next Scheduled EDR Contact: 07/22/2013
Data Release Frequency: Varies

Federal CERCLIS NFRAP site List

CERCLIS-NFRAP: CERCLIS No Further Remedial Action Planned

Archived sites are sites that have been removed and archived from the inventory of CERCLIS sites. Archived status indicates that, to the best of EPA's knowledge, assessment at a site has been completed and that EPA has determined no further steps will be taken to list this site on the National Priorities List (NPL), unless information indicates this decision was not appropriate or other considerations require a recommendation for listing at a later time. This decision does not necessarily mean that there is no hazard associated with a given site; it only means that, based upon available information, the location is not judged to be a potential NPL site.

Date of Government Version: 02/05/2013
Date Data Arrived at EDR: 03/01/2013
Date Made Active in Reports: 03/13/2013
Number of Days to Update: 12

Source: EPA
Telephone: 703-412-9810
Last EDR Contact: 04/05/2013
Next Scheduled EDR Contact: 03/11/2013
Data Release Frequency: Quarterly

Federal RCRA CORRACTS facilities list

CORRACTS: Corrective Action Report

CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Date of Government Version: 02/12/2013
Date Data Arrived at EDR: 02/21/2013
Date Made Active in Reports: 02/27/2013
Number of Days to Update: 6

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 05/02/2013
Next Scheduled EDR Contact: 07/15/2013
Data Release Frequency: Quarterly

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF: RCRA - Treatment, Storage and Disposal

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Transporters are individuals or entities that move hazardous waste from the generator offsite to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.

Date of Government Version: 02/12/2013
Date Data Arrived at EDR: 02/15/2013
Date Made Active in Reports: 02/27/2013
Number of Days to Update: 12

Source: Environmental Protection Agency
Telephone: 800-438-2474
Last EDR Contact: 05/02/2013
Next Scheduled EDR Contact: 07/15/2013
Data Release Frequency: Quarterly

Federal RCRA generators list

RCRA-LQG: RCRA - Large Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Large quantity generators (LQGs) generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month.

Date of Government Version: 02/12/2013
Date Data Arrived at EDR: 02/15/2013
Date Made Active in Reports: 02/27/2013
Number of Days to Update: 12

Source: Environmental Protection Agency
Telephone: 800-438-2474
Last EDR Contact: 05/02/2013
Next Scheduled EDR Contact: 07/15/2013
Data Release Frequency: Quarterly

RCRA-SQG: RCRA - Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Small quantity generators (SQGs) generate between 100 kg and 1,000 kg of hazardous waste per month.

Date of Government Version: 02/12/2013
Date Data Arrived at EDR: 02/15/2013
Date Made Active in Reports: 02/27/2013
Number of Days to Update: 12

Source: Environmental Protection Agency
Telephone: 800-438-2474
Last EDR Contact: 05/02/2013
Next Scheduled EDR Contact: 07/15/2013
Data Release Frequency: Quarterly

RCRA-CESQG: RCRA - Conditionally Exempt Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Conditionally exempt small quantity generators (CESQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month.

Date of Government Version: 02/12/2013
Date Data Arrived at EDR: 02/15/2013
Date Made Active in Reports: 02/27/2013
Number of Days to Update: 12

Source: Environmental Protection Agency
Telephone: 800-438-2474
Last EDR Contact: 05/02/2013
Next Scheduled EDR Contact: 07/15/2013
Data Release Frequency: Varies

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Federal institutional controls / engineering controls registries

US ENG CONTROLS: Engineering Controls Sites List

A listing of sites with engineering controls in place. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health.

Date of Government Version: 12/19/2012
Date Data Arrived at EDR: 12/26/2012
Date Made Active in Reports: 02/27/2013
Number of Days to Update: 63

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 03/11/2013
Next Scheduled EDR Contact: 06/24/2013
Data Release Frequency: Varies

US INST CONTROL: Sites with Institutional Controls

A listing of sites with institutional controls in place. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.

Date of Government Version: 12/19/2012
Date Data Arrived at EDR: 12/26/2012
Date Made Active in Reports: 02/27/2013
Number of Days to Update: 63

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 03/11/2013
Next Scheduled EDR Contact: 06/24/2013
Data Release Frequency: Varies

LUCIS: Land Use Control Information System

LUCIS contains records of land use control information pertaining to the former Navy Base Realignment and Closure properties.

Date of Government Version: 12/09/2005
Date Data Arrived at EDR: 12/11/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 31

Source: Department of the Navy
Telephone: 843-820-7326
Last EDR Contact: 02/18/2013
Next Scheduled EDR Contact: 06/03/2013
Data Release Frequency: Varies

Federal ERNS list

ERNS: Emergency Response Notification System

Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 12/31/2012
Date Data Arrived at EDR: 01/17/2013
Date Made Active in Reports: 02/15/2013
Number of Days to Update: 29

Source: National Response Center, United States Coast Guard
Telephone: 202-267-2180
Last EDR Contact: 04/02/2013
Next Scheduled EDR Contact: 07/15/2013
Data Release Frequency: Annually

State- and tribal - equivalent NPL

SHWS: Hazardous Sites Cleanup Act Site List

The Hazardous Sites Cleanup Act Site List includes sites listed on PA Priority List, sites delisted from PA Priority List, Interim Response Completed sites, and Sites Being Studied or Response Being Planned.

Date of Government Version: 01/08/2013
Date Data Arrived at EDR: 01/24/2013
Date Made Active in Reports: 02/19/2013
Number of Days to Update: 26

Source: Department Environmental Protection
Telephone: 717-783-7816
Last EDR Contact: 04/26/2013
Next Scheduled EDR Contact: 08/05/2013
Data Release Frequency: Semi-Annually

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

HSCA: HSCA Remedial Sites Listing

A list of remedial sites on the PA Priority List. This is the PA state equivalent of the federal NPL superfund list.

Date of Government Version: 12/31/2012
Date Data Arrived at EDR: 01/25/2013
Date Made Active in Reports: 02/19/2013
Number of Days to Update: 25

Source: Department of Environmental Protection
Telephone: 717-783-7816
Last EDR Contact: 04/24/2013
Next Scheduled EDR Contact: 08/05/2013
Data Release Frequency: Varies

State and tribal landfill and/or solid waste disposal site lists

SWF/LF: Operating Facilities

The listing includes Municipal Waste Landfills, Construction/Demolition Waste Landfills and Waste-to-Energy Facilities.

Date of Government Version: 02/26/2013
Date Data Arrived at EDR: 02/28/2013
Date Made Active in Reports: 04/17/2013
Number of Days to Update: 48

Source: Department of Environmental Protection
Telephone: 717-787-7564
Last EDR Contact: 02/26/2013
Next Scheduled EDR Contact: 06/10/2013
Data Release Frequency: Semi-Annually

State and tribal leaking storage tank lists

LUST: Storage Tank Release Sites

Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.

Date of Government Version: 03/04/2013
Date Data Arrived at EDR: 03/20/2013
Date Made Active in Reports: 04/18/2013
Number of Days to Update: 29

Source: Department of Environmental Protection
Telephone: 717-783-7509
Last EDR Contact: 05/02/2013
Next Scheduled EDR Contact: 07/01/2013
Data Release Frequency: Semi-Annually

UNREG LTANKS: Unregulated Tank Cases

Leaking storage tank cases from unregulated storage tanks.

Date of Government Version: 04/12/2002
Date Data Arrived at EDR: 08/14/2003
Date Made Active in Reports: 08/29/2003
Number of Days to Update: 15

Source: Department of Environmental Protection
Telephone: 717-783-7509
Last EDR Contact: 08/14/2003
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

LAST: Storage Tank Release Sites

Leaking Aboveground Storage Tank Incident Reports.

Date of Government Version: 03/04/2013
Date Data Arrived at EDR: 03/20/2013
Date Made Active in Reports: 04/18/2013
Number of Days to Update: 29

Source: Department of Environmental Protection
Telephone: 717-783-7509
Last EDR Contact: 05/02/2013
Next Scheduled EDR Contact: 07/01/2013
Data Release Frequency: Semi-Annually

INDIAN LUST R8: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming.

Date of Government Version: 08/27/2012
Date Data Arrived at EDR: 08/28/2012
Date Made Active in Reports: 10/16/2012
Number of Days to Update: 49

Source: EPA Region 8
Telephone: 303-312-6271
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Quarterly

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

INDIAN LUST R10: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Alaska, Idaho, Oregon and Washington.

Date of Government Version: 02/05/2013
Date Data Arrived at EDR: 02/06/2013
Date Made Active in Reports: 04/12/2013
Number of Days to Update: 65

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Quarterly

INDIAN LUST R1: Leaking Underground Storage Tanks on Indian Land
A listing of leaking underground storage tank locations on Indian Land.

Date of Government Version: 09/28/2012
Date Data Arrived at EDR: 11/01/2012
Date Made Active in Reports: 04/12/2013
Number of Days to Update: 162

Source: EPA Region 1
Telephone: 617-918-1313
Last EDR Contact: 05/01/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Varies

INDIAN LUST R7: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Iowa, Kansas, and Nebraska

Date of Government Version: 12/31/2012
Date Data Arrived at EDR: 02/28/2013
Date Made Active in Reports: 04/12/2013
Number of Days to Update: 43

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Varies

INDIAN LUST R6: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in New Mexico and Oklahoma.

Date of Government Version: 09/12/2011
Date Data Arrived at EDR: 09/13/2011
Date Made Active in Reports: 11/11/2011
Number of Days to Update: 59

Source: EPA Region 6
Telephone: 214-665-6597
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Varies

INDIAN LUST R4: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Florida, Mississippi and North Carolina.

Date of Government Version: 02/06/2013
Date Data Arrived at EDR: 02/08/2013
Date Made Active in Reports: 04/12/2013
Number of Days to Update: 63

Source: EPA Region 4
Telephone: 404-562-8677
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Semi-Annually

INDIAN LUST R9: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Arizona, California, New Mexico and Nevada

Date of Government Version: 03/01/2013
Date Data Arrived at EDR: 03/01/2013
Date Made Active in Reports: 04/12/2013
Number of Days to Update: 42

Source: Environmental Protection Agency
Telephone: 415-972-3372
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Quarterly

State and tribal registered storage tank lists

UST: Listing of Pennsylvania Regulated Underground Storage Tanks
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Date of Government Version: 03/01/2013
Date Data Arrived at EDR: 03/21/2013
Date Made Active in Reports: 04/17/2013
Number of Days to Update: 27

Source: Department of Environmental Protection
Telephone: 717-772-5599
Last EDR Contact: 05/02/2013
Next Scheduled EDR Contact: 07/01/2013
Data Release Frequency: Varies

AST: Listing of Pennsylvania Regulated Aboveground Storage Tanks
Registered Aboveground Storage Tanks.

Date of Government Version: 03/01/2013
Date Data Arrived at EDR: 03/21/2013
Date Made Active in Reports: 04/17/2013
Number of Days to Update: 27

Source: Department of Environmental Protection
Telephone: 717-772-5599
Last EDR Contact: 05/02/2013
Next Scheduled EDR Contact: 07/01/2013
Data Release Frequency: Varies

INDIAN UST R4: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 4 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee and Tribal Nations)

Date of Government Version: 02/06/2013
Date Data Arrived at EDR: 02/08/2013
Date Made Active in Reports: 04/12/2013
Number of Days to Update: 63

Source: EPA Region 4
Telephone: 404-562-9424
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Semi-Annually

INDIAN UST R7: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 7 (Iowa, Kansas, Missouri, Nebraska, and 9 Tribal Nations).

Date of Government Version: 12/31/2012
Date Data Arrived at EDR: 02/28/2013
Date Made Active in Reports: 04/12/2013
Number of Days to Update: 43

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Varies

INDIAN UST R5: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 5 (Michigan, Minnesota and Wisconsin and Tribal Nations).

Date of Government Version: 08/02/2012
Date Data Arrived at EDR: 08/03/2012
Date Made Active in Reports: 11/05/2012
Number of Days to Update: 94

Source: EPA Region 5
Telephone: 312-886-6136
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Varies

INDIAN UST R6: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 6 (Louisiana, Arkansas, Oklahoma, New Mexico, Texas and 65 Tribes).

Date of Government Version: 05/10/2011
Date Data Arrived at EDR: 05/11/2011
Date Made Active in Reports: 06/14/2011
Number of Days to Update: 34

Source: EPA Region 6
Telephone: 214-665-7591
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Semi-Annually

INDIAN UST R1: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 1 (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont and ten Tribal Nations).

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Date of Government Version: 09/28/2012
Date Data Arrived at EDR: 11/07/2012
Date Made Active in Reports: 04/12/2013
Number of Days to Update: 156

Source: EPA, Region 1
Telephone: 617-918-1313
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Varies

INDIAN UST R10: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 10 (Alaska, Idaho, Oregon, Washington, and Tribal Nations).

Date of Government Version: 02/05/2013
Date Data Arrived at EDR: 02/06/2013
Date Made Active in Reports: 04/12/2013
Number of Days to Update: 65

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Quarterly

INDIAN UST R9: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 9 (Arizona, California, Hawaii, Nevada, the Pacific Islands, and Tribal Nations).

Date of Government Version: 02/21/2013
Date Data Arrived at EDR: 02/26/2013
Date Made Active in Reports: 04/12/2013
Number of Days to Update: 45

Source: EPA Region 9
Telephone: 415-972-3368
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Quarterly

INDIAN UST R8: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 8 (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming and 27 Tribal Nations).

Date of Government Version: 08/27/2012
Date Data Arrived at EDR: 08/28/2012
Date Made Active in Reports: 10/16/2012
Number of Days to Update: 49

Source: EPA Region 8
Telephone: 303-312-6137
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Quarterly

FEMA UST: Underground Storage Tank Listing
A listing of all FEMA owned underground storage tanks.

Date of Government Version: 01/01/2010
Date Data Arrived at EDR: 02/16/2010
Date Made Active in Reports: 04/12/2010
Number of Days to Update: 55

Source: FEMA
Telephone: 202-646-5797
Last EDR Contact: 04/18/2013
Next Scheduled EDR Contact: 07/29/2013
Data Release Frequency: Varies

State and tribal institutional control / engineering control registries

ENG CONTROLS: Engineering Controls Site Listing
Under the Land Recycling Act (Act 2) persons who perform a site cleanup using the site-specific standard or the special industrial area standard may use engineering or institutional controls as part of the response action. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health.

Date of Government Version: 05/15/2008
Date Data Arrived at EDR: 05/16/2008
Date Made Active in Reports: 06/12/2008
Number of Days to Update: 27

Source: Department of Environmental Protection
Telephone: 717-783-9470
Last EDR Contact: 04/24/2013
Next Scheduled EDR Contact: 08/05/2013
Data Release Frequency: Varies

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

AUL: Environmental Covenants Listing
A listing of sites with environmental covenants.

Date of Government Version: 01/22/2013
Date Data Arrived at EDR: 01/24/2013
Date Made Active in Reports: 02/19/2013
Number of Days to Update: 26

Source: Department of Environmental Protection
Telephone: 717-783-7509
Last EDR Contact: 04/23/2013
Next Scheduled EDR Contact: 08/05/2013
Data Release Frequency: Varies

INST CONTROL: Institutional Controls Site Listing
Under the Land Recycling Act (Act 2) persons who perform a site cleanup using the site-specific standard or the special industrial area standard may use engineering or institutional controls as part of the response action. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.

Date of Government Version: 05/15/2008
Date Data Arrived at EDR: 05/16/2008
Date Made Active in Reports: 06/12/2008
Number of Days to Update: 27

Source: Department of Environmental Protection
Telephone: 717-783-9470
Last EDR Contact: 04/24/2013
Next Scheduled EDR Contact: 08/05/2013
Data Release Frequency: Varies

State and tribal voluntary cleanup sites

INDIAN VCP R7: Voluntary Cleanup Priority Lisitng
A listing of voluntary cleanup priority sites located on Indian Land located in Region 7.

Date of Government Version: 03/20/2008
Date Data Arrived at EDR: 04/22/2008
Date Made Active in Reports: 05/19/2008
Number of Days to Update: 27

Source: EPA, Region 7
Telephone: 913-551-7365
Last EDR Contact: 04/20/2009
Next Scheduled EDR Contact: 07/20/2009
Data Release Frequency: Varies

INDIAN VCP R1: Voluntary Cleanup Priority Listing
A listing of voluntary cleanup priority sites located on Indian Land located in Region 1.

Date of Government Version: 09/28/2012
Date Data Arrived at EDR: 10/02/2012
Date Made Active in Reports: 10/16/2012
Number of Days to Update: 14

Source: EPA, Region 1
Telephone: 617-918-1102
Last EDR Contact: 04/05/2013
Next Scheduled EDR Contact: 07/15/2013
Data Release Frequency: Varies

VCP: Voluntary Cleanup Program Sites
The VCP listings included Completed Sites, Sites in Progress and Act 2 Non-Use Aquifer Determinations Sites. Formerly known as the Act 2, the Land Recycling Program encourages the voluntary cleanup and reuse of contaminated commercial and industrial sites.

Date of Government Version: 01/15/2013
Date Data Arrived at EDR: 01/16/2013
Date Made Active in Reports: 02/19/2013
Number of Days to Update: 34

Source: Department of Environmental Protection
Telephone: 717-783-2388
Last EDR Contact: 04/17/2013
Next Scheduled EDR Contact: 07/29/2013
Data Release Frequency: Semi-Annually

State and tribal Brownfields sites

BROWNFIELDS: Brownfields Sites
Brownfields are generally defined as abandoned or underused industrial or commercial properties where redevelopment is complicated by actual or perceived environmental contamination. Brownfields vary in size, location, age and past use. They can range from a small, abandoned corner gas station to a large, multi-acre former manufacturing plant that has been closed for years.

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Date of Government Version: 02/19/2013	Source: Department of Environmental Protection
Date Data Arrived at EDR: 02/21/2013	Telephone: 717-783-1566
Date Made Active in Reports: 04/17/2013	Last EDR Contact: 04/24/2013
Number of Days to Update: 55	Next Scheduled EDR Contact: 08/05/2013
	Data Release Frequency: Varies

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS: A Listing of Brownfields Sites

Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment. Assessment, Cleanup and Redevelopment Exchange System (ACRES) stores information reported by EPA Brownfields grant recipients on brownfields properties assessed or cleaned up with grant funding as well as information on Targeted Brownfields Assessments performed by EPA Regions. A listing of ACRES Brownfield sites is obtained from Cleanups in My Community. Cleanups in My Community provides information on Brownfields properties for which information is reported back to EPA, as well as areas served by Brownfields grant programs.

Date of Government Version: 12/10/2012	Source: Environmental Protection Agency
Date Data Arrived at EDR: 12/11/2012	Telephone: 202-566-2777
Date Made Active in Reports: 12/20/2012	Last EDR Contact: 03/26/2013
Number of Days to Update: 9	Next Scheduled EDR Contact: 07/08/2013
	Data Release Frequency: Semi-Annually

Local Lists of Landfill / Solid Waste Disposal Sites

ODI: Open Dump Inventory

An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D Criteria.

Date of Government Version: 06/30/1985	Source: Environmental Protection Agency
Date Data Arrived at EDR: 08/09/2004	Telephone: 800-424-9346
Date Made Active in Reports: 09/17/2004	Last EDR Contact: 06/09/2004
Number of Days to Update: 39	Next Scheduled EDR Contact: N/A
	Data Release Frequency: No Update Planned

DEBRIS REGION 9: Torres Martinez Reservation Illegal Dump Site Locations

A listing of illegal dump sites location on the Torres Martinez Indian Reservation located in eastern Riverside County and northern Imperial County, California.

Date of Government Version: 01/12/2009	Source: EPA, Region 9
Date Data Arrived at EDR: 05/07/2009	Telephone: 415-947-4219
Date Made Active in Reports: 09/21/2009	Last EDR Contact: 04/29/2013
Number of Days to Update: 137	Next Scheduled EDR Contact: 08/12/2013
	Data Release Frequency: No Update Planned

HIST LF INACTIVE: Inactive Facilities List

A listing of inactive non-hazardous facilities (10000 & 300000 series). This listing is no longer updated or maintained by the Department of Environmental Protection. At the time the listing was available, the DEP?s name was the Department of Environmental Resources.

Date of Government Version: 12/20/1994	Source: Department of Environmental Protection
Date Data Arrived at EDR: 07/12/2005	Telephone: 717-787-7381
Date Made Active in Reports: 08/11/2005	Last EDR Contact: 06/21/2005
Number of Days to Update: 30	Next Scheduled EDR Contact: 12/19/2005
	Data Release Frequency: No Update Planned

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

HIST LF INVENTORY: Facility Inventory

A listing of solid waste facilities. This listing is no longer updated or maintained by the Department of Environmental Protection. At the time the listing was available, the DEP?s name was the Department of Environmental Resources.

Date of Government Version: 06/02/1999
Date Data Arrived at EDR: 07/12/2005
Date Made Active in Reports: 08/11/2005
Number of Days to Update: 30

Source: Department of Environmental Protection
Telephone: 717-787-7381
Last EDR Contact: 09/19/2005
Next Scheduled EDR Contact: 12/19/2005
Data Release Frequency: No Update Planned

HIST LF ALI: Abandoned Landfill Inventory

The report provides facility information recorded in the Pennsylvania Department of Environmental Protection ALI database. Some of this information has been abstracted from old records and may not accurately reflect the current conditions and status at these facilities

Date of Government Version: 01/04/2005
Date Data Arrived at EDR: 01/04/2005
Date Made Active in Reports: 02/04/2005
Number of Days to Update: 31

Source: Department of Environmental Protection
Telephone: 717-787-7564
Last EDR Contact: 11/26/2012
Next Scheduled EDR Contact: 03/11/2013
Data Release Frequency: Varies

INDIAN ODI: Report on the Status of Open Dumps on Indian Lands

Location of open dumps on Indian land.

Date of Government Version: 12/31/1998
Date Data Arrived at EDR: 12/03/2007
Date Made Active in Reports: 01/24/2008
Number of Days to Update: 52

Source: Environmental Protection Agency
Telephone: 703-308-8245
Last EDR Contact: 05/03/2013
Next Scheduled EDR Contact: 08/19/2013
Data Release Frequency: Varies

Local Lists of Hazardous waste / Contaminated Sites

US CDL: Clandestine Drug Labs

A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 11/14/2012
Date Data Arrived at EDR: 12/11/2012
Date Made Active in Reports: 02/15/2013
Number of Days to Update: 66

Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 03/04/2013
Next Scheduled EDR Contact: 06/17/2013
Data Release Frequency: Quarterly

US HIST CDL: National Clandestine Laboratory Register

A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 09/01/2007
Date Data Arrived at EDR: 11/19/2008
Date Made Active in Reports: 03/30/2009
Number of Days to Update: 131

Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 03/23/2009
Next Scheduled EDR Contact: 06/22/2009
Data Release Frequency: No Update Planned

Local Lists of Registered Storage Tanks

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

ARCHIVE UST: Archived Underground Storage Tank Sites

The list includes tanks storing highly hazardous substances that were removed from the DEP's Storage Tank Information database because of the Department's policy on sensitive information. The list also may include tanks that are removed or permanently closed.

Date of Government Version: 03/01/2013
Date Data Arrived at EDR: 03/21/2013
Date Made Active in Reports: 04/18/2013
Number of Days to Update: 28

Source: Department of Environmental Protection
Telephone: 717-772-5599
Last EDR Contact: 05/02/2013
Next Scheduled EDR Contact: 07/01/2013
Data Release Frequency: Varies

ARCHIVE AST: Archived Aboveground Storage Tank Sites

The list includes aboveground tanks with a capacity greater than 21,000 gallons that were removed from the DEP's Storage Tank Information database because of the Department's policy on sensitive information. The list also may include tanks that are removed or permanently closed.

Date of Government Version: 03/01/2013
Date Data Arrived at EDR: 03/21/2013
Date Made Active in Reports: 04/18/2013
Number of Days to Update: 28

Source: Department of Environmental Protection
Telephone: 717-772-5599
Last EDR Contact: 05/02/2013
Next Scheduled EDR Contact: 07/01/2013
Data Release Frequency: Varies

Local Land Records

LIENS 2: CERCLA Lien Information

A Federal CERCLA ('Superfund') lien can exist by operation of law at any site or property at which EPA has spent Superfund monies. These monies are spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties.

Date of Government Version: 02/16/2012
Date Data Arrived at EDR: 03/26/2012
Date Made Active in Reports: 06/14/2012
Number of Days to Update: 80

Source: Environmental Protection Agency
Telephone: 202-564-6023
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Varies

ACT 2-DEED: Act 2-Deed Acknowledgment Sites

This listing pertains to sites where the Department has approved a cleanup requiring a deed acknowledgment under Act 2. This list includes sites remediated to a non-residential Statewide health standard (Section 303(g)); all sites demonstrating attainment of a Site-specific standard (Section 304(m)); and sites being remediated as a special industrial area (Section 305(g)). Persons who remediated a site to a standard that requires a deed acknowledgment shall comply with the requirements of the Solid Waste Management Act or the Hazardous Sites Cleanup Act, as referenced in Act 2. These statutes require a property description section in the deed concerning the hazardous substance disposal on the site. The location of disposed hazardous substances and a description of the type of hazardous substances disposed on the site shall be included in the deed acknowledgment. A deed acknowledgment is required at the time of conveyance of the property.

Date of Government Version: 04/23/2010
Date Data Arrived at EDR: 04/28/2010
Date Made Active in Reports: 04/30/2010
Number of Days to Update: 2

Source: Department of Environmental Protection
Telephone: 717-783-9470
Last EDR Contact: 07/22/2011
Next Scheduled EDR Contact: 11/07/2011
Data Release Frequency: Varies

Records of Emergency Release Reports

HMIRS: Hazardous Materials Information Reporting System

Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 12/31/2012
Date Data Arrived at EDR: 01/03/2013
Date Made Active in Reports: 02/27/2013
Number of Days to Update: 55

Source: U.S. Department of Transportation
Telephone: 202-366-4555
Last EDR Contact: 04/02/2013
Next Scheduled EDR Contact: 07/15/2013
Data Release Frequency: Annually

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

SPILLS: State spills

A listing of hazardous material incidents.

Date of Government Version: 01/16/2013
Date Data Arrived at EDR: 01/24/2013
Date Made Active in Reports: 02/19/2013
Number of Days to Update: 26

Source: DEP, Emergency Response
Telephone: 717-787-5715
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 07/29/2013
Data Release Frequency: Varies

Other Ascertainable Records

RCRA NonGen / NLR: RCRA - Non Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste.

Date of Government Version: 02/12/2013
Date Data Arrived at EDR: 02/15/2013
Date Made Active in Reports: 02/27/2013
Number of Days to Update: 12

Source: Environmental Protection Agency
Telephone: 800-438-2474
Last EDR Contact: 05/02/2013
Next Scheduled EDR Contact: 07/15/2013
Data Release Frequency: Varies

DOT OPS: Incident and Accident Data

Department of Transporation, Office of Pipeline Safety Incident and Accident data.

Date of Government Version: 07/31/2012
Date Data Arrived at EDR: 08/07/2012
Date Made Active in Reports: 09/18/2012
Number of Days to Update: 42

Source: Department of Transporation, Office of Pipeline Safety
Telephone: 202-366-4595
Last EDR Contact: 05/07/2013
Next Scheduled EDR Contact: 08/19/2013
Data Release Frequency: Varies

DOD: Department of Defense Sites

This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 11/10/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 62

Source: USGS
Telephone: 888-275-8747
Last EDR Contact: 04/19/2013
Next Scheduled EDR Contact: 07/29/2013
Data Release Frequency: Semi-Annually

FUDS: Formerly Used Defense Sites

The listing includes locations of Formerly Used Defense Sites properties where the US Army Corps of Engineers is actively working or will take necessary cleanup actions.

Date of Government Version: 12/31/2011
Date Data Arrived at EDR: 02/26/2013
Date Made Active in Reports: 03/13/2013
Number of Days to Update: 15

Source: U.S. Army Corps of Engineers
Telephone: 202-528-4285
Last EDR Contact: 03/11/2013
Next Scheduled EDR Contact: 06/24/2013
Data Release Frequency: Varies

CONSENT: Superfund (CERCLA) Consent Decrees

Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: 12/31/2011
Date Data Arrived at EDR: 01/15/2013
Date Made Active in Reports: 03/13/2013
Number of Days to Update: 57

Source: Department of Justice, Consent Decree Library
Telephone: Varies
Last EDR Contact: 04/01/2013
Next Scheduled EDR Contact: 07/15/2013
Data Release Frequency: Varies

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

ROD: Records Of Decision

Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 12/18/2012
Date Data Arrived at EDR: 03/13/2013
Date Made Active in Reports: 04/12/2013
Number of Days to Update: 30

Source: EPA
Telephone: 703-416-0223
Last EDR Contact: 03/13/2013
Next Scheduled EDR Contact: 06/24/2013
Data Release Frequency: Annually

UMTRA: Uranium Mill Tailings Sites

Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of the sand-like material (mill tailings) remain after uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases tailings were used as construction materials before the potential health hazards of the tailings were recognized.

Date of Government Version: 09/14/2010
Date Data Arrived at EDR: 10/07/2011
Date Made Active in Reports: 03/01/2012
Number of Days to Update: 146

Source: Department of Energy
Telephone: 505-845-0011
Last EDR Contact: 02/25/2013
Next Scheduled EDR Contact: 06/10/2013
Data Release Frequency: Varies

US MINES: Mines Master Index File

Contains all mine identification numbers issued for mines active or opened since 1971. The data also includes violation information.

Date of Government Version: 08/18/2011
Date Data Arrived at EDR: 09/08/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 21

Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959
Last EDR Contact: 03/06/2013
Next Scheduled EDR Contact: 06/17/2013
Data Release Frequency: Semi-Annually

TRIS: Toxic Chemical Release Inventory System

Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 09/01/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 131

Source: EPA
Telephone: 202-566-0250
Last EDR Contact: 02/26/2013
Next Scheduled EDR Contact: 06/10/2013
Data Release Frequency: Annually

TSCA: Toxic Substances Control Act

Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/2006
Date Data Arrived at EDR: 09/29/2010
Date Made Active in Reports: 12/02/2010
Number of Days to Update: 64

Source: EPA
Telephone: 202-260-5521
Last EDR Contact: 03/28/2013
Next Scheduled EDR Contact: 07/08/2013
Data Release Frequency: Every 4 Years

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-566-1667
Last EDR Contact: 02/25/2013
Next Scheduled EDR Contact: 06/10/2013
Data Release Frequency: Quarterly

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
A listing of FIFRA/TSCA Tracking System (FTTS) inspections and enforcements.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA
Telephone: 202-566-1667
Last EDR Contact: 02/25/2013
Next Scheduled EDR Contact: 06/10/2013
Data Release Frequency: Quarterly

HIST FTTS: FIFRA/TSCA Tracking System Administrative Case Listing
A complete administrative case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2007
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

HIST FTTS INSP: FIFRA/TSCA Tracking System Inspection & Enforcement Case Listing
A complete inspection and enforcement case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2008
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

SSTS: Section 7 Tracking Systems
Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the Environmental Protection Agency by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 12/10/2010
Date Made Active in Reports: 02/25/2011
Number of Days to Update: 77

Source: EPA
Telephone: 202-564-4203
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Annually

ICIS: Integrated Compliance Information System
The Integrated Compliance Information System (ICIS) supports the information needs of the national enforcement and compliance program as well as the unique needs of the National Pollutant Discharge Elimination System (NPDES) program.

Date of Government Version: 07/20/2011
Date Data Arrived at EDR: 11/10/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 61

Source: Environmental Protection Agency
Telephone: 202-564-5088
Last EDR Contact: 04/15/2013
Next Scheduled EDR Contact: 07/29/2013
Data Release Frequency: Quarterly

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

PADS: PCB Activity Database System

PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 11/01/2010
Date Data Arrived at EDR: 11/10/2010
Date Made Active in Reports: 02/16/2011
Number of Days to Update: 98

Source: EPA
Telephone: 202-566-0500
Last EDR Contact: 04/19/2013
Next Scheduled EDR Contact: 07/29/2013
Data Release Frequency: Annually

MLTS: Material Licensing Tracking System

MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 06/21/2011
Date Data Arrived at EDR: 07/15/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 60

Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
Last EDR Contact: 03/11/2013
Next Scheduled EDR Contact: 06/24/2013
Data Release Frequency: Quarterly

RADINFO: Radiation Information Database

The Radiation Information Database (RADINFO) contains information about facilities that are regulated by U.S. Environmental Protection Agency (EPA) regulations for radiation and radioactivity.

Date of Government Version: 01/08/2013
Date Data Arrived at EDR: 01/09/2013
Date Made Active in Reports: 04/12/2013
Number of Days to Update: 93

Source: Environmental Protection Agency
Telephone: 202-343-9775
Last EDR Contact: 04/11/2013
Next Scheduled EDR Contact: 07/22/2013
Data Release Frequency: Quarterly

FINDS: Facility Index System/Facility Registry System

Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 10/23/2011
Date Data Arrived at EDR: 12/13/2011
Date Made Active in Reports: 03/01/2012
Number of Days to Update: 79

Source: EPA
Telephone: (215) 814-5000
Last EDR Contact: 03/12/2013
Next Scheduled EDR Contact: 06/24/2013
Data Release Frequency: Quarterly

RAATS: RCRA Administrative Action Tracking System

RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/1995
Date Data Arrived at EDR: 07/03/1995
Date Made Active in Reports: 08/07/1995
Number of Days to Update: 35

Source: EPA
Telephone: 202-564-4104
Last EDR Contact: 06/02/2008
Next Scheduled EDR Contact: 09/01/2008
Data Release Frequency: No Update Planned

RMP: Risk Management Plans

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

When Congress passed the Clean Air Act Amendments of 1990, it required EPA to publish regulations and guidance for chemical accident prevention at facilities using extremely hazardous substances. The Risk Management Program Rule (RMP Rule) was written to implement Section 112(r) of these amendments. The rule, which built upon existing industry codes and standards, requires companies of all sizes that use certain flammable and toxic substances to develop a Risk Management Program, which includes a(n): Hazard assessment that details the potential effects of an accidental release, an accident history of the last five years, and an evaluation of worst-case and alternative accidental releases; Prevention program that includes safety precautions and maintenance, monitoring, and employee training measures; and Emergency response program that spells out emergency health care, employee training measures and procedures for informing the public and response agencies (e.g the fire department) should an accident occur.

Date of Government Version: 05/08/2012
Date Data Arrived at EDR: 05/25/2012
Date Made Active in Reports: 07/10/2012
Number of Days to Update: 46

Source: Environmental Protection Agency
Telephone: 202-564-8600
Last EDR Contact: 04/29/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Varies

BRS: Biennial Reporting System

The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/2011
Date Data Arrived at EDR: 02/26/2013
Date Made Active in Reports: 04/19/2013
Number of Days to Update: 52

Source: EPA/NTIS
Telephone: 800-424-9346
Last EDR Contact: 02/26/2013
Next Scheduled EDR Contact: 06/10/2013
Data Release Frequency: Biennially

UIC: Underground Injection Wells

A listing of underground injection well locations.

Date of Government Version: 03/26/2013
Date Data Arrived at EDR: 03/26/2013
Date Made Active in Reports: 04/18/2013
Number of Days to Update: 23

Source: Department of Environmental Protection
Telephone: 717-783-7209
Last EDR Contact: 03/26/2013
Next Scheduled EDR Contact: 07/08/2013
Data Release Frequency: Varies

NPDES: NPDES Permit Listing

A listing of facilities with an NPDES permit.

Date of Government Version: 12/26/2012
Date Data Arrived at EDR: 03/13/2013
Date Made Active in Reports: 04/18/2013
Number of Days to Update: 36

Source: Department of Environmental Protection
Telephone: 717-787-9642
Last EDR Contact: 03/13/2013
Next Scheduled EDR Contact: 06/24/2013
Data Release Frequency: Varies

PA MANIFEST: Manifest Information

Hazardous waste manifest information.

Date of Government Version: 12/31/2011
Date Data Arrived at EDR: 07/23/2012
Date Made Active in Reports: 09/18/2012
Number of Days to Update: 57

Source: Department of Environmental Protection
Telephone: 717-783-8990
Last EDR Contact: 04/23/2013
Next Scheduled EDR Contact: 08/05/2013
Data Release Frequency: Annually

DRYCLEANERS: Drycleaner Facility Locations

A listing of drycleaner facility locations.

Date of Government Version: 03/25/2013
Date Data Arrived at EDR: 03/25/2013
Date Made Active in Reports: 04/18/2013
Number of Days to Update: 24

Source: Department of Environmental Protection
Telephone: 717-787-9702
Last EDR Contact: 03/25/2013
Next Scheduled EDR Contact: 07/08/2013
Data Release Frequency: Varies

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

AIRS: Permit and Emissions Inventory Data
Permit and emissions inventory data.

Date of Government Version: 12/31/2011
Date Data Arrived at EDR: 01/04/2013
Date Made Active in Reports: 02/15/2013
Number of Days to Update: 42

Source: Department of Environmental Protection
Telephone: 717-787-9702
Last EDR Contact: 04/01/2013
Next Scheduled EDR Contact: 07/15/2013
Data Release Frequency: Annually

INDIAN RESERV: Indian Reservations
This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640 acres.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 12/08/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 34

Source: USGS
Telephone: 202-208-3710
Last EDR Contact: 04/19/2013
Next Scheduled EDR Contact: 07/29/2013
Data Release Frequency: Semi-Annually

SCRD DRYCLEANERS: State Coalition for Remediation of Drycleaners Listing
The State Coalition for Remediation of Drycleaners was established in 1998, with support from the U.S. EPA Office of Superfund Remediation and Technology Innovation. It is comprised of representatives of states with established drycleaner remediation programs. Currently the member states are Alabama, Connecticut, Florida, Illinois, Kansas, Minnesota, Missouri, North Carolina, Oregon, South Carolina, Tennessee, Texas, and Wisconsin.

Date of Government Version: 03/07/2011
Date Data Arrived at EDR: 03/09/2011
Date Made Active in Reports: 05/02/2011
Number of Days to Update: 54

Source: Environmental Protection Agency
Telephone: 615-532-8599
Last EDR Contact: 05/06/2013
Next Scheduled EDR Contact: 08/05/2013
Data Release Frequency: Varies

PCB TRANSFORMER: PCB Transformer Registration Database
The database of PCB transformer registrations that includes all PCB registration submittals.

Date of Government Version: 02/01/2011
Date Data Arrived at EDR: 10/19/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 83

Source: Environmental Protection Agency
Telephone: 202-566-0517
Last EDR Contact: 05/03/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Varies

US FIN ASSUR: Financial Assurance Information
All owners and operators of facilities that treat, store, or dispose of hazardous waste are required to provide proof that they will have sufficient funds to pay for the clean up, closure, and post-closure care of their facilities.

Date of Government Version: 11/20/2012
Date Data Arrived at EDR: 11/30/2012
Date Made Active in Reports: 02/27/2013
Number of Days to Update: 89

Source: Environmental Protection Agency
Telephone: 202-566-1917
Last EDR Contact: 02/19/2013
Next Scheduled EDR Contact: 06/03/2013
Data Release Frequency: Quarterly

EPA WATCH LIST: EPA WATCH LIST
EPA maintains a "Watch List" to facilitate dialogue between EPA, state and local environmental agencies on enforcement matters relating to facilities with alleged violations identified as either significant or high priority. Being on the Watch List does not mean that the facility has actually violated the law only that an investigation by EPA or a state or local environmental agency has led those organizations to allege that an unproven violation has in fact occurred. Being on the Watch List does not represent a higher level of concern regarding the alleged violations that were detected, but instead indicates cases requiring additional dialogue between EPA, state and local agencies - primarily because of the length of time the alleged violation has gone unaddressed or unresolved.

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Date of Government Version: 07/31/2012
Date Data Arrived at EDR: 08/13/2012
Date Made Active in Reports: 09/18/2012
Number of Days to Update: 36

Source: Environmental Protection Agency
Telephone: 617-520-3000
Last EDR Contact: 02/12/2013
Next Scheduled EDR Contact: 05/27/2013
Data Release Frequency: Quarterly

US AIRS MINOR: Air Facility System Data
A listing of minor source facilities.

Date of Government Version: 11/15/2012
Date Data Arrived at EDR: 11/16/2012
Date Made Active in Reports: 02/15/2013
Number of Days to Update: 91

Source: EPA
Telephone: 202-564-5962
Last EDR Contact: 04/01/2013
Next Scheduled EDR Contact: 07/15/2013
Data Release Frequency: Annually

US AIRS (AFS): Aerometric Information Retrieval System Facility Subsystem (AFS)
The database is a sub-system of Aerometric Information Retrieval System (AIRS). AFS contains compliance data on air pollution point sources regulated by the U.S. EPA and/or state and local air regulatory agencies. This information comes from source reports by various stationary sources of air pollution, such as electric power plants, steel mills, factories, and universities, and provides information about the air pollutants they produce. Action, air program, air program pollutant, and general level plant data. It is used to track emissions and compliance data from industrial plants.

Date of Government Version: 11/15/2012
Date Data Arrived at EDR: 11/16/2012
Date Made Active in Reports: 02/15/2013
Number of Days to Update: 91

Source: EPA
Telephone: 202-564-5962
Last EDR Contact: 04/01/2013
Next Scheduled EDR Contact: 07/15/2013
Data Release Frequency: Annually

MINES: Abandoned Mine Land Inventory
This data set portrays the approximate location of Abandoned Mine Land Problem Areas containing public health, safety, and public welfare problems created by past coal mining.

Date of Government Version: 10/02/2012
Date Data Arrived at EDR: 01/30/2013
Date Made Active in Reports: 02/21/2013
Number of Days to Update: 22

Source: PASDA
Telephone: 814-863-0104
Last EDR Contact: 05/02/2013
Next Scheduled EDR Contact: 08/12/2013
Data Release Frequency: Semi-Annually

FEDLAND: Federal and Indian Lands
Federally and Indian administrated lands of the United States. Lands included are administrated by: Army Corps of Engineers, Bureau of Reclamation, National Wild and Scenic River, National Wildlife Refuge, Public Domain Land, Wilderness, Wilderness Study Area, Wildlife Management Area, Bureau of Indian Affairs, Bureau of Land Management, Department of Justice, Forest Service, Fish and Wildlife Service, National Park Service.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 02/06/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 339

Source: U.S. Geological Survey
Telephone: 888-275-8747
Last EDR Contact: 04/19/2013
Next Scheduled EDR Contact: 07/29/2013
Data Release Frequency: N/A

PRP: Potentially Responsible Parties
A listing of verified Potentially Responsible Parties

Date of Government Version: 12/02/2012
Date Data Arrived at EDR: 01/03/2013
Date Made Active in Reports: 03/13/2013
Number of Days to Update: 69

Source: EPA
Telephone: 202-564-6023
Last EDR Contact: 04/04/2013
Next Scheduled EDR Contact: 07/15/2013
Data Release Frequency: Quarterly

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

2020 COR ACTION: 2020 Corrective Action Program List

The EPA has set ambitious goals for the RCRA Corrective Action program by creating the 2020 Corrective Action Universe. This RCRA cleanup baseline includes facilities expected to need corrective action. The 2020 universe contains a wide variety of sites. Some properties are heavily contaminated while others were contaminated but have since been cleaned up. Still others have not been fully investigated yet, and may require little or no remediation. Inclusion in the 2020 Universe does not necessarily imply failure on the part of a facility to meet its RCRA obligations.

Date of Government Version: 11/11/2011
Date Data Arrived at EDR: 05/18/2012
Date Made Active in Reports: 05/25/2012
Number of Days to Update: 7

Source: Environmental Protection Agency
Telephone: 703-308-4044
Last EDR Contact: 02/15/2013
Next Scheduled EDR Contact: 05/27/2013
Data Release Frequency: Varies

LEAD SMELTER 2: Lead Smelter Sites

A list of several hundred sites in the U.S. where secondary lead smelting was done from 1931and 1964. These sites may pose a threat to public health through ingestion or inhalation of contaminated soil or dust

Date of Government Version: 04/05/2001
Date Data Arrived at EDR: 10/27/2010
Date Made Active in Reports: 12/02/2010
Number of Days to Update: 36

Source: American Journal of Public Health
Telephone: 703-305-6451
Last EDR Contact: 12/02/2009
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

LEAD SMELTER 1: Lead Smelter Sites

A listing of former lead smelter site locations.

Date of Government Version: 01/29/2013
Date Data Arrived at EDR: 02/14/2013
Date Made Active in Reports: 02/27/2013
Number of Days to Update: 13

Source: Environmental Protection Agency
Telephone: 703-603-8787
Last EDR Contact: 04/08/2013
Next Scheduled EDR Contact: 07/22/2013
Data Release Frequency: Varies

COAL ASH EPA: Coal Combustion Residues Surface Impoundments List

A listing of coal combustion residues surface impoundments with high hazard potential ratings.

Date of Government Version: 08/17/2010
Date Data Arrived at EDR: 01/03/2011
Date Made Active in Reports: 03/21/2011
Number of Days to Update: 77

Source: Environmental Protection Agency
Telephone: N/A
Last EDR Contact: 03/15/2013
Next Scheduled EDR Contact: 06/24/2013
Data Release Frequency: Varies

COAL ASH DOE: Sleam-Electric Plan Operation Data

A listing of power plants that store ash in surface ponds.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 08/07/2009
Date Made Active in Reports: 10/22/2009
Number of Days to Update: 76

Source: Department of Energy
Telephone: 202-586-8719
Last EDR Contact: 04/18/2013
Next Scheduled EDR Contact: 07/29/2013
Data Release Frequency: Varies

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR MGP: EDR Proprietary Manufactured Gas Plants

The EDR Proprietary Manufactured Gas Plant Database includes records of coal gas plants (manufactured gas plants) compiled by EDR's researchers. Manufactured gas sites were used in the United States from the 1800's to 1950's to produce a gas that could be distributed and used as fuel. These plants used whale oil, rosin, coal, or a mixture of coal, oil, and water that also produced a significant amount of waste. Many of the byproducts of the gas production, such as coal tar (oily waste containing volatile and non-volatile chemicals), sludges, oils and other compounds are potentially hazardous to human health and the environment. The byproduct from this process was frequently disposed of directly at the plant site and can remain or spread slowly, serving as a continuous source of soil and groundwater contamination.

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

EDR US Hist Auto Stat: EDR Exclusive Historic Gas Stations

EDR has searched selected national collections of business directories and has collected listings of potential gas station/filling station/service station sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include gas station/filling station/service station establishments. The categories reviewed included, but were not limited to gas, gas station, gasoline station, filling station, auto, automobile repair, auto service station, service station, etc. This database falls within a category of information EDR classifies as "High Risk Historical Records", or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but may not show up in current government records searches.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

EDR US Hist Cleaners: EDR Exclusive Historic Dry Cleaners

EDR has searched selected national collections of business directories and has collected listings of potential dry cleaner sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include dry cleaning establishments. The categories reviewed included, but were not limited to dry cleaners, cleaners, laundry, laundromat, cleaning/laundry, wash & dry etc. This database falls within a category of information EDR classifies as "High Risk Historical Records", or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but may not show up in current government records searches.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

EDR US Hist Cleaners: EDR Proprietary Historic Dry Cleaners - Cole

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: N/A
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

EDR US Hist Auto Stat: EDR Proprietary Historic Gas Stations - Cole

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: N/A
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

CT MANIFEST: Hazardous Waste Manifest Data
Facility and manifest data. Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a tsd facility.

Date of Government Version: 02/18/2013
Date Data Arrived at EDR: 02/18/2013
Date Made Active in Reports: 03/21/2013
Number of Days to Update: 31

Source: Department of Energy & Environmental Protection
Telephone: 860-424-3375
Last EDR Contact: 02/18/2013
Next Scheduled EDR Contact: 06/03/2013
Data Release Frequency: Annually

NJ MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2011
Date Data Arrived at EDR: 07/19/2012
Date Made Active in Reports: 08/28/2012
Number of Days to Update: 40

Source: Department of Environmental Protection
Telephone: N/A
Last EDR Contact: 04/19/2013
Next Scheduled EDR Contact: 07/29/2013
Data Release Frequency: Annually

NY MANIFEST: Facility and Manifest Data
Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a TSD facility.

Date of Government Version: 02/01/2013
Date Data Arrived at EDR: 02/07/2013
Date Made Active in Reports: 03/15/2013
Number of Days to Update: 36

Source: Department of Environmental Conservation
Telephone: 518-402-8651
Last EDR Contact: 05/09/2013
Next Scheduled EDR Contact: 08/19/2013
Data Release Frequency: Annually

RI MANIFEST: Manifest information
Hazardous waste manifest information

Date of Government Version: 12/31/2011
Date Data Arrived at EDR: 06/22/2012
Date Made Active in Reports: 07/31/2012
Number of Days to Update: 39

Source: Department of Environmental Management
Telephone: 401-222-2797
Last EDR Contact: 02/25/2013
Next Scheduled EDR Contact: 06/10/2013
Data Release Frequency: Annually

VT MANIFEST: Hazardous Waste Manifest Data
Hazardous waste manifest information.

Date of Government Version: 02/15/2013
Date Data Arrived at EDR: 02/21/2013
Date Made Active in Reports: 03/15/2013
Number of Days to Update: 22

Source: Department of Environmental Conservation
Telephone: 802-241-3443
Last EDR Contact: 01/21/2013
Next Scheduled EDR Contact: 05/06/2013
Data Release Frequency: Annually

WI MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2011
Date Data Arrived at EDR: 07/19/2012
Date Made Active in Reports: 09/27/2012
Number of Days to Update: 70

Source: Department of Natural Resources
Telephone: N/A
Last EDR Contact: 03/18/2013
Next Scheduled EDR Contact: 07/01/2013
Data Release Frequency: Annually

Oil/Gas Pipelines: This data was obtained by EDR from the USGS in 1994. It is referred to by USGS as GeoData Digital Line Graphs from 1:100,000-Scale Maps. It was extracted from the transportation category including some oil, but primarily gas pipelines.

Electric Power Transmission Line Data
Source: Rextag Strategies Corp.
Telephone: (281) 769-2247
U.S. Electric Transmission and Power Plants Systems Digital GIS Data

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

AHA Hospitals:
Source: American Hospital Association, Inc.
Telephone: 312-280-5991
The database includes a listing of hospitals based on the American Hospital Association's annual survey of hospitals.

Medical Centers: Provider of Services Listing
Source: Centers for Medicare & Medicaid Services
Telephone: 410-786-3000
A listing of hospitals with Medicare provider number, produced by Centers of Medicare & Medicaid Services, a federal agency within the U.S. Department of Health and Human Services.

Nursing Homes
Source: National Institutes of Health
Telephone: 301-594-6248
Information on Medicare and Medicaid certified nursing homes in the United States.

Public Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on elementary and secondary public education in the United States. It is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts, which contains data that are comparable across all states.

Private Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on private school locations in the United States.

Daycare Centers: Child Care Facility List
Source: Department of Public Welfare
Telephone: 717-783-3856

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 2003 & 2011 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002 and 2005 from the U.S. Fish and Wildlife Service.

Scanned Digital USGS 7.5' Topographic Map (DRG)
Source: United States Geologic Survey
A digital raster graphic (DRG) is a scanned image of a U.S. Geological Survey topographic map. The map images are made by scanning published paper maps on high-resolution scanners. The raster image is georeferenced and fit to the Universal Transverse Mercator (UTM) projection.

STREET AND ADDRESS INFORMATION

Appendix D
Analytical Data from Locations SWPAGW13 and SWPAGW14
Retrospective Case Study in Southwestern Pennsylvania

U.S. Environmental Protection Agency
Office of Research and Development
Washington, DC

May 2015
EPA/600/R-14/084

Table D1. Water quality data from locations SWPAGW13 and SWPAGW14.

	SWPAGW13						SWPAGW14		
Parameter	August 2009[1]	Method[2]	July 2011[3]	March 2012[3]	May 2013[3]		August 2009[1]	March 2012[3]	May 2013[3]
pH	7.19	SM 4500H-B	7.02	6.95	7.05		7.29	7.10	6.74
SC (µS/cm)	445	SM 2510B	2005	1869	1530		446	1120	1002
Na (mg/L)	6.06	200.7/6010	43.4	23.3	20.6		4.2	11.8	11.8
K (mg/L)	1.01	200.7/6010	1.39	1.21	1.36		0.90	1.10	1.11
Ca (mg/L)	99.0	200.7/6010	351	295	288		109	190	175
Mg (mg/L)	9.6	200.7/6010	16.1	14.1	13.0		6.4	12.2	12.1
Sr (µg/L)	304	200.7/6010	830	690	595		232	514	499
Ba (µg/L)	71	200.7/6010	291	223	172		66	142	122
Cl (mg/L)	3.7	SM4500CIC	631	462	390		2.5	228	179
SO_4 (mg/L)	36	D516-02	25.7	27.3	31.3		38	25.8	31.3
HCO_3 (mg/L)			267	283	272			278	291
Alkalinity (mg/L)	254	SM2320B	198	192	225		254	194	224
Fe (µg/L)	52	200.7/6010	<67	<67	27		42	26	93
Mn (µg/L)	13	200.7/6010	<14	<14	1.7		<5	38	57
Charge balance (%)[4]	0.8		2.9	1.3	3.0		1.9	0.7	6.3

[1] Data collected prior to this study. Results reported by Environmental Service Laboratories, Inc. (samples collected on 8/11/2009; water bailed from spring discharges).

[2] Methods used to analyze samples collected in August 2009. [3] Data from this study; all results are from field-filtered samples. [4] Charge balance calculated using the AqQA software package (v. 1.1.1).

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