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IN THE UNITED STATES DISTRICT COURT
FOR THE MIDDLE DISTRICT OF PENNSYLVANIA

WAYNE LAND AND MINERAL GROUP, LLC, Plaintiff, v. DELAWARE RIVER BASIN COMMISSION, Defendant, and DELAWARE RIVERKEEPER NETWORK and MAYA K. VAN ROSSUM, THE DELAWARE RIVERKEEPER Intervenors-Defendants.	))))))))))))))))	No. 3:16-cv-00897 Hon. Robert D. Mariani

DELAWARE RIVERKEEPER NETWORK AND MAYA VAN ROSSUM, THE DELAWARE RIVERKEEPER'S MOTION FOR SUMMARY JUDGMENT

For the reasons set forth in the accompanying Brief in Support of the Motion for Summary Judgment of the Delaware Riverkeeper Network and Maya K. van

Rossum, the Delaware Riverkeeper (collectively "DRN"), DRN moves this Court pursuant to Federal Rule of Civil Procedure 56 to grant summary judgment in favor of DRN and Defendant Delaware River Basin Commission ("DRBC") and against Plaintiff Wayne Land and Mineral Group, LLC ("WLMG").

WHEREFORE, DRN moves this Court to grant DRN's Motion to for Summary Judgment enter declaratory judgement against WLMG that:

1. The proposed activities of WLMG are a "project" within the meaning of the Delaware River Basin Compact, and therefore subject to the jurisdiction of Defendant Delaware River Basin Commission.

Dated: April 7, 2020

Respectfully submitted,

CURTIN & HEEFNER LLP

By:

/s/ Joanna A. Waldron

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WAYNE LAND AND MINERAL GROUP, LLC, Plaintiff,	)	
v.	)	No. 3:16-cv-00897 Hon. Robert D. Mariani
DELAWARE RIVER BASIN COMMISSION, Defendant, and	)	
DELAWARE RIVERKEEPER NETWORK and MAYA K. VAN ROSSUM, THE DELAWARE RIVERKEEPER Intervenors-Defendants.	)	

CERTIFICATE OF SERVICE

I hereby certify that I have, on this date, served a true and correct copy of the foregoing via First Class Mail and electronic mail to the following:

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DELAWARE RIVERKEEPER NETWORK AND MAYA K. VAN ROSSUM, THE DELAWARE RIVERKEEPER'S BRIEF IN SUPPORT OF THEIR SUMMARY JUDGMENT MOTION

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The Delaware Riverkeeper Network and Maya K. van Rossum, the Delaware Riverkeeper (collectively "DRN"), submit this Brief in support of their Motion for Summary Judgment against Wayne Land and Mineral Group, LLC ("WLMG").

I. SUMMARY OF ARGUMENT

DRN is entitled to summary judgment that WLMG's planned activities fall squarely within the definition of project, as revealed by the intent drafters, and the course of conduct. WLMG plans deliberative and repetitive use of water at its Property. Further, hydraulic fracturing water use and attendant infrastructure activities support the conclusion that the WLMG's plan is a project subject to DRBC jurisdiction.

WLMG and all parties have now had ample opportunity to develop facts supporting an interpretation of DRBC's "project" authority, and those facts are in dispute. WLMG's planned activities include construction of and equipment for collecting and storing water resources and managing the wastewater at the Property. Therefore, summary judgment is appropriate, necessary, and in the interest of the conservation of judicial resources.

II. PROCEDURAL HISTORY

WLMG commenced this action against the Delaware River Basin Commission ("DRBC") on May 17, 2016 in the United States District Court for the Middle District of Pennsylvania. On July 5, 2016, DRN filed a Motion for Leave to Intervene as Defendant, which was granted on September 12, 2016.

On March 23, 2017, this Court dismissed WLMG's Complaint with prejudice. *Wayne Land and Mineral Group, LLC v. Delaware River Basin Commission*, 247 F. Supp. 3d 477 (M.D. Pa. 2017) ("*Wayne I*"). WLMG appealed the dismissal to the United States Court of Appeals for the Third Circuit ("Third Circuit"), and on July 3, 2018, the Third Circuit vacated *Wayne I*'s holding and remanded the case to this Court for further fact-finding and consideration. *Wayne Land and Mineral Group, LLC v. Delaware River Basin Comm'n*, 894 F.3d 509 (3d Cir. 2018) ("*Wayne II*").

The parties engaged in extensive discovery on remand, with document productions and interrogatories. Further, on October 9, 2019, DRN and DRBC each served two expert reports. Concise Statement at ¶ 7. WLMG did not serve an expert report on that date; however, November 6, 2019, WLMG served rebuttal reports of Daniel Arthur and Dr. Greenwald. WLMG subsequently advised the parties that Daniel Arthur would not testify at trial. Concise Statement at ¶ 10. The parties have conducted depositions of WLMG representatives, Curt Coccodrilli, A.J. Sandone, and consultant, John Holko, as well as expert depositions of DRBC expert, Dr. Littlefield, and WLMG expert, Dr. Greenwald. Concise Statement at ¶ 9.

III. STATEMENT OF FACTS

DRN's Concise Statement of Material Facts in Support of Motion for Summary Judgment ("Concise Statement"), filed this date, is incorporated herein by reference. As evidenced by the Concise Statement, the material facts are not in dispute. WLMG asks this Court to declare "that the [DRBC] lacks authority under the Delaware River Basin Compact ("Compact") to review and approve a natural gas well pad, gas well and related facilities and associated activities on WLMG's property in the Delaware River Basin ("Basin")." Exhibit 1 at 1. Specifically, WLMG's Complaint claims that such activities are not "projects" that fall under DRBC jurisdiction as the well pad and associated activities to be carried out by WLMG will not have a "substantial effect" on the water resources of the Basin" and are not undertaken for the "conservation, utilization, control, development or management of water resources." Id, ¶¶ 27 and 47.

The Delaware River Basin Commission is tasked with the "conservation …management, and control of the *water and related resources* of the Delaware River Basin." Concise Statement at Exhibit 7, whereas clause (emphasis added). The Commission, comprised of representatives from the federal government, Pennsylvania, New Jersey, New York, and Delaware was established to manage the "regional asset" that is the Delaware River Basin, and the Compact was created out of the parties' joint recognition of the need to work together to protect the shared resources of the Basin. The members willingly and knowingly crafted the Compact to grant broad authority to the Commission to manage surface and ground water and related natural resources. *See Id.* §§ 1.2(i) (defining "water resources" as "water and related natural resources in, on, under, or above the ground, including related uses of land…"), and 1.3(e) (describing the purposes of the Compact, among which is "to encourage and provide for the planning, conservation, utilization, development, management and control of the water resources of the basin…").

The Commission is guided by the Compact, creates a Comprehensive Plan for management of the Basin's resources, and creates relevant regulations such as the Water Code. The authority granted by the Compact allows the Commission to address the full breadth of potentially impactful activities in the watershed. Activities subject to DRBC jurisdiction are given a docket number and reviewed by the Commission *in addition to* all state and federal regulatory reviews. The four states have adopted the Compact into their state law, and state law frequently defers to DRBC regulations when DRBC regulations are more protective of water quality. *See, for example,* 25 Pa. Code § 93.2(b) ("When…an interstate compact…establishes water quality standards regulations applicable to surface waters of this Commonwealth, including wetlands, more stringent than those in this title, the more stringent standards apply"); see also *Sludge Free UMBT, et al.,* *v. Commw. Pa.*, EHB Docket No. 2014-015-L, 2015 WL 4410439 at *10 (Pa. Envtl. Hrg. Bd. July 1, 2015).

Pursuant to the broad authority granted to it by the member states and federal government, the DRBC has identified hydraulic fracturing and natural gas development activities as posing a risk to the water resources of the Basin. The Commission has considered this issue in meetings, through three Executive Director Determinations ("EDDs"), and draft regulations, *inter alia.* The EDDs and meeting minutes describe the DRBC's concern over the effects on water resources including the potential to alter the physical, biological, chemical, or hydrological characteristics of Special Protection Waters.[1] Concise Statement at ¶ 16.

Additionally, federal agencies such as the U.S. Fish and Wildlife Service and the National Park Service have authority to refer projects to the Commission for review. 18 C.F.R. §§ 401.35(a), (c); DRBC Rules of Practice and Procedure §§ 2.3.5.A, C. Both Agencies have referred all projects that involve the development of natural gas wells to the DRBC for project review because of the need to protect the Basin's water quality from natural gas development's potential adverse effects.

[1] Special Protection Waters are waters with high water quality and in which no measureable change in existing water quality can occur. This is accomplished via a watershed approach that includes regulating point and nonpoint sources of pollution. DRBC, Special Protection Waters Program Overview, (Jan. 25, 2017), *available at* http://www.nj.gov/drbc/programs/quality/spw.html.

Concise Statement at ¶17. Once DRBC receives such a referral it *must* take action under Section 3.8 of the Compact. 18 C.F.R. § 401.35(c).

IV. STATEMENT OF QUESTION INVOLVED

Question: Whether DRN is entitled to summary judgment on WLMG's planned development activities, including wastewater management equipment and water resource structures, as a project under the Compact?

Proposed Answer: Yes

V. ARGUMENT

A. The Standard for Summary Judgment

Rule 56 of the Federal Rules of Civil Procedure ("Rules") provides that "[t]he court shall grant summary judgment if the movant shows that there is no genuine dispute as to any material fact and the movant is entitled to judgment as a matter of law." Fed. R. Civ. P. 56. "[The summary judgment] standard mirrors the standard for a directed verdict ... which is that the trial judge must direct a verdict if, under the governing law, there can be but one reasonable conclusion as to the verdict. If reasonable minds could differ as to the import of the evidence ... a verdict should not be directed...." *Williams v. Borough of W. Chester, Pa.*, 891 F.2d 458, 460 (3d Cir. 1989)(citing *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 250 (1986).

The responsibility of the court "is not to resolve disputed issues of fact, but to determine whether any factual issues exist to be tried. … we will grant summary judgment unless the evidence is such that a reasonable jury could return a verdict for the nonmoving party." *Frazier v. Heckingers*, 96 F. Supp. 2d 486, 488 (E.D. Pa. 2000)(internal citations omitted).

B. <u>DRN Is Entitled to Summary Judgment as a Matter of Law</u>

The material facts are not in dispute. WLMG intends a multitude of activities at its Property including equipment and structures for wastewater management. WLMG's activities will be deliberative use and repetitive use of water. Further, based on the facts developed about the scope of WLMG's hydraulic fracturing, and under the governing law, there can be but one reasonable conclusion as to WLMG proposed activities at the Property. The proposed activity is a project with the drafter's intent of the word "project." Summary Judgment must be entered against WLMG.

The development of facts on remand related to WLMG's proposed activities establishes that WLMG's proposed well pad activities include water resource management and wastewater management, about which there can be no disagreement, within the meaning of the word "project" in the Compact. The course of performance, negotiations and legislative history show the parties to the Compact purposefully granted DRBC broad authority to protect water quality and regulate activities that threaten water quality. The Third Circuit, in remanding the case for further fact-finding, stated that information concerning WLMG's proposed activities on the land is needed to determine whether hydraulic fracturing projects fall within the scope of the DRBC's regulatory powers under the Compact. *See Wayne Land Mineral Group LLC v. Delaware River Basin Commission,* 894 F.3d 509, 528 (3d. Cir. 2019)"*Wayne Land II")*("we also review de novo whether WLMG's proposed activities on the face of the complaint fall within the scope of the Compact's text.").

The Third Circuit emphasized the significance of reviewing information on remand concerning WLMG's proposed activities in evaluating whether hydraulic fracturing can be considered a "project" under the Compact. Specifically, the Third Circuit directed that this Court on remand to consider "[w]hether the Compact's definition of 'project' encompasses [WLMG]'s proposed well pad and related activities." *Wayne II*, 894 F.3d at 528. Similarly, the Third Circuit anticipated that this Court would make its determination based on "[i]nterpreting the Compact according to its language ***and in light of Wayne's proposed activities***…" *Id.* at 529 (emphasis added).

Further, the Third Circuit identified specific details in WLMG's plans for the property that would aid in determining the meaning of "project" in the context of hydraulic fracturing activities. *See Wayne II*, 894 F.3d at 530 ("It is not at all clear on this record how 5 million gallons of water used in its fracking a well compares with the quantity of water used to perform other activities … the Commission was intended to control").

WLMG proposes deliberative, repetitive use of water. The Third Circuit indicated the if WLMG's proposed activities involved "[d]eliberative, repetitive use of water," DRBC jurisdiction could be satisfied. *Wayne II* at 530. (identifying that the Court would need to pay "careful attention" to determine if hydraulic fracturing could also fall under DRBC jurisdiction due to the "[d]eliberative, repetitive use of water,"). WLMG intends deliberative and repetitive use of water through equipment and structures for wastewater management, and water resource protection, and those equipment and structures are facilities under the Compact.

C. <u>WLMG's Deliberative and Repetitive Use of Water Is A Project</u>

WLMG's planned activities include wastewater management and water resource management squarely within their suggested interpretation of "project." WLMG claims the DRBC "lacks authority under the [Compact] to review and approve a natural gas well pad, a gas well and related facilities and associated activities on WLMG's property." Concise Statement at ¶ 3, Exhibit 1 at 1. To do so, however, WLMG has repeatedly attempted to differentiate its proposed plans from other projects currently under the scope of the DRBC jurisdiction. See *Wayne*

II, 894 F.3d at 533. However, the facts are now clear that the activities WLMG proposes, fall squarely within their own definition of "project."

WLMG initially claimed that it planned to frack well pads without constructing resources that will control or manage the water on the property. *See Wayne II* at 533 (noting that WLMG claims that "water 'will be managed and delivered to the [w]ell [p]ad' site and presumably stored until used, but oddly, that none of the appurtenant facilities to be constructed" will be for the "control…or management of water resources.'"). Development of the factual record on remand, however, confirms the Third Circuit's suspicion.

WLMG will engage in deliberative use of water at the well pad along with repetitive use of water. WLMG will have structures and equipment that are "facilities" within the meaning of the Compact. Concise Statement at ¶ 15 ("any and all things and appurtenances necessary, useful or convenient for the control, collection, storage, withdrawal, diversion, release, treatment," and "to conserve and protect the water resources of the basin or any existing or future water supply source").

WLMG plans to store water and wastewater on the site. Concise Statement at ¶ 25. Upon development of the mandatory wastewater management plan, WLMG intends to recycle wastewater on site, and to have tanks placed at the Property to haul wastewater. Concise Statement at ¶ 23, 26, 27. WLMG plans to recycle wastewater and then put remaining wastewater into the earth by way of an injection well or place in a landfill. Concise Statement at ¶ 28.

WLMG's filings discussed the well pad, access road, two wells, and "appurtenant facilities" to be constructed in the Special Protection Waters of the Basin. *See, for example*, Exhibit 1 at ¶¶ 21-24. It is beyond dispute that these activities utilize Basin waters, involve the development of Basin resources, have the potential to substantially affect Basin water quality, have been referred to the Commission by two Federal Agencies, and have been identified by the Commission as "projects" subject to DRBC jurisdiction.

The Third Circuit likewise made clear that the potential for future hydraulic fracturing in the Basin, and the cumulative effects, must be considered in looking at jurisdiction, in addition to the activities that WLMG described in its Complaint. *Id.* at 530 (identifying that the Court would need to pay "careful attention" to determine if hydraulic fracturing could also fall under DRBC jurisdiction if "the collective quantity of water used by all the fracking wells that could be drilled in the Basin is so large that it could not escape the [DRBC]'s reach.").

D. WLMG's Lack of Knowledge About the Known Risks of Its Planned Activities Does Not Exempt it from DRBC's Jurisdiction

In addition to attempting to narrow the description of its proposed activities, WLMG suggests that its lack of knowledge about specifics of its planned hydraulic fracturing activities are evidence that its plans are outside of the term "project," and outside of the DRBC's jurisdiction.

WLMG intends to expand the Well Pad to get return on its investment, and concedes that a profitable operation would require 5,000 acres. Concise Statement at ¶ 20. DRBC's expert, Dr. Mauser posited that the individual well pad site would "probably be 6 acres in size" and that "over half of the area would be to store water, wastewater and chemicals" Concise Statement at ¶ Exhibit 5 at 18. WLMG offered no expert testimony suggesting a different size of a profitable operation. Further, Dr. Ingraffe concludes that "a single well on a single pad" "is highly unlikely, of itself, to be a profitable enterprise for WLMG." Concise Statement at ¶ 6, Exhibit 3 at p.6. WLMG has not determined how many wells it will develop or how many acres might be needed to make a pipeline feasible, or even consideration to which shale formations it wishes to target. Concise Statement at ¶ ¶ 42, 43.

WLMG claims it does not know how much water it will use at the Project; however, the volumes of water that are needed for unconventional gas production are large compared to the existing human demand in Wayne County. Concise Statement at Exhibit ¶ 2. WLMG has not conducted a wetland delineation or a pre-drill survey to identify water supplies within 3,000 feet of the proposed well locations. Concise Statement at ¶ ¶ 47, 48. The fact that WLMG fails to identify the proposed activities in detail does not negate jurisdiction.

WLMG's Complaint described its view of DRBC's project authority in ¶¶ 3-7, and 17-19 (setting out DRBC's stated authority over projects with a substantial effect on water resources of the Basin and the Commission's work to develop regulations).

DRBC's position on the deleterious effects of natural gas development in the Basin and its authority to regulate these activities is clear. Concise Statement at ¶ 16, Exhibit 8. DRBC's relevant EDDs, DRBC Meeting Minutes from May 5, 2010, and draft regulations thoroughly describe DRBC's identification of natural gas development's potential negative impacts and the authority under which DRBC can regulate said activities. For example, the EDDs and meeting minutes describe adverse environmental effects, including effects on water resources such as the potential to alter the physical, biological, chemical, or hydrological characteristics of Special Protection Waters. Specifically, DRBC identified these activities as presenting "unique interstate threats to water resources" via various point and nonpoint vectors including "well siting and site clearing, well pad activities, use of open pits, well construction, well stimulation (hydraulic fracturing), pipelines, pad site restoration, and aging wells." *Id.* at 45, 76.

DRBC determined that it must consider cumulative impacts and the "likely industry 'footprint'" because natural gas development activities would occur in the headwaters region of the River where there is "exceptionally high water quality," seventy percent forest land cover, and because potential natural gas development would occur in the Special Protection Waters area wherein exists a "no measureable change" water quality management objective under the DRBC's Water Quality Regulations § 10.3A.2. *Id*. at 77, 79.

The experts in this case agree. There are numerous known risks associated with hydraulic fracking, such as spills and leaks, spills of inadequately treated hydraulic fracturing wastewater to surface water, disposal in unlined pits and injection of hydraulic fracturing fluids directly into groundwater. Exhibit 2, at p. 2. WLMG anticipates it will use Stormwater controls and pits for waste fluids, but also dikes and surface facilities for storing and treating drilling fluids and waste fluids. Concise Statement at ¶ 29. The standard industry practice for profitable production of the shale reservoir creates a network of infrastructure elements that include such items as gathering and transmission pipelines, compressor stations, material/equipment/waste storage facilities, new roads, processing facilities, and waste disposal facilities. Exhibit 3, at p. 6. As such, the Basin consequences of WLMG's activities are inevitable and must be subject to DRBC's jurisdiction.

E. The DRBC's Power to Abate Pollution Suggest the Drafter's <u>Intent to Grant Broad Authority over Projects</u>

The DRBC's power to abate pollution is apparent and exercised since the inception of the Compact. In addition to the Commission's duties to create plans and policies for the management of the watershed's resources, the Compact grants

DRBC the "jurisdiction to control future pollution and abate existing pollution in the waters of the basin…" Concise Statement at Exhibit 7, § 5.2. Section 5.2 grants the Commission the broad authority to control pollution by the adoption and amendment of rules, regulations, and standards, "to protect the public health or to preserve the waters of the basin in accordance with the comprehensive plan." *Id.* Section 5.4 allows DRBC to enforce these rules and regulations via the issuance of orders against any entity, including private corporations, when the Commission determines the entity has violated rules and regulations regarding the prevention and abatement of pollution. *Id.* § 5.4. In the event that this authority is not clear enough, Section 3.6 allows the Commission to:

> [e]xercise such other and different powers as may be delegated to it by th[e] compact or otherwise pursuant to law, and…*exercise all powers necessary or convenient to carry out its express powers or which may be reasonably implied therefrom*.

Id. § 3.6(h) (emphasis added).

These powers, taken together, demonstrate the Commission's broad authority and, in fact, duty to preserve basin water quality by controlling and regulating pollution, and to create and enforce relevant regulations and rules. Nothing in the Compact or DRBC's course of performance suggests otherwise.

VI. CONCLUSION

For the foregoing reasons, DRN respectfully requests that this Honorable Court grant the Motion to for Summary Judgment.

Dated: April 7, 2020

Respectfully submitted,

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<u>CERTIFICATE OF SERVICE</u>

I hereby certify that I have, on this date, served a true and correct copy of the Motion for Summary Judgment and accompanying Brief have been filed electronically using the CM/EMF system which will send electronic notifications of such filing to the following:

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Table of Citations

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DELAWARE RIVERKEEPER NETWORK AND MAYA VAN ROSSUM, THE DELAWARE RIVERKEEPER'S CONCISE STATEMENT OF UNDISPUTED FACTS IN MOTION FOR SUMMARY JUDGMENT

1. Delaware Riverkeeper Network is a non-profit organization established in 1988.

2. Intervenor Maya van Rossum ("Ms. Van Rossum" and together with the Delaware Riverkeeper Network, collectively "Intervenors" or "DRN") is the Delaware Riverkeeper and leader of the Delaware Riverkeeper Network.

3. On or about May 17, 2016, WLMG filed the Complaint in this matter, which asks this Court to declare "that the [DRBC] lacks authority under the Delaware River Basin Compact ("Compact") to review and approve a natural gas well pad, gas well and related facilities and associated activities on WLMG's property in the Delaware River Basin ("Basin")." Complaint at page 1. A true and correct copy of the Complaint is attached hereto at Exhibit 1.

4. On March 23, 2017, this Court granted DRBC's Motion to Dismiss.

5. On appeal by Plaintiff, the Third Circuit, remanded the case for further fact-finding, *Wayne Land and Mineral Group, LLC v. Delaware River Basin Comm'n*, 894 F.3d 509 (3d Cir. 2018) ("*Wayne II*").

6. On October 9, 2019, DRN served two expert reports: 1) "Environmental Consequences of Proposed Unconventional Gas Well Drilling in the Delaware River Basin" prepared by Schmid & Company, Inc., dated October 8, 2019; and 2) Expert Report of Dr. Anthony Ingraffea , dated October 8, 2019, along with the curriculum vitae of Dr. James Schmid and Dr. Ingraffea. True correct copies of the Schmid Expert Report and the Ingraffea Report are attached hereto as Exhibit 2 and 3.

7. On October 9, 2019, DRBC served two expert reports: 1) "Report on the History of the Delaware River Basin Company with Specific Focus on Sections 1.2(G) and 3.8, by Dr. Douglas R. Littlefield of Littlefield Historical Research, dated October 2, 2019; and 2) DRBC's second expert report of Dr. Mauser, a Report on the Deliberate Utilization, Management, and Conservation of Water Resources During Natural Gas Development and Production Activities, A true and correct copy of portions of Dr. Littlefield's report is attached hereto as Exhibit 4; and a true and correct copy of Dr. Mauser's report is attached hereto as Exhibit 5. .

8. On October 22, 2019, this Court entered an Order, ruling on WLMG Motion for Extension of Time to Serve Rebuttal Reports, and for Modification of the Scheduling Order, providing that WLMG should serve its rebuttal expert reports by December 9, 2019, and that Supplementations were due on or before January 23, 2020.

9. The October 22, 2019 Order further provided that Expert discovery shall be completed by March 6, 2020, and that dispositive motions shall be filed on or before April 6, 2020.

10. On December 9, 2019, WLMG served two reports: Report of J. Daniel Arthur, P.E. (undated); and 2) "The Meaning of 'Project' in the 1961 Delaware River Basin Compact" by Dr. Emily Greenwald, Historical Research Associates, Inc., dated December 9, 2019.

11. On January 23, 2020, DRBC served two supplemental reports: 1) "Supplemental Report on the History of the Delaware River Basin Compact with Specific Focus on the Report by Emily Greenwald, PhD, entitled 'The Meaning of 'Project' In the 1961 Delaware River Basin Compact.'" and 2) the Supplemental Report Containing Response to Report Authored by J. Daniel Arthur on November 6, 2019, dated January 23, 2020.

12. On February 13, 2020, WLMG notified the parties that it did not intend to call J. Daniel Arthur as a witness. Exhibit 6.

DRBC Background

13. The Delaware River Basin Commission ("DRBC" or "Commission") is tasked with the "conservation…management, and control of the water and related resources of the Delaware River Basin." *Delaware River Basin Compact*, Pub. L. No. 87-328, Recitals, 75 Stat. 688 (1961) (hereinafter "Compact"). A true and correct copy is attached hereto as Exhibit 7.

14. The DRBC Compact was ratified less than eight months after the final draft was submitted to the four basin states' legislature and Congress. Littlefield at p. 51, fn. 53 (citing 75 Stat. 688, P.L. 87-238 (Sept. 27, 1961)).

15. Section 1.2 (g) of the Compact defines a "project" as:

> Any work, service or activity which is separately planned, financed or identified by the Commission, or any separate *facility* undertaken or to be undertaken within a specified area, for the conservation, utilization, control,

> development or management of water resources which can be established and utilized independently or as an addition to an existing facility, and can be considered as a separate entity for purposes of evaluation..

Section 1.2 (e) of that compact defines a "facility" as:

> …any real or personal property, within or without the basin, and improvements thereof or thereon, and any and all rights of way, water, water rights, plants, structures, machinery and equipment, acquired, constructed, operated or maintained for the beneficial use of water resources or related land uses including, without limiting the generality of the foregoing, any and all things and appurtenances necessary, useful or convenient for the control, collection, storage, withdrawal, diversion, release, treatment, transmission, sale or exchange of water; or for navigation thereon, or the development and use of hydroelectric energy and power, and public recreational facilities; or the propagation of fish and wildlife; or to conserve and protect the water resources of the basin or any existing or future water supply source, or to facilitate any other uses of any of them.

Exhibit 7.

16. The Commission has considered jurisdiction over hydraulic fracturing in meetings, through three Executive Director Determinations ("EDDs"), and draft regulations, *inter alia.* The EDDs and meeting minutes describe the DRBC's concern over the effects on water resources including the potential to alter the physical, biological, chemical, or hydrological characteristics of Special Protection Waters. See ECF 22-1, WLMG Br. in Opp'n to DRBC's Mot. to Dismiss Ex. A., *Wayne Land & Mineral Grp., LLC v. Delaware River Basin Comm'n*, No. 3:16-

CV-00897 (M.D. Pa. Mar. 23, 2017). A true and correct copy of ECF No. 22-1 is attached hereto as Exhibit 8.

17. U.S. Fish and Wildlife Service and the National Park Service have referred all projects that involve development of natural gas well to DRBC for project review. See, ECF No-1, 2, DRN Br. in Support of Def. DRBC's Mot. to Dismiss, Exhibit A, B, *Wayne Land & Mineral Grp., LLC v. Delaware River Basin Comm'n*, No. 3:16-CV-00897 (M.D. Pa. Mar. 23, 2017) ECF No. 33-1, 2. (a true and correct copy is attached hereto as Exhibit 9

WLMG Proposed Project Activities

18. WLMG proposes to construct a "well pad and appurtenant facilities" "as well related activities to be carried out" on 180 acres of land that WLMG owns in Wayne County, Pennsylvania, 75 acres of which land is within the Delaware River Basin. Complaint at ¶¶ 12, 26, 27.

19. WLMG intend to extract and sell natural gas associated, not only with the Property it owns as represented in the Complaint, but also "other nearby land" to "earn a reasonable return on, its investment". Complaint at ¶ 21.

20. WLMG states that to have a profitable operation would require about 5,000 acres. Coccodrilli Tr. at 236:22-25. A true and correct copy of portions of Coccodrilli, are attached hereto as Exhibit 10.

21. WLMG's first activities at the Property will be the construction of an access road and the well pad. Complaint at ¶ 22.

22. WLMG's activities will include "proper development of water management," a "key component to the drilling and development of shale wells" June 18, 2019 letter to A. J. Sandone from John Holko, Holko Transcript, August 28, 2019, Exhibit 1; WLMG 2229-2233. A true and correct cop of the Holko letter is attached hereto as Exhibit 11.

Deliberate and Repetitive Use of Water

23. WLMG anticipates needing 3 million gallons of additional water needs per well at the well pad. Holko Tr. at 144:6-13. A true and correct copy of portions of the Deposition of John Holko, Transcript dated August 28, 2019 are attached hereto as Exhibit 12.

24. WLMG's planned hydraulic fracturing operations will include storing water and wastewater on the Property. Complaint at ¶ 30; Exhibit 10, 156:21-25.

25. WLMG will recycle wastewater on the Property. Exhibit 10, at 161: 1-4.; Sandone Tr. at 113: 20-25. A true and correct copy of portions of the Deposition of A.J. Sandone, III, Transcript dated September 24, 2019 are attached hereto as Exhibit 13.

26. WLMG intends to place tanks at the Well Pad site on the Property site to haul wastewater. Exhibit 10, at 216.

27. Wastewater will be recycled, with the remaining wastewater placed into the earth by way of an injection well or place in a landfill. Exhibit 10 at 217: 15-21.

28. WLMG will be required to implement stormwater controls and may use pits "to accumulate waste fluids," including drilling fluids, dikes and surface facilities to accumulate and treat drilling fluids and waste fluids. Exhibit 12 at 68;7-12; 69.

29. The completion site pad would be designed to handle the produced water coming out of the well. Exhibit 12, at 73.

30. WLMG does not know what water source will be utilized. Exhibit 12 at 78-83.

31. WLMG intends to use produced water at the site during the completion process. Exhibit 10 at 89.

32. WLMG's water management plan has not been finalized, but they anticipate as many as 100 tanks. Exhibit 12 at 91.

33. The proposed operations could use an unknown number of taknk of unknown size for water storage at the Property. Exhibit 13 at 113: 20-25.

34. WLMG has not prepared a waste management plan. Exhibit 12 at 99.

35. WLMG has not developed a wastewater management plan. Exhibit 12 at 104.

36. WLMG does not have plans for how the wastewater will be disposed or recycled. Exhibit 12 at 109.

37. WLMG does not know the volume of wastewater to be recovered from its well. Exhibit 13 at 112.

38. An individual well pad site would "probably be 6 acres in size" and that "over half of the area would be to store water, wastewater and chemicals" Exhibit 5 at 18.

39. Volumes of water needed for unconventional gas production are large compared to the existing human demand in Wayne County. Exhibit 1, at 2.

40. WLMG does not know how many wells it would develop, or how many times each well would be fracked. Exhibit 12 at 144;9-16; 145;1-9.

41. WLMG has not given any consideration to which shale formations it wishes to target. Exhibit 13 at 98;2-5, 100;2-5.

42. WLMG may target either the Marcellus formation or the Utica formation or both, and does not know how times the wells might be fracked,. Exhibit 10 at 258;5-15; Exhibit 12 at 64-65.

43. WLMG does not know how many wells it would drill. Exhibit 12 at 92:23-25.

44. WLMG's representative did not know how many acres would need to be in production to make a pipeline feasible. Exhibit 12 at 179:8-11.

45. WLMG does not have a list of chemicals that would be used in the fracturing fluid. Exhibit 12 at 102:8-17; Exhibit 13 at 135.

46. WLMG has not done a pre-drill survey to identify water supplies within 3,000 feet of the proposed well locations. Exhibit 10 at 117-118.

47. WLMG did not perform a wetland delineation. Exhibit 10 at 127.

48. WLMG's representative did not know the location of the well pad to any delineated wetlands or surface waters. Exhibit 12 at 172-73.

49. The developer would utilize more water the farther out from the well pad the laterals extend, and WLMG does not know how far out that would be. Exhibit 10 at 253.

50. WLMG does not know how many times the wells might be fracked, either targeting the Marcellus formation or the Utica formation. Exhibit 10 at 258.

51. Hydraulic fracturing activities as conducted in compliance with applicable regulations result in predictable impairment to the environment and human health, including , for example, impairment of water resources, and adverse impacts streams and aquatic life . Exhibit 4 at 6, Exhibit 3 at 12-13; 15.

52. The term project is not limited to projects as identified or constructed by the Army Corps of Engineers . Transcript of Greenwald, March 3, 2020 Transcript at 151-157:21. A true and correction copy of portions of the transcript dated March 3, 2020 of Greenwald are attached hereto as Exhibit 14.

Dated: April 7, 2020

Respectfully submitted,

CURTIN & HEEFNER LLP

By:

____

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IN THE UNITED STATES DISTRICT COURT
FOR THE MIDDLE DISTRICT OF PENNSYLVANIA

WAYNE LAND AND MINERAL GROUP, LLC, Plaintiff, v. DELAWARE RIVER BASIN COMMISSION, Defendant, and DELAWARE RIVERKEEPER NETWORK and MAYA K. VAN ROSSUM, THE DELAWARE RIVERKEEPER Intervenors-Defendants.	)	No. 3:16-cv-00897 Hon. Robert D. Mariani

CERTIFICATE OF SERVICE

I hereby certify that I have, on this date, served a true and correct copy of the Motion for Summary Judgment and accompanying Brief have been filed electronically using CM/EMF system which will send electronic notification of such filing to the following:

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Date: April 7, 2020

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IN THE UNITED STATES DISTRICT COURT
FOR THE MIDDLE DISTRICT OF PENNSYLVANIA

WAYNE LAND AND MINERAL GROUP, LLC, Plaintiff, v. DELAWARE RIVER BASIN COMMISSION, Defendant, and DELAWARE RIVERKEEPER NETWORK and MAYA K. VAN ROSSUM, THE DELAWARE RIVERKEEPER Intervenors-Defendants.	)))))))))))))))	No. 3:16-cv-00897 Hon. Robert D. Mariani

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CERTIFICATE OF NONCONCURRENCE AND PARTIAL CONCURRENCE

Pursuant to Local Rule 7.1, I, Joanna A. Waldron, Esq. of Curtin & Heefner LLP, Counsel for Defendant Intervenor Delaware Riverkeeper Network and Maya K. van Rossum, the Delaware Riverkeeper (collectively "DRN"), hereby certify that we conferred with Christopher Nestor, Esq. of Overstreet & Nestor LLC, Counsel for Plaintiff regarding DRN's Summary Judgment Motion, and were informed that Plaintiff does not concur. Further, we conferred with Mark Greenfogel, Esq. of Warren Environmental Counsel LLP, counsel for Defendant Delaware River Basin Commission ("DRBC") and were informed that DRBC concurs in DRN's summary judgment motion to the extent it seeks a ruling with respect to wastewater management activities and facilities as projects, but does not concur to the extent that DRN seeks summary judgment on other non-wastewater activities and facilities at this time.

Date: April 7, 2020 By:

/s/ Joanna A. Waldron

____

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IN THE UNITED STATES DISTRICT COURT
FOR THE MIDDLE DISTRICT OF PENNSYLVANIA

WAYNE LAND AND MINERAL GROUP, LLC, Plaintiff, v. DELAWARE RIVER BASIN COMMISSION, Defendant, and DELAWARE RIVERKEEPER NETWORK and MAYA K. VAN ROSSUM, THE DELAWARE RIVERKEEPER Intervenors-Defendants.	)	No. 3:16-cv-00897 Hon. Robert D. Mariani

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<u>CERTIFICATION OF WORD-COUNT OF BRIEF</u>

Pursuant to Local Rule 7.8(b)(2) and subject to to Fed. R.Civ. P. 11, I, Joanna A. Waldron, Counsel for Defendant Intervenor Delaware Riverkeeper Network and Maya K. van Rossum, the Delaware Riverkeeper (collectively "DRN"), hereby certify that pursuant to the word-count tool of Microsoft Word, the DRN Brief in Support of its Motion for Summary Judgment is 3930 and therefore does not exceed the 5, 000 word-count limit set forth in Local Rule 7.8(b)(2).

/s/ Joanna A. Waldron
____
Joanna A. Waldron

EXHIBIT "1"

IN THE UNITED STATES COURT
FOR THE MIDDLE DISTRICT OF PENNSYLVANIA

WAYNE LAND AND MINERAL GROUP, LLC,	:	
Plaintiff,	:	
v.	:	Civil Action No.
DELAWARE RIVER BASIN COMMISSION,	:	
Defendant.	:	(Electronically Filed)

COMPLAINT

Wayne Land and Mineral Group, LLC ("WLMG") asks this Court to declare that the Delaware River Basin Commission ("Commission") lacks authority under the Delaware River Basin Compact ("Compact") to review and approve a natural gas well pad, a gas well and related facilities and associated activities on WLMG's property in the Delaware River Basin ("Basin") and, in support, states:

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INTRODUCTION

1. The Commission, purporting to interpret and rely on Section 3.8 of the Compact, claims discretionary authority to review, approve, and thereby regulate nearly all forms of human activity in the Basin, including the use of private land for residential, commercial and industrial purposes.

2. The Commission's position, distilled to its essence, is that any activity, development or other human undertaking in the Basin that uses water in some manner is a "project" that the Commission has the prerogative to review and approve if the Commission believes that the undertaking may have a "substantial effect" on the water resources of the Basin.

3. Because it is difficult, if not impossible, to identify an undertaking in the Basin that does not involve water in some manner, the Commission's discretionary "project" review authority purportedly extends to nearly every form of human endeavor in the Basin, subject only to the Commission believing, in a given case, that a proposed "project" may have a "substantial effect" on the water resources of the Basin.

4. The Commission, relying on the enormous power that it contends has been delegated to it by Section 3.8 of the Compact, and seeking to placate those State governments and special interest groups opposed to natural gas development, has declared that all natural gas well pads and related facilities targeting shale formations in the Basin are "projects" that it will review under Section 3.8 of the Compact.

5. In addition to asserting that well pads and related facilities are "projects" that it must approve before they are constructed, the Commission has announced that it will not review applications for well pads and related facilities, and associated activities, until it adopts governing regulations. This moratorium, which amounts to a ban on the lawful use of land that cannot be remedied at the ballot box, has been in effect since 2010.

6. WLMG, by this Complaint, seeks relief from the Commission's *ultra vires* assertion of jurisdiction and related dictate that WLMG is prohibited from constructing a well pad and drilling a natural gas well without Commission approval.

7. WLMG, as partial relief for the trampling of its constitutionally protected rights, and seeking to make otherwise lawful

use of its property, requests that the Court declare that the Commission does not have authority to require WLMG to apply for and obtain Commission "project" approval for a natural gas well pad and related facilities targeting natural gas in shale formations on WLMG's property.

JURISDICTION AND VENUE

8. This action arises under the Compact. The Commission is asserting jurisdiction, pursuant to Section 3.8 of the Compact, over the construction of a well pad, appurtenant facilities, and unspecified "related" activities, associated with the drilling, completing and operating of a gas well targeting shale formations on private property owned by WLMG.

9. The Commission's assertion of jurisdiction is based on its current interpretation of Section 3.8 of the Compact, which provides for Commission approval of "projects," and its related assertion that natural gas well pads and related infrastructure associated with exploration and production wells targeting shale formations, together with related activities conducted on the well pads, constitute "projects" as that term is defined in the Compact.

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10. The Court has subject matter jurisdiction over this action under 28 U.S.C. § 1331 because it raises a federal question, and under the statute effectuating the Compact, Pub. L. 87-328, 75 Stat. 688, § 15.1(p) (1961), because this action arises under the Compact. WLMG seeks declaratory and other appropriate relief under 28 U.S.C. §§ 2201 and 2202.

11. Venue is proper within this district pursuant to 28 U.S.C. § 1391(b).

PARTIES AND THE PROPERTY

12. WLMG resides, and owns approximately 180 acres of land, including the natural gas and minerals present on the land, in Wayne County, Pennsylvania. Approximately 75 acres of the land owned by WLMG is located in the Basin (the "Property").

13. The Property is located in a part of the Basin that overlays natural gas reserves in shale formations.

14. The Commission is an agency created by, and with only such authority as is expressly conferred on it by, the Compact. The Compact is an agreement among the United States, New York, Pennsylvania, New Jersey, and Delaware, as approved by Congress in 1961.

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BACKGROUND

A. "Project" Review.

15. Section 3.8 of the Compact states: "No project having a substantial effect on the water resources of the basin shall hereafter be undertaken by any person, corporation or governmental authority unless it shall have been first submitted to and approved by the commission . . . ."

16. For purposes of Section 3.8 of the Compact, a "project" is: "any work, service or activity which is separately planned, financed, or identified by the commission, or any separate facility undertaken or to be undertaken within a specified area, for the conservation, utilization, control, development or management of water resources which can be established and utilized independently or as an addition to an existing facility, and can be considered as a separate entity for purposes of evaluation."

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B. The Commission's Assertion of Jurisdiction Over Natural Gas Well Pads and Related Facilities and Activities.

17. The Commission, purporting to rely on authority to review and approve proposed "projects" pursuant to Section 3.8 of the Compact, has determined, and, by publicly announcing its position, has informed WLMG and other landowners in the Basin, that it has jurisdiction over natural gas well pads, all appurtenant facilities, and related activities carried out in connection with gas wells targeting shale formations in the Basin (collectively "Well Pads").

18. The Commission, as the basis for its assertion of jurisdiction, has determined, and publicly announced, that Well Pads constitute "projects" that cannot be constructed or undertaken in Wayne County, Pennsylvania and other areas of the Basin with first applying for and obtaining Commission approval.

19. The Commission has also announced that it will not consider applications for approvals for Well Pads, which are referred to by the Commission as "well pad dockets," until after it adopts regulations purporting to govern Well Pads.

20. The Commission's *de facto* moratorium on the otherwise lawful use of private property for natural gas development has been in force since 2010 and the Commission has yet to adopt regulations governing Well Pads.

C. WLMG's Planned Development of the Property.

21. WLMG acquired the Property with an intent to explore for, extract and sell the natural gas located in shale formations associated with the Property and other nearby land in order to recoup, and earn a reasonable return on, its investment in the Property.

22. WLMG will proceed in phases, beginning with the construction of an access road and well pad on the Property.

23. WLMG has identified a location for the access road and well pad on the Property, taking into account siting requirements.

24. After the access road and well pad are constructed, WLMG will drill an exploratory well to locate productive zones of natural gas located in shale formations on the Property. The next phase of development will include the drilling of one or more lateral wells followed by hydraulic fracturing and, ultimately, the production of natural gas.

25. Pennsylvania has adopted comprehensive environmental regulations governing all phases of the development of natural gas resources within Pennsylvania. Pursuant thereto, persons and entities seeking to construct well pads and appurtenant facilities, and proposing to carry out related activities such as drilling, fracturing, completing and operating natural gas wells in Pennsylvania, must obtain permits and approvals from the Pennsylvania Department of Environmental Protection ("PaDEP").

26. The well pad and appurtenant facilities to be constructed on the Property, as well as related activities to be carried out on the Property, will be designed, constructed and carried out in accordance with all applicable statutory and regulatory requirements including those implemented by PaDEP.

27. The well pad and the appurtenant facilities to be constructed on the Property, as well as all related activities to be carried out on the Property, will be designed, built, operated and carried out for the exploration, extraction and development of natural gas and not for the conservation, utilization, control, development or management of water resources.

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28. WLMG does not propose to develop, construct or operate a water withdrawal, dam, impoundment or reservoir, or to construct or operate a wastewater treatment or discharge facility in connection with the development on the Property.

29. All water used in connection with the planned Well Pad on the Property will be obtained from properly licensed and approved sources owned and operated by persons or entities other than WLMG, will be managed and delivered to the Well Pad in accordance with all applicable laws and regulations and any applicable fees will be paid.

30. All wastewater generated in connection with the Well Pad on the Property will be managed by properly licensed and/or permitted entities other than WLMG in accordance with all applicable laws and regulations.

31. When the obstacle created by the Commission's assertion of project approval jurisdiction is removed, WLMG will make the substantial investment associated with obtaining, and take steps necessary to secure, all required permits and approvals from PaDEP and, upon receipt of same, will carry out its plans for the Property.

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32. It would be futile and wasteful for WLMG to apply for permits and approvals from PaDEP before resolving the insurmountable obstacle created by the Commission's assertion of jurisdiction and imposition of a moratorium. Permits and approvals issued by PaDEP are valid for defined and limited periods of time and, moreover, PaDEP will not issue final permits and approvals for a Well Pad over which the Commission has asserted jurisdiction and project review authority until after the Commission reviews and approves the Well Pad.

33. Given the Commission's decision not to consider well pad dockets until some indefinite point in the future, it would be futile for WLMG to apply for Commission approval for the Well Pad to be developed on the Property.

34. WLMG, moreover, should not be required to engage in an expensive, time consuming and ultimately futile exercise of attempting to obtain review and approval by the Commission for its Well Pad where, as set forth above, no such review and approval is required under the Compact.

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D. Harm To WLMG.

35. The Commission's final determination that Well Pads constitute "projects" subject to Commission review and approval under Section 3.8 of the Compact has an immediate and practical impact on WLMG. The Commission's unlawful assertion of jurisdiction is an absolute barrier to WLMG's ability to move forward with its plan to develop a Well Pad on the Property.

36. Other than the Commission's unlawful assertion of jurisdiction over a Well Pad on the Property, an injury to WLMG which has been aggravated by imposition of the *de facto* moratorium, there are no known impediments to WLMG securing all permits and approvals necessary for the construction and operation of its Well Pad. Thus, the sole, insurmountable obstacle to the development of the Property as described herein is the Commission's unlawful assertion of jurisdiction.

37. As a result of the Commission's unlawful assertion of jurisdiction, WLMG is unable to develop a Well Pad on the Property and to thereby recoup its upfront costs and earn a reasonable return on its investment. Among other things, WLMG is unable to drill an exploratory well in order to precisely identify productive gas zones on the Property

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and, thereby, to immediately increase the value of the Property and WLMG's nearby land.

38. The Commission is authorized to seek civil penalties from a person who undertakes a "project" without Commission approval pursuant to Section 3.8 of the Compact. Specifically, Section 14.17 of the Compact provides that a person, association or corporation who violates or attempts or conspires to violate a provision of the Compact or a rule, regulation or order of the Commission may be liable for a penalty of as much as $1,000 for each offense and $1,000 per day for a continuing violation, attempt or conspiracy to be fixed by a court of competent jurisdiction.

39. The Commission's final determination regarding its jurisdiction and authority under the Compact puts the public on notice that persons that construct well pads and appurtenant facilities, or that engage in related activities, in connection with wells targeting shales located in Wayne County and other areas of the Basin without prior authorization from the Commission that they are at risk of incurring substantial civil penalties and other potential enforcement actions.

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40. WLMG must choose between proceeding in the face of incurring substantial civil penalties and other sanctions or waiting for the Commission to lift the moratorium at some indefinite point in the future and then incurring the substantial expense of seeking Commission approval for an undertaking over which the Commission does not have jurisdiction.

41. In light of the fact that the Commission is not considering applications for project approval of Well Pads, WLMG must choose between the substantial risks associated with proceeding without Commission approval or indefinitely deferring otherwise lawful use of the Property.

42. The Commission's assertion of jurisdiction over otherwise lawful use of land in connection with natural gas extraction by WLMG, as well the Commission's assertion of jurisdiction over "related" activities, materially and adversely affects WLMG by interfering with WLMG's right to use the Property in conducting a lawful business activity. The material and adverse effect on WLMG's rights to use the Property and to conduct a lawful business activity is caused by the

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Commission's unlawful assertion of jurisdiction, not simply by the existence of the Compact.

43. A decision in favor of WLMG in this case will remove the sole insurmountable barrier to WLMG's plan to develop the Property in the manner described in this complain and also will result in an increase in the market value of the Property and nearby land owned by WLMG.

44. Absent the relief requested herein, WLMG will be deprived of its constitutionally protected right to use its Property in a lawful and productive manner. In addition, WLMG will incur economic injury in that it will be prevented from confirming the full scope of, and then extracting and selling natural gas associated with, the Property and also from benefiting from an increase in the market value of the Property which will follow the drilling of an exploratory well.

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COUNT I – DECLARATORY JUDGMENT

45. WLMG repeats and re-alleges paragraphs 1 through 44 of this complaint as if fully set forth herein.

46. The Commission's "project" approval jurisdiction does not extend to all human undertakings that may have a substantial effect on the water resources of the Basin.

47. The Commission's project approval jurisdiction under Section 3.8 of the Compact is limited to "projects" that have a substantial effect on the water resources of the Basin

48. The Well Pad as proposed by WLMG does not constitute a "project" under Section 3.8 of the Compact.

49. Because WLMG's proposed Well Pad does not constitute a "project," the Commission lacks authority under Section 3.8 of the Compact to require WLMG to obtain Commission approval for the Well Pad.

50. Because WLMG's proposed Well Pad does not constitute a "project," it is irrelevant whether or not the Commission believes that the proposed Well Pad may have a substantial effect on water resources in the Basin.

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51. The Commission otherwise lacks authority to require WLMG to submit for its review, and to obtain its prior approval for, the proposed Well Pad.

52. The Commission, in asserting jurisdiction over WLMG's proposed Well Pad, is misconstruing and unlawfully exceeding its authority under the Compact.

53. The Commission, in asserting jurisdiction over, and by precluding the development of WLMG's proposed Well Pad, has and will continue to deprive WLMG of constitutionally protected rights.

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WHEREFORE, WLMG requests that the Court:

1. Declare that the Commission does not have jurisdiction over, or the authority to review and approve, or to require WLMG to seek prior approval from the Commission for, or to otherwise preclude the development of, WLMG's proposed well pad, appurtenant facilities or the related activities to be carried out on the Property.

2. Grant such further relief as the Court deems appropriate.

Respectfully submitted,

May 17, 2016

s/David R. Overstreet

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Attorneys for Wayne Land and Mineral Group, LLC

EXHIBIT "2"

Environmental Consequences of Proposed Unconventional Gas Well Drilling in the Delaware River Basin

Wayne County, Pennsylvania

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8 October 2019

Environmental Consequences of Proposed Unconventional Gas Well Drilling in the Delaware River Basin, Wayne County, Pennsylvania

Wayne Land and Mineral Group, LLC (WLMG) seeks to construct and operate wells to extract natural gas within the Delaware River Basin in northwestern Wayne County, Pennsylvania. This is a speculative venture aiming, if successful in locating economic quantities similar to those found farther west, to extend the current production of natural gas about 9 miles eastward from existing "unconventional" (that is, deep, long horizontal bore, hydraulically fractured) wells in the Susquehanna River Basin of eastern Susquehanna County. To this end WLMG is challenging in federal court the authority of the Delaware River Basin Commission (DRBC), a federal-interstate entity broadly charged with protecting water resources for more than 15 million people, to exercise project review authority over natural gas drilling and production activities within the 13,539 square miles of outstanding watershed lands that it oversees. Since 2010 there has been an effective moratorium on unconventional gas production in the Delaware River Basin (**Figure 1**), given the current absence of DRBC regulations seeking to protect Basin resources and residents from adverse effects if unconventional shale gas were to be developed here. There is also a moratorium on such wells in effect throughout New York State, both within and outside the Delaware River Basin. Mineral rights reportedly have been leased by gas operators beneath about 200,000 acres of land in the upper Delaware River Basin.

The Marcellus Shale, a geological layer in the Appalachian Mountains, formed in the bed of ancient seas of Devonian age about 400 million years ago. Natural gas has long been known to exist, tightly bound within the layer of Marcellus Shale found more than 1 mile below the surface in Wayne County, but recent technological advances have rendered it relatively more accessible and profitable for extraction. Unconventional natural gas production from the Marcellus Shale has expanded rapidly during the 21st century in Pennsylvania, spreading from west to east outside the Delaware River Basin. More than two thirds of the nearly 16,000 wells drilled in Marcellus Shale 2008-2018 are in Pennsylvania (Jacquet et al. 2018).

Its initial vertical test well is proposed by WLMG to be drilled in an undeveloped, interior section of the Marcellus Shale geological formation that the plaintiff hopes will prove to be economically productive. Hundreds of productive Marcellus Shale gas wells have been drilled in Susquehanna County, but virtually none to date in western Wayne County or the adjacent lands of eastern Susquehanna County (**Figure 2**). Below the Marcellus, an older (Ordovician) and deeper formation known as the Utica Shale also contains natural gas and oil resources. It, too, has begun to be developed farther west in Pennsylvania and Ohio. The Utica Shale is more extensive than the Marcellus Shale in Wayne County and also prospectively could be developed there in the future. WLMG has indicated that it may sample the Utica Shale as well as the Marcellus Shale in its initial test well. A lateral from the vertical test well then would be extended horizontally to enable gas production, and additional wells would be installed on the well pad. Gas production would continue for decades if the reserves are sufficient. Noise, light, smells, air pollution, and traffic peak during shale gas well development, but continue for the life of well production. Unless abandoned wells are plugged successfully, leakage of gases and polluted waters from them can continue indefinitely.

Minimal environmental inventory, engineering design, and economic planning have been performed by WLMG, which controls only 182 acres of land and minerals in Wayne County. Thus it is difficult to address many specific details when addressing the foreseeable environmental consequences, if WLMG were allowed to proceed with its project. Economic value can be extracted from the proposed WLMG well pad only if a major industrial transformation is accomplished in Wayne County similar to that which has occurred recently in Bradford and Susquehanna Counties, not merely by installation of a single test well on WLMG's land. The infrastructure to support well development and to transport natural gas to market currently does not exist locally.

This report addresses reasonably foreseeable environmental consequences of proposed drilling, fracking, and transporting natural gas, were unconventional gas production to be allowed in the Delaware River Basin. Citations are provided to the ever-growing literature documenting the consequences of this industry, especially in Pennsylvania. All opinions contained in this report are expressed with a reasonable degree of professional certainty.

The Delaware River Basin is known for the quality of its surface waters and groundwaters, which supply millions of users in several States. The Marcellus Shale formation underlies much of that northern section of the Basin which has been designated as Special Protection waters (**Figure 1**). The production of shale gas using unconventional wells is a water-intensive process. In its major nationwide review of unconventional gas and oil production USEPA (2016) found scientific evidence that hydraulic fracturing activities can adversely impact drinking water resources. That report identified the conditions under which frequent and/or severe impacts from hydraulic fracturing activities can be expected:

- Water withdrawals for hydraulic fracturing in times or areas of low water availability, particularly in areas with limited or declining groundwater resources;
- Spills during the handling of hydraulic fracturing fluids and chemicals, fuel, and produced water that result in large volumes or high concentrations of chemicals reaching groundwater resources;
- Injection of hydraulic fracturing fluids into wells with inadequate mechanical integrity, allowing gases or liquids to move to groundwater resources;
- Injection of hydraulic fracturing fluids directly into groundwater resources;
- Spills and discharge of inadequately treated hydraulic fracturing wastewater to surface water; and
- Disposal or storage of hydraulic fracturing wastewater in unlined pits resulting in contamination of groundwater resources (Veil 2015).

The volumes of water needed for unconventional gas production are large compared to existing human demand in the Wayne County segment of the Upper Delaware River Basin. By 2018 the average Marcellus well required roughly 14 million gallons of water (Hughes 2019), about 80% of which remains long- term underground in the well and does not return to the surface water cycle. This withdrawal can aggregate to 500 to 1,200% of local existing water demands under full gas exploitation in the vicinity of the proposed WLMG project (Habicht et al. 2015). If taken from small streams during periods of low flow, the water withdrawn for fracking can pose a major loss to the aquatic ecosystem at the withdrawal site. WLMG representatives have suggested using pond or onsite well water for potable purposes during natural gas development. Drilling water and frackwater are expected to be trucked in, but plans remain uncertain.

Figure 1. The Upper Delaware River Basin, Special Protection Watersheds, and extent of Marcellus Shale Formation. Proposed WLMG site is shown by the asterisk. Basemap is from the Delaware River Basin Commission.

Significant quantities of wastewater are generated by unconventional wells, despite the fact that most frackwater remains underground. The major constituents of water returned to the surface from unconventional natural gas wells raising environmental concerns are:

- salt content (measured as salinity, conductivity, or total dissolved solids [TDS]),
- oil and grease (a composite collection of hydrocarbons),
- inorganic and organic toxic compounds introduced as chemical additives to frackwater or that leached into the produced water from sources in the geological formation, and
- naturally occurring radioactive materials (NORM) that leach from the geological formation.

"Produced" waters from unconventional Marcellus Shale wells are much more saline than seawater, and their salt content increases over time during the life of a well (**Table 1**). During well development chemicals are added to the water and sand being forced into the well bore in order to combat scaling and maintain production efficiency, to inhibit corrosion, to coagulate fluids or break emulsions, and to dissolve mixtures. These chemicals affect the toxicity of produced waters, which can affect humans as well as fish and other aquatic biota (NYSDEC 2009). Chemicals of concern include benzene and its derivatives, methanol, xylene, naphthalene, kerosene, formaldehyde, ethylene glycol, butanol, and various acids. Concentrations of "wet" gases (hydrocarbons other than methane) and of crude oil are significantly lower in the Marcellus Shale gas wells of northeastern Pennsylvania than in the unconventional Marcellus wells of the southwestern Pennsylvania.

Table 1. Salt concentrations increase over time in the produced water of Pennsylvania wells (Veil 2015).

Total Dissolved Solids Data (mg/L) over Time for Flowback Water from Selected Marcellus Shale Wells

Day 0	Day 1	Day 5	Day 14	Day 90
990	15,400	54,800	105,000	216,000
27,800	22,400	87,800	112,000	194,000
719	24,700	61,900	110,000	267,000
1,410	9,020	40,700	no data	155,000
7,080	19,200	150,000	206,000	345,000

Source of data: Hayes (2009)

Frac fluid water that does not initially return to the surface remains in contact with new rock surfaces created underground through the fracturing process and is able to dissolve additional constituents from the interstitial pores containing salts from ancient oceans (Balashov et al. 2015). The longer the water remains in contact with the fractures and pore spaces, the higher the dissolved constituents are likely to be, up to some practical saturation or equilibrium point. For the most concentrated example in **Table 1** (345,000 parts per million) more than one-third of the water sample consisted of TDS. This concentration approaches the limits of solubility.

Other constituents of flowback (the produced water discharged within 30 days of fracking in Pennsylvania) and waters subsequently discharged with the natural gas also show a trend of increasing concentration over time. This makes treatment of the later produced water more challenging than treatment of the early flowback water, although the early flowback consists of higher volumes. Operators seek to reuse produced water to the extent practicable, treating it to the extent necessary, because this is the least cost option for disposal of well fluids. Very little produced water from Marcellus Shale is treated sufficiently to allow its discharge to surface waters in Pennsylvania. There are few opportunities for underground injection of wellfield sludges in Pennsylvania or for depositing them in landfills. Most underground injection of Pennsylvania wellfield fluids that cannot be reused has occurred in Ohio, distant from Wayne County, and one of the consequences there has been increased earthquakes.

Methane is a much more potent greenhouse gas than carbon dioxide, and it is released to the atmosphere intentionally or inadvertently at every stage of gas production and distribution. Various chemicals become airborne as a result of unconventional gas development. They not only can travel through the air to damage human health but also are conveyed by rain onto ecosystems and into surface and ground waters.

Unconventional oil and gas production generated 90% of the Commonwealth's natural gas and 57% of its oil (crude plus condensate) in 2012 (Veil 2015). Over the period 2007-2012 Pennsylvania oil production increased 280%; gas production, 1300%; and produced water, 874%. Unconventional wells use much more water than conventional wells. On average, in 2012 each conventional Pennsylvania well generated 2.5 Mmcf of gas, 28 bbl of oil and condensate, and 80 bbl of water per year. Each Marcellus Shale well generated 331 Mmcf of gas, 300 bbl of oil and condensate, and 4,394 bbl of water (64% of that water was produced water). Each average Marcellus Shale well produced 11 times more oil, 132 times more gas, and 55 times more wastewater than each conventional well in 2012. Shale gas well return-water volumes are not required to be measured and reported in Pennsylvania.

The environmental consequences of drilling unconventional gas wells within the Delaware River Basin in Wayne County are discussed below, first at the local level in the vicinity of the proposed wellheads on the WLMG pad and then more generally for the upper Basin in Pennsylvania. Both segments of this discussion necessarily are constrained by (1) the absence of thorough environmental resource inventory for the lands that would be directly affected by WLMG well construction, operation, and support infrastructure including gathering pipelines, (2) an absence of detailed description concerning the vaguely proposed WLMG well construction, number of wells, operations, supporting pipelines, water supply, waste disposal, infrastructure including road improvements, and site decommissioning practices, and 3) a still fragmentary but growing literature analyzing the impacts of shale gas production. What is certain is that

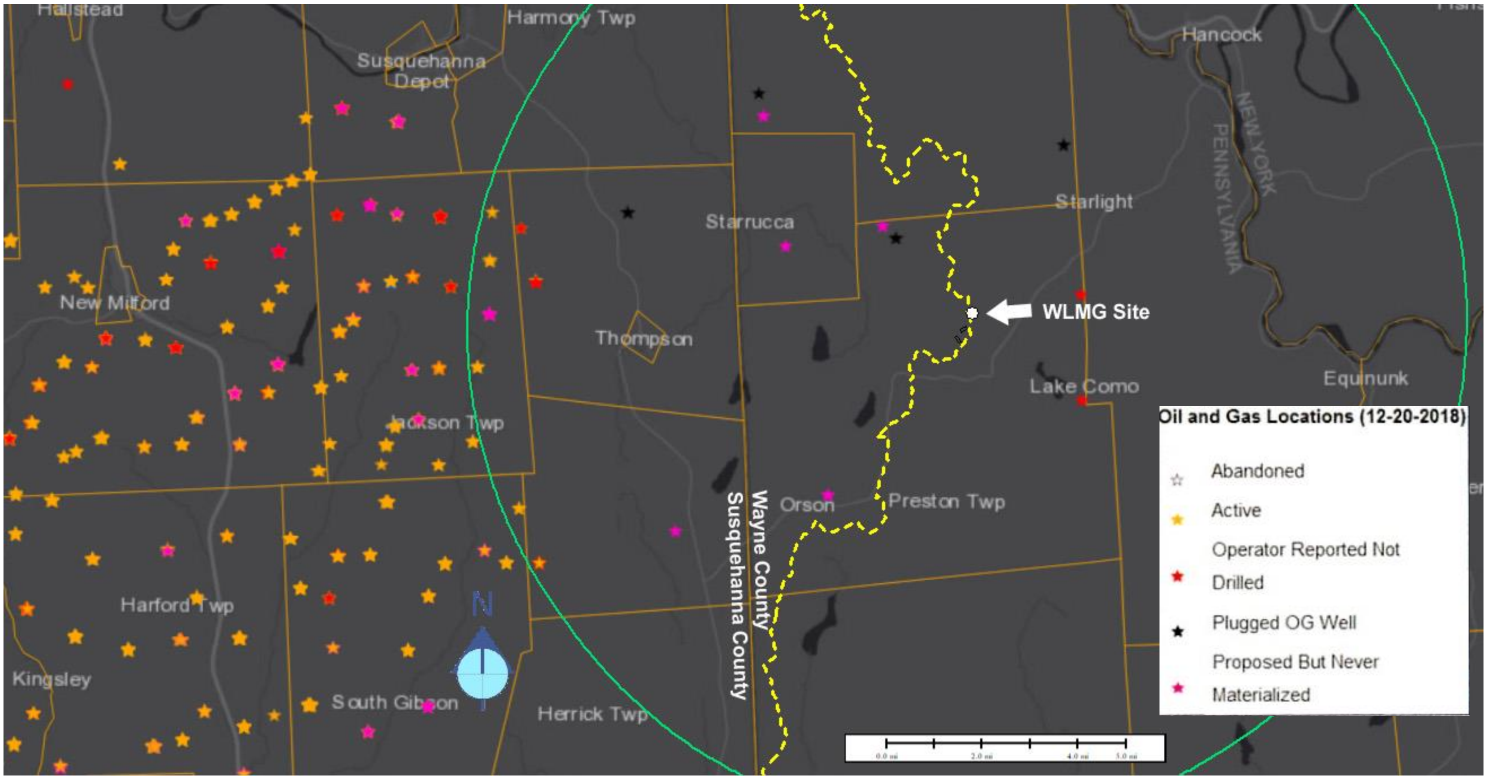

Figure 2. Existing oil and gas wells in eastern Susquehanna and northern Wayne Counties, Pennsylvania. Municipal boundaries are indicated. Green 10-mile radius circle is centered on proposed WLMG site. Yellow dashed line is boundary between Susquehanna (left, west) and Delaware (right, east) River Basins. Basemap from FracTracker.org.

gas production would convert the affected lands from rural forestry and farming uses to heavy industrial uses for many years. The proposed WLMG wells would be drilled about 9 miles east of existing oil and gas wells in Susquehanna County. The property is about 9 miles south and about 6 miles west of the Pennsylvania-New York boundary (**Figure 2**).

The geographical extent of mineral rights that WLMG controls apparently is 182 acres beneath a property of irregular shape with maximum dimensions of about 4,250 feet northeast-southwest and 2,250 feet northwest-southeast. WLMG has no detailed information on local geology and has made no estimate of the quantity or value of its natural gas reserves. Its representatives hope to gain access to additional property if their vertical test well encounters a promise of sufficient gas, prior to initiating horizontal drilling for production, given the uneconomically short lateral(s) that they could advance solely within their own land from their initial test bore or subsequent wellheads. Restricting short lateral bores within the limits of the 182-acre WLMG property clearly would not be economic under current market conditions for gas production from Marcellus Shale (**Figure 3**). No plan for the length or orientation of any borings from the proposed pad has been presented. Apparently as many as six wells might be installed on the proposed 5.7-acre pad, if access in future were gained to additional productive

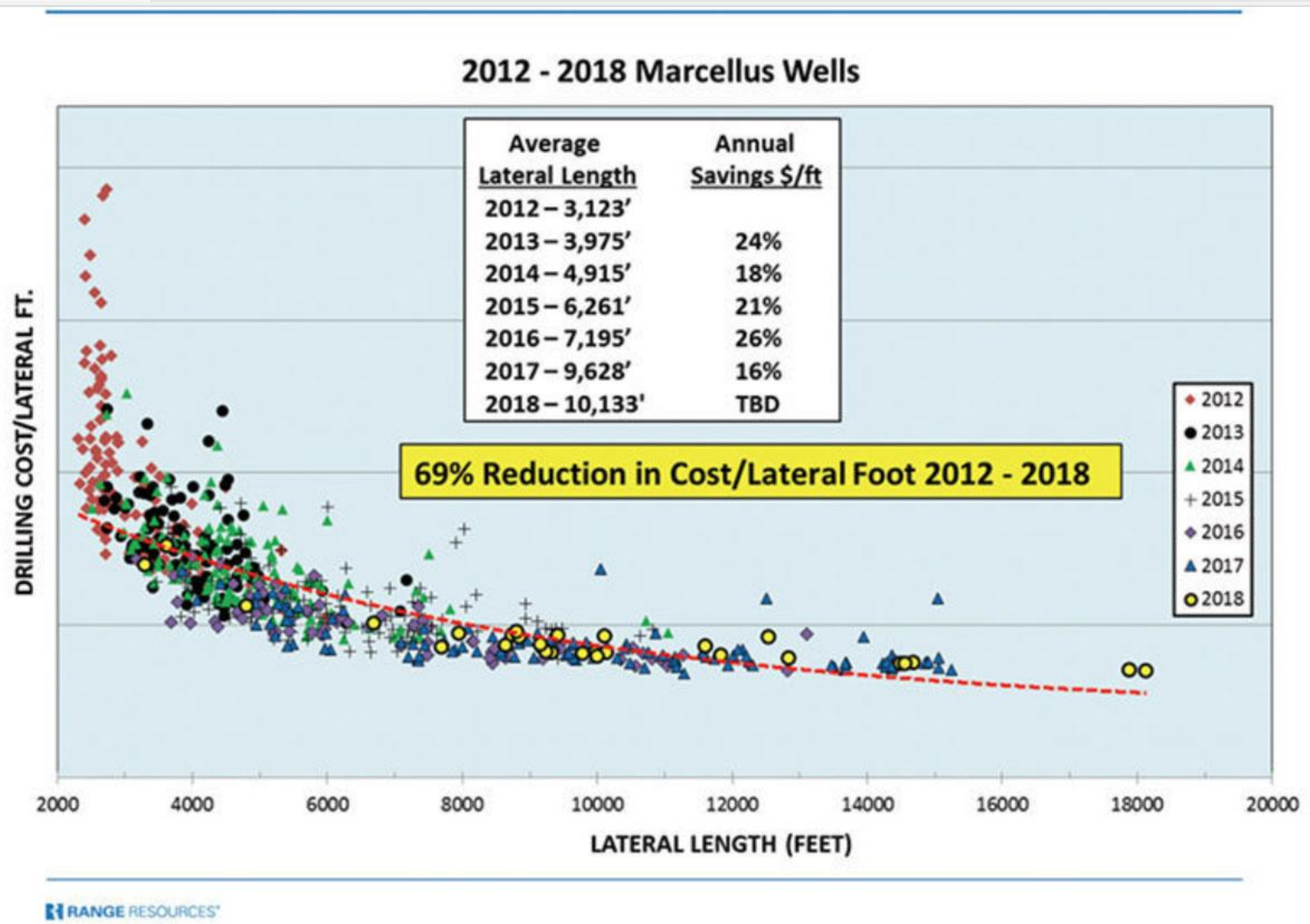

Figure 3. Cost reductions associated with increasing length of laterals at unconventional gas wells (Anonymous 2018). The economic trend toward wells with longer horizontal bores is clear.

shale beyond the current WLMG land. Some large well pads in Pennsylvania now support more than twenty individual wells, inasmuch as clustered wellheads and long laterals are efficient and entail less surface disturbance.

Current technology allows extension of laterals in Pennsylvania Marcellus wells 3.5 miles or more from the wellhead by well-capitalized operators (Fitzsimmons 2017, Carpenter 2019). Thus wells drilled on the WLMG site theoretically could extract gas from more than 38 square miles of surrounding lands, about 63% in the Delaware and 37% in the Susquehanna River Basins, if the applicant could acquire the mineral rights, constructed additional pads, and faced only technological constraints. Such well laterals potentially could extend into several municipalities in northern Wayne County (**Figure 4**). The initial proposal is for only one relatively short lateral extending 4 to 5 thousand feet from the wellhead of the initial vertical test bore. The orientation of lateral bores in Pennsylvania typically is adjusted to maximize the potential for gas capture, given the dip and strike of the local shale. These have not been ascertained at the WLMG site. Industry practice typically has located gas well pads 1 to 2 miles apart, aligned with natural fracture patterns.

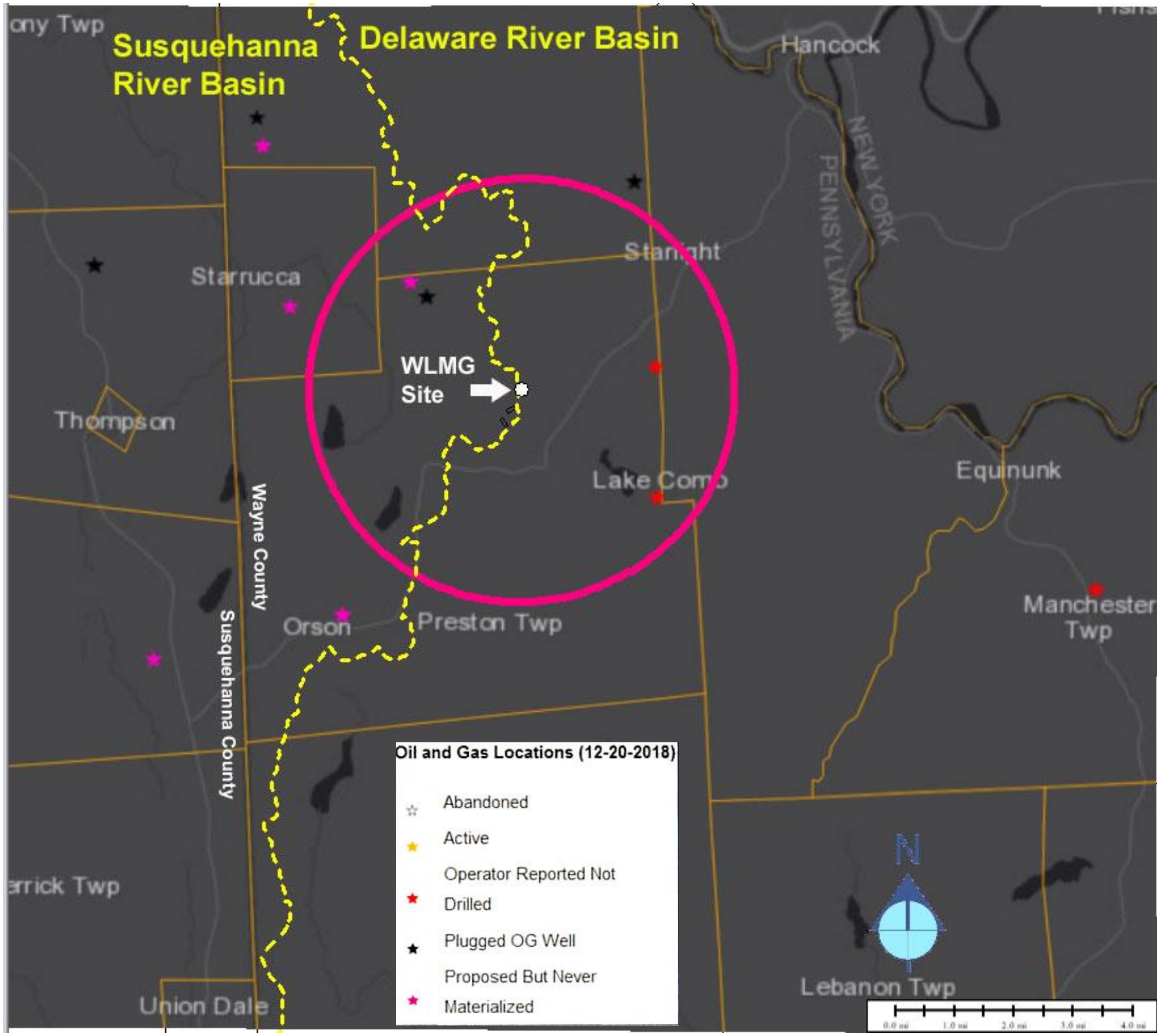

Figure 4. Theoretical gas withdrawal area surrounding proposed WLMG well pad. Pink circle is 3.5-mile radius (enclosing nearly 25,000 acres) to which practicable well laterals now can extend. Dashed yellow line separates Susquehanna (left, west) from Delaware (right, east) River Basin.

The general size of an unconventional gas "production unit" in Pennsylvania currently is about 640 acres. Several production units generally are needed for economic wellfield development, and gas production from about 5,000 acres reportedly is needed to warrant construction of a gathering pipeline. Natural gas can be compressed onsite and trucked to market, but the added cost at present usually is considered to render trucking an uneconomic alternative to gathering pipelines.

Localized Impacts

WLMG has proposed a rectangular, 5.7-acre well pad in the northeastern section of its property (black outlined rectangle, **Figure 5**). Pad dimensions have been identified as approximately 330 by 765 feet. This pad may or may not accommodate all of the wells that could be developed on the WLMG property. Additional land will be needed for access roadways (WLMG proposes the orange outline in **Figure 5**), for a gathering pipeline, and possibly for other ancillary facilities. Reportedly any pad would be rendered unlikely to leak spilled materials by installing a liner and a surrounding berm to confine precipitation and other liquids within it.

The subject property is no longer in use as a dairy farm, although one barn remains onsite. A mineral lease on the property by the Hess Corporation reportedly has expired. The WLMG land currently is used by a hunting club, and there is a hunting cabin onsite. WLMG reportedly sold some timber from forests on the property in 2016, shortly after acquiring ownership during a period of downturn in the natural gas industry. There are about five hayfields onsite (**Figure 6**), which WLMG maintains by mowing. There is one old quarry about 0.5 mile northeast underway nearby, so WLMG representatives think they could quarry rock onsite. There has been no recent survey of the property. The precise locations of its aquatic resources and any aquifer recharge areas have not been identified. One onstream pond and several patches of wetlands are known to exist onsite. Headwaters drain in several directions from the property, generally westward toward the Susquehanna River or eastward toward the Delaware River from the drainage divide.

The proposed WLMG pad location is covered mostly by core forest comprised primarily of deciduous trees. It occupies moderate to steep slopes (all within Wayne County soil survey slope classes B and C, with reported slopes in the relevant C class as steep as 25%). All five soil map units on the pad site also are classed by USDA-NRCS as Highly Erodible Land where erosion and sedimentation are especially likely to occur. LiDAR mapping shows a flow path northwest-southeast through the center of the proposed pad, although no US Geological Survey topographic maps or National Wetlands Inventory maps show aquatic features beneath these headwater forests. Onsite streams have not been delineated or inventoried for WLMG within the property, so potential direct impacts on those resources are not readily determined. There is one undelineated, 4-acre, onstream pond (a palustrine unconsolidated bottom wetland with fringing emergent herbaceous wetland margins) in the northwestern section of the property west of Beaver Hollow Road. Consultants to the plaintiff preliminarily have identified six wetland parcels totaling 4.5 acres onsite near the proposed well pad (**Figure 6**). The completeness and accuracy of the plaintiff's delineation of onsite wetlands and other waters have not been confirmed by any agency and have not been entered onto a professional land survey drawing. At least one forested wetland appears to continue northward beyond the limits of WLMG land.

Alternative locations for a proposed 5.7-acre well pad have received little attention. WLMG representatives reportedly first sought a pad location straddling the river basin boundary near the center of the property and oriented northeast-southwest. An alternative location was identified farther north, and that alternative reportedly was shifted eastward to the currently proposed pad site.

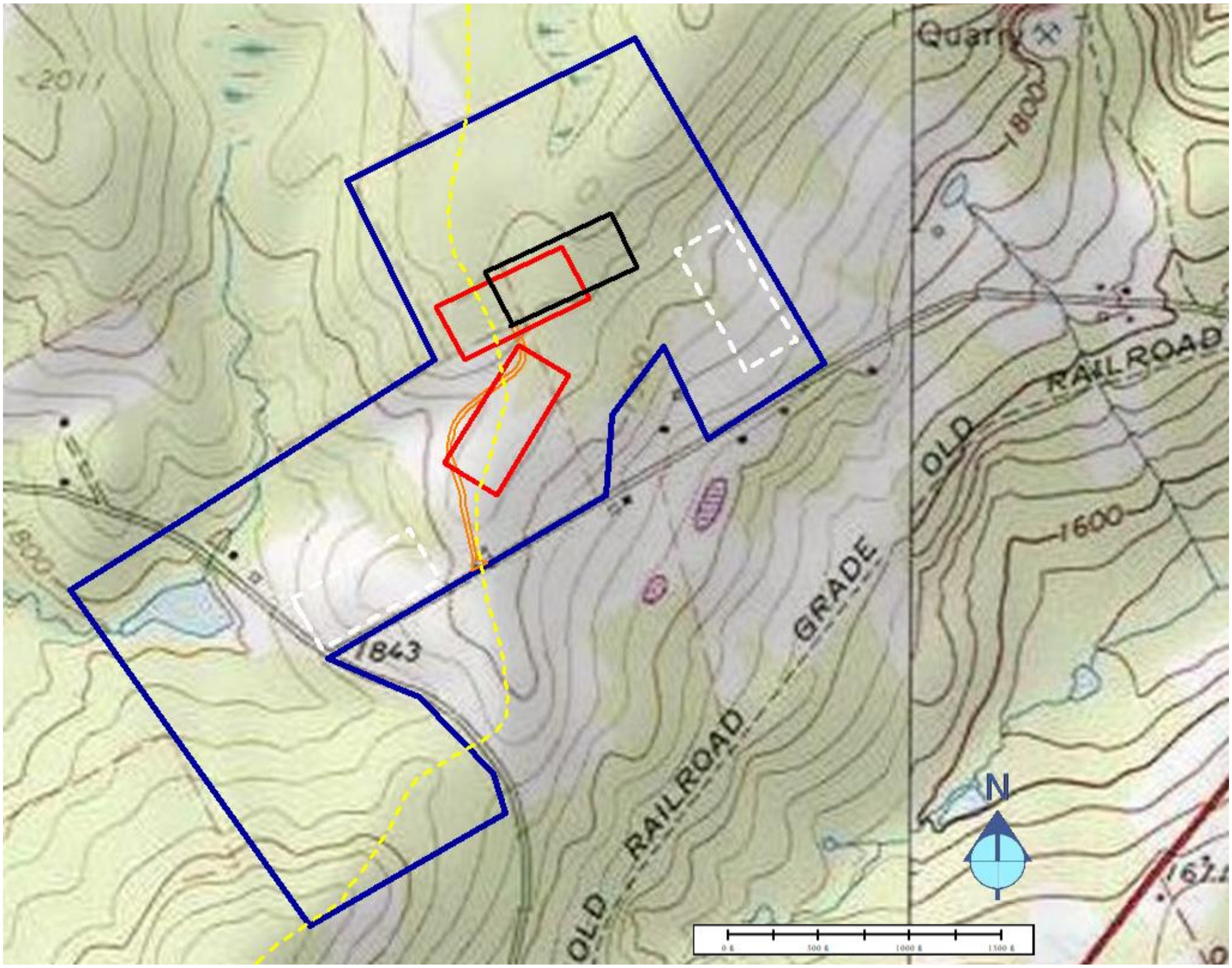

Figure 5. WLMG property (blue outline) on the 1992-95 Orson PA US Geological Survey 7.5-minute topographic quadrangle. The currently proposed wellpad is outlined in black; access road, in orange. Plaintiff's initially preferred location is outlined in red, as is its original alternate location. Other potential pad locations to minimize forest destruction are outlined in white (dashed). The ridge line between Delaware River Basin (right) and Susquehanna River Basin (left) is dashed in yellow. Rainbow Road forms the southeastern boundary of the property. Beaver Hollow Road crosses the western part of the site. Both those township roads intersect State Route 370, a small part of which is shown in the lower right corner of the map image (on the adjacent Lake Como PA quadrangle).

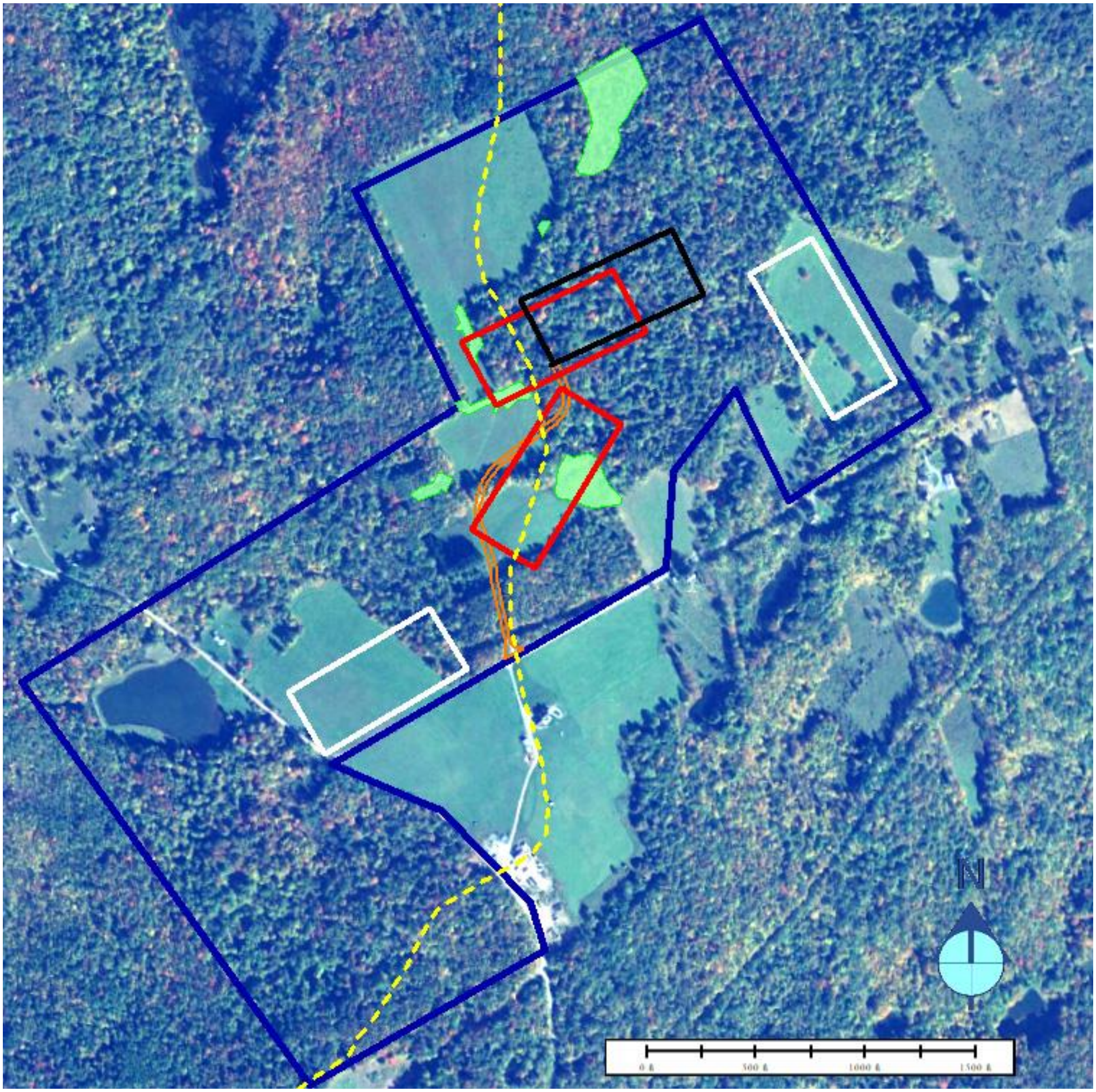

Figure 6. WLMG property (blue outline) on 10 September 2017 GoogleEarth aerial photograph. Proposed wellpad is outlined in black; access road, in orange. Plaintiff's initially preferred pad locations are outlined in red. Applicant's acknowledged wetlands are in yellow-green overprint. Other potential pad locations to minimize forest destruction are outlined in white. The ridge line between Delaware River Basin (right) and Susquehanna River Basin (left) is dashed in yellow.

Additional potential well pad locations in the Susquehanna Basin sections of the WLMG property exist within a few hundred or thousand feet of the proposed pad. For example, two alternatives can be identified chiefly in mowed hayfields close to Rainbow Road (white rectangles in **Figures 5** and **6**). One of these lies entirely within the Susquehanna River Basin. None of the alternative sites is flat, but slope is not a significant constraint for well pad locations in Pennsylvania, where land sculpting to form flat well pad sites on mountainous terrain is a common practice. It is obvious that there are several possible locations for a well pad on the WLMG land, if a comprehensive effort were made to avoid potential environmental impacts, based on a careful inventory of existing resources on and downslope from the WLMG site. Alternative potential well pads warrant careful evaluation in order to avoid or minimize potential impact to the Special Protection waters onsite and downslope in the Delaware River Basin.

WLMG indicated a preference for the well pad to be located in the southeastern part of the property near Rainbow Road, reportedly hoping to minimize distance and cost when connecting to a possible future pipeline under consideration by Linden Energy that might someday occupy an abandoned New York, Ontario, and Western Railroad right of way (**Figure 5**). There are no gas pipelines near the WLMG site at present. No route for any gathering pipeline to connect any encountered gas from WLMG to market has been identified by the plaintiff, and no pipeline right of way has been acquired or leased by WLMG.

Phased construction would include first building an onsite access road for heavy industrial truck traffic to the pad site. The 0.9-acre access road passes within 150 feet of three acknowledged onsite wetlands. Offsite township roads also may need improvements to support the truck traffic during the years of gas well development. The nearest State road is PA Route 370 about 1 mile east of the proposed WLMG well pad.

Where and how WLMG might stockpile and eventually dispose any rock cuttings, drilling mud, frackwater, return wastewater, or other materials and equipment off the proposed well pad during the years of well development have not been identified, so potential impacts of those facilities cannot be estimated. Such support facilities typically entail further land disturbance, soil compaction, and construction of impervious surfaces beyond a well pad and access road, especially if more than the initially estimated six wells here were to be constructed onsite. Sometimes such support facilities are shared among developers of nearby well pads in the Pennsylvania gas fields. The water needed for well development may be conveyed to the WLMG site by truck, and an existing source on the Delaware River mainstem at Hancock has been tentatively identified. Hancock is nearly 8 miles distant from the WLMG site as the crow flies, and the water must be raised more than 1,000 feet vertically in route to the proposed well pad. If 8,000-gallon tank trucks are used, 1,750 truckloads could be needed to import frackwater. To the extent support facilities may be removed or reduced in size following the completion of well development, some onsite land restoration may be possible, but none apparently has been proposed by WLMG. Closed canopy forest requires decades to regrow at minimum, if decompaction and topsoil are provided.

As a result of forest clearing and site regrading for the currently proposed well pad, soil erosion, stream sedimentation, and eutrophication are likely to increase downstream in the Special Protection Kinneyville Creek watershed of the Delaware River Basin. Current PADEP Best Management Practices in Pennsylvania do not protect sites and water bodies from erosion during the increasingly intense thunderstorms resulting from global warming, which are the periods when the greatest erosion and sedimentation occur. No protection is required by PADEP capable of handling large storms (those with a less than 2-year recurrence interval). Trout and other aquatic organisms have declined in the Marcellus gas fields of Pennsylvania, and have been destroyed completely by spills in some pristine streams (Grant et al. 2016).

All streams in the surrounding area of the Delaware River Basin are PADEP-designated High Quality Cold Water Fisheries (HQ-CWF) entitled to Special Protection. Streams in the adjacent Susquehanna River Basin west of the proposed pad are designated Cold Water Fisheries (CWF), not a Special Protection regulatory category. Existing use determinations have not been made in these streams, any of which may warrant protection of higher quality attained uses. A few scattered Class A wild trout streams have been recognized several miles to the southwest of the WLMG site and elsewhere in Wayne County that particularly warrant Special Protection by PADEP and are treated as having Exceptional Value attained use (these are Tier 3 Outstanding National Resource Waters in the terminology of the federal Clean Water Act). Such streams could most likely become impacted by spills from truck traffic carrying fracking chemicals and produced water or by gathering pipeline construction serving the WLMG site and other wells. In northwestern Pennsylvania fracking wastes have been linked to acidity and bacterial changes adversely affecting trout (Ulrich et al. 2018), and fracking also has been associated with mercury poisoning of fish (Grant et al. 2016).

Soils beneath forests readily accept precipitation, keep water temperature low via shading, and convey precipitation to groundwater for slow release to streams during periods of low flow. Hydrologic changes from gas well construction that reduce groundwater recharge and thereby reduce stream flow include effects such as forest clearing, soil compaction, and expansion of impervious surfaces during the construction of well pads, roads, storage basins, and pipelines (CHPNY and PSR 2019). These effects are most noticeable in small headwater streams high in the landscape. WLMG proposes to site its well pad at the top of the watershed at the uppermost limit of the Delaware River Basin. At the same time, consumptive use of fresh water from local sources is typical of unconventional gas well development, potentially causing damage to aquatic habitat during low flow periods if withdrawals are not accurately forecast and restrictive conditions observed. Perhaps the millions of gallons of drilling and fracking water needed by WLMG for gas well development can be successfully drawn from the Delaware River at Hancock. Some might be reused frackwater from wells in Susquehanna County. Soil compaction presumably could be partially addressed during site restoration, but its remediation is often overlooked and not required in Pennsylvania (Frazier 2018).

Proposed construction at the WLMG site will involve clearing and grading enough land to accommodate the heavy industrial uses, installing impervious surfaces to capture and contain precipitation and spills, followed by the importation and storage of equipment, steel pipe, water, sand (about 1 ton per lateral foot of bore), chemicals, diesel fuel, and other supplies to enable drilling an anticipated 7 to 8 thousand feet first downward into and then laterally several thousand feet more within the Marcellus Shale. The plaintiff anticipates drilling of the initial lateral bore 4 to 5 thousand feet outward from the test well, hoping in the future to obtain additional subsurface mineral rights extending some distance beyond the surface property. Then fracturing of additional wells with laterals is to occur within the shale layer to release the gas from natural fractures into the borings that extend outward from the wellheads. WLMG representatives hope the Marcellus Shale layer is 100 to more than 400 feet thick beneath their property and that it proves capable of yielding much natural gas.

The locations and methods of proposed disposal for wastewaters and solids generated by drilling, fracking, and gas recovery operations have not been specified. If water, sand, drill cuttings, and other materials were to be imported from and exported to existing gas well pads in the Susquehanna River Basin, it is more than 15 miles via local roads to the nearest State road in that direction (PA Route 171). Both "produced" flowback wastewater returned from unconventional gas wells and the solid materials generated by drilling contain various hazardous chemical and radioactive contaminants that need special care in handling, storage, treatment, and ultimate disposal because of their ability to pollute air, land, and water (Schmid & Co., Inc. 2013c).

In order to accomplish the plaintiff's purpose of producing and marketing the natural gas it hopes to extract from beneath its land and surrounding properties, construction of major gathering pipeline infrastructure will be necessary if the gas is to be competitively priced. WLMG has not indicated whether its operations will be paused at the stage of identifying extractable gas from its well(s). No gas can reach markets from shut-in wells until there is a pipeline connection. Construction of a pipeline on the abandoned railroad right of way southeast of the WLMG property is a speculative prospect that likely would benefit WLMG if it were to occur. But an offsite connecting pipeline would be needed even to reach that old railroad grade. There are no existing gathering pipelines in the surrounding parts of Wayne County. About 8 to 10 miles of new gathering lines are needed, extending either westward to connect with existing gathering lines that serve existing wells west of Thompson in Susquehanna County (**Figure 2**) or southward to reach an existing Tennessee major interstate gas transmission line that crosses Wayne County (**Figure 10**). Absent the arrival of an adjacent pipeline built by parties other than the plaintiff, installation of a gathering line merely to transport gas from WLMG wells to an existing market link would convert more than 100 acres of additional offsite forest and/or farmland to long-term industrial use.

According to WLMG, the cost of a gathering line probably would not be justified until gas production was assured from about 5,000 acres (nearly 8 square miles) of land (C. Coccodrilli 2019:236). Crossings of public roads, streams, and wetlands are likely, inasmuch as gathering lines are not confined to public road or utility rights of way in Pennsylvania. WLMG has not indicated that it has acquired any pipeline right of way. Thus it might need to postpone gathering line construction, possibly for years after initial test well development on its proposed or pad, until the cost can be spread among additional well pads in the vicinity.

WLMG has not disclosed sufficient information to assess the extent of forest, core forest, wetland, and stream crossing destruction that its natural gas development, if successful, would cause. The approximate limits of wetlands near the proposed pad have been preliminarily identified and avoided, but perennial and intermittent streamcourses onsite have not been surveyed. Temporarily disturbed forests will require many decades to regrow, and longer if their soils are not decompacted and then replanted with appropriate native species post-disturbance (Sitler 2013). Pennsylvania normally waives regulation of obstructions and encroachments into headwater streams with drainage areas smaller than 100 acres [25 Pa. Code §105.12(a)(2)], irrespective of their designated use, attained use, or ecological significance. Pipeline corridors typically are kept clear of trees permanently. Forested wetlands along pipelines are converted to herbaceous cover, even where wetland conditions are restored successfully. Offsite mitigation would be needed to replace the functions of forested wetlands in pipeline corridors, if impact mitigation were attempted.

The siting of gathering pipelines is virtually unregulated in Pennsylvania (Schmid & Co., Inc. 2013c). Unmarked, high-pressure gathering lines at various depths pose a sometimes-fatal hazard to equipment operators subsequent to well development (Phillips 2016). State permits are required where pipelines cross State roadways and where they cross streams in large watersheds. Permits also may be required where they cross recognized wetlands. Gathering pipelines for unconventional wells are being constructed in ever larger diameters at ever higher pressures similar to those of major transmission lines, but are not required to meet interstate construction standards. Pennsylvania regulators have been slow to recognize the dramatic increase in risk from that long posed by traditional gas well gathering lines of 6- to 8-inch diameter and low pressure. Gathering lines are seldom inspected by any agency representatives. Virtually no data have been collected on the risks they pose to people and the environment. Municipal authority to affect pipeline locations has been restricted in Pennsylvania, and few municipalities have tried to direct the location of gas development. Both well pads and pipelines often are sited in close proximity to homes in rural Pennsylvania, posing genuine risks to human health (**Figure 7**).

Gas gathering pipeline under construction near Warrensville, Lycoming County

A pipeline laying operation near a home in Greene County. (Michael Bryant / Staff Photographer)

Well pad fire in Avela PA, February 2011.

Figure 7. Shale gas gathering pipelines and a well pad fire in rural Pennsylvania (LWVPA 2012).

Generalized Impacts

If unconventional wells are constructed and operated successfully by WLMG at its proposed well pad, additional gas production from the Marcellus and Utica Shales is virtually certain to occur elsewhere in northern and central Wayne County within the partially known geologic deposits, which are considered potentially more productive than those in eastern Susquehanna County (**Figure 8**). The pace of well construction in Pennsylvania to date has been determined primarily by demand as reflected in the market price of natural gas. Experience over the past decade in nearby Bradford and Susquehanna Counties and elsewhere in Pennsylvania Marcellus gas fields provides guidance as to likely impacts. State drilling permits for individual counties in northeastern Pennsylvania have been issued at rates of several hundred per year (Schmid & Co., Inc. 2013c). The pace of actual well development activity has varied with market conditions.

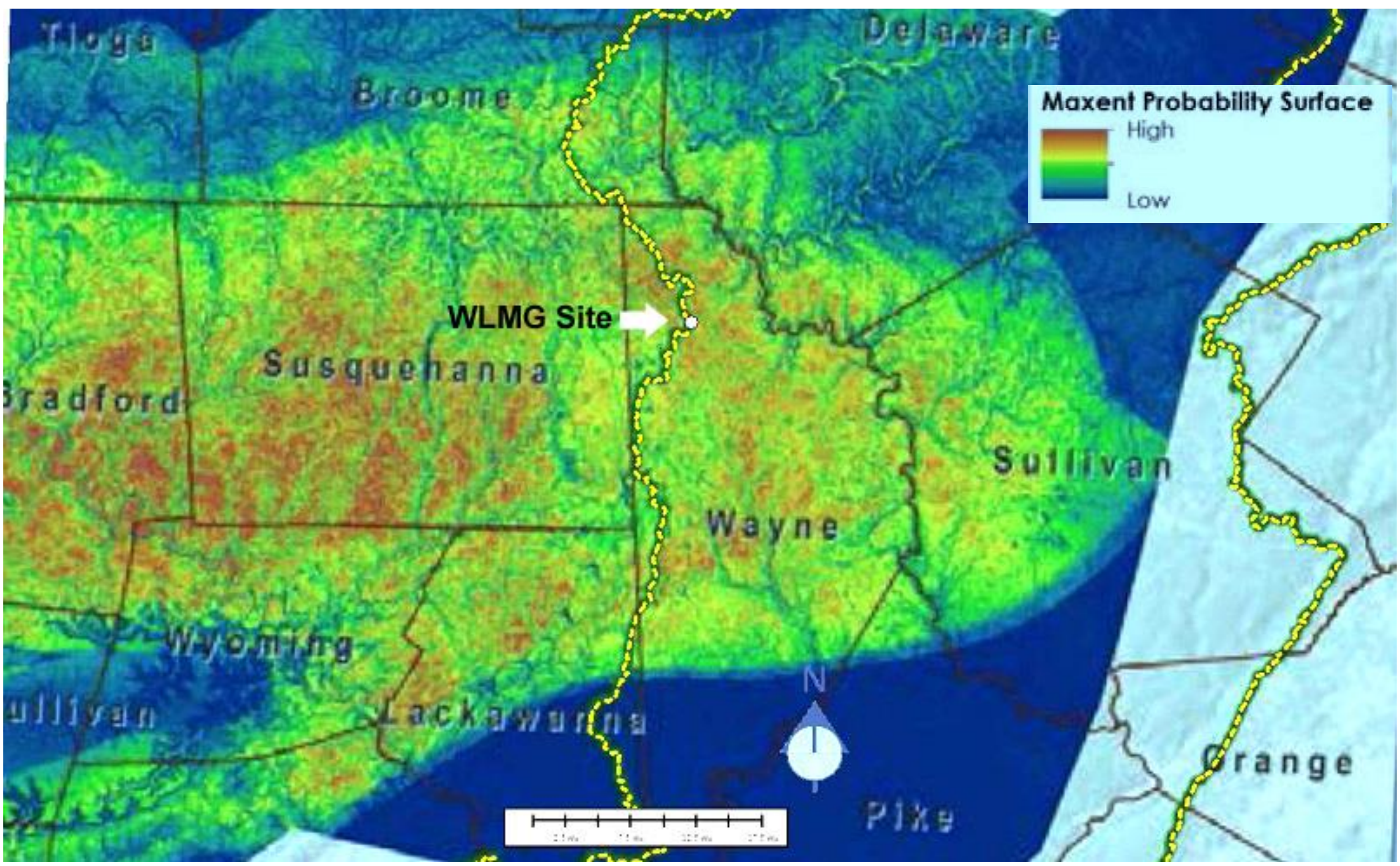

Figure 8. Marcellus Shale resource probability in northeastern Pennsylvania (Habicht et al. 2015). Limits of Delaware River Basin are highlighted by dashed yellow line. Counties are labeled.

The impacts of gas field development can be summarized as land use change, forest fragmentation, water and waste management issues, truck traffic, water quality reduction, air quality decline, and human health and safety consequences. During the 2010-2016 period about 4 percent of core forest in Lycoming County was lost as a result of gas development, primarily from construction of roads and pipelines (Langlois et al. 2017). Core forests are critical habitat for many species of wildlife, including migratory birds whose populations are declining. Land use changes, truck traffic, noise levels, and potential water pollution typically peak during well development. Gas production declines rapidly in Marcellus Shale wells, and refracturing may be needed after a few years. Methane and other contaminants may leak from wells and pipe joints during an extended period of resource production over years or decades, and the compressors moving gas long distances along gathering pipelines and transmission pipelines will emit significant noise, leak methane, and discharge exhaust from their large engines for many years. Pipeline maintenance blowdowns are another major source of methane and other air pollutants (SPEHP 2015). Compressor stations leak gases even when not in operation (Subramanian et al. 2015). Incomplete combustion and sunlight conversion of methane released at compressor stations has led to production of formaldehyde, a known human carcinogen, and other toxics such as benzene and hexane also are measurable around compressors (Macey et al. 2014; Neuhauser et al. 2014). Increasingly the adverse consequences for human health are being identified among populations living close to oil and gas operations, as further discussed below.

Sludges filtered from well wastewaters are typically disposed in landfills, where they can generate polluting leachates unless the landfills were designed specifically for toxic chemicals (Troutman 2019). There are no facilities for treating oil and gas waste near the WLMG pad (**Figure 9**). USEPA has not sought to regulate numerous oil and gas chemical additives, relying instead on voluntary adoption of management practices by the industry to lessen consequences for human health (USEPA 2019; Horwitt 2016, 2018). Wastes from Pennsylvania wells are not closely tracked (Hill et al. 2019, Tasker et al. 2018). Meanwhile the industry, in cooperation with PADEP, is eager for USEPA to continue allowing discharge of well wastewaters to Publicly Owned Treatment Works and for PADEP to expand use of wellfield brines for roadway dust suppression and ice melting (CDAC 2019).

Disposal of conventional oil and gas well brines long was allowed in Pennsylvania for deicing and for dust control on unpaved roads after minimal testing. These wastewaters contain various salts, radioactivity, and organic contaminant concentrations, often many times higher than drinking water standards. Bioassays also indicated that these wastewaters contain organic micropollutants that affected signaling pathways consistent with xenobiotic metabolism and caused toxicity to aquatic organisms. The potential toxicity of these wastewaters is a concern as lab experiments demonstrated that nearly all of the metals from these wastewaters leach from roads after rain events, likely reaching ground and surface water (Tasker et al. 2018). In Pennsylvania from 2008 to 2014, spreading conventional O&G wastewater on roads released over 4 times more radium to the environment than O&G wastewater treatment facilities and 200 times more radium than spill events.

Through computerized modeling based on physical constraints and recent experience in other Pennsylvania counties, Habicht et al. (2015) estimated that there could be more than 2,400 Marcellus wells developed on several hundred well pads in the Delaware River Basin section of Wayne County, if current moratoria were lifted (**Figure 10**). Their modeling was based on the resource probability shown in **Figure 8**. The

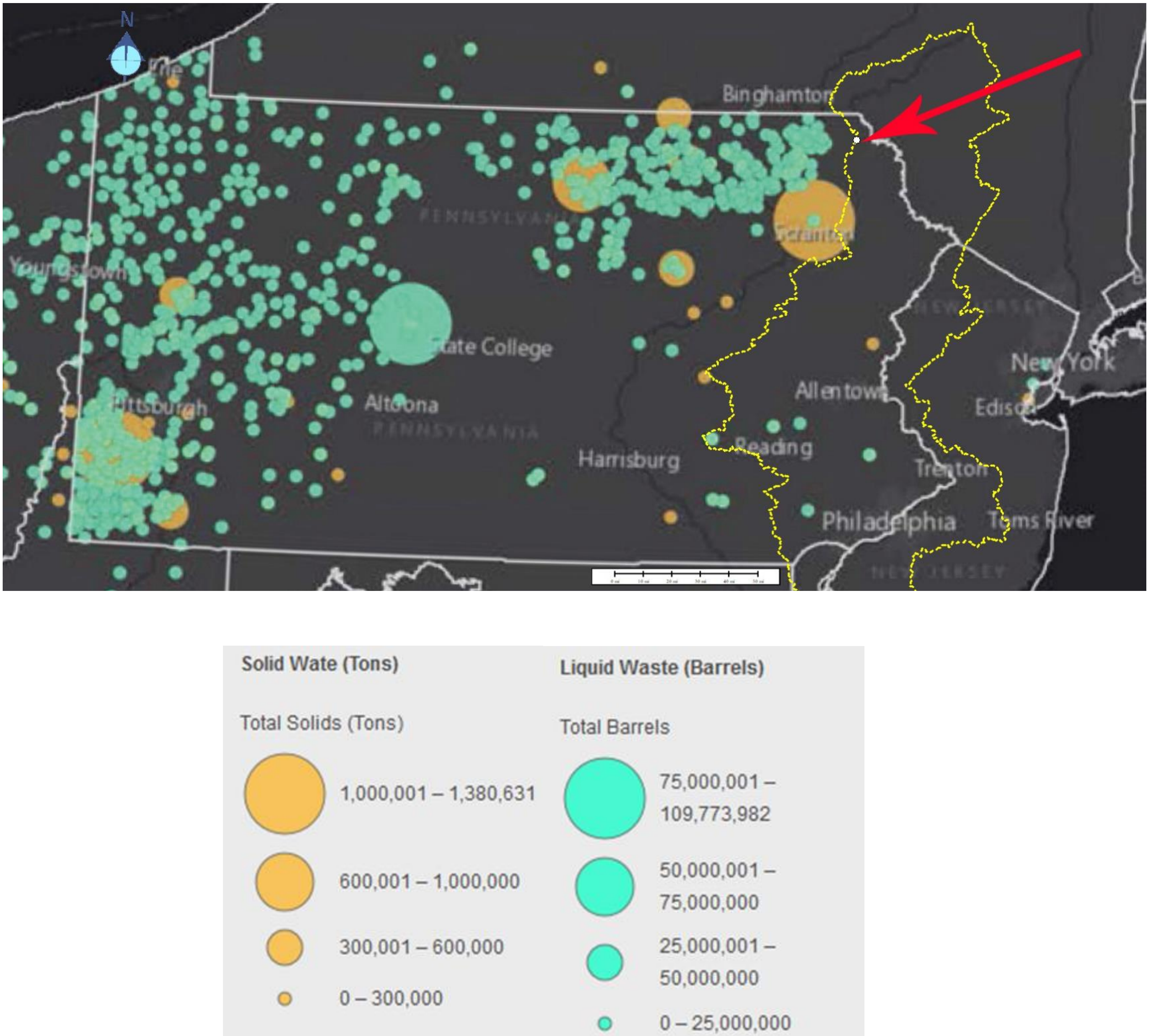

Figure 9. There are no gas waste disposal facilities in Wayne County, so much truck haulage will be needed for the proposed WLMG well(s). WLMG site is the white dot at the end of the red arrow. Delaware River Basin is outlined in yellow. Base graphic from FrackTracker.

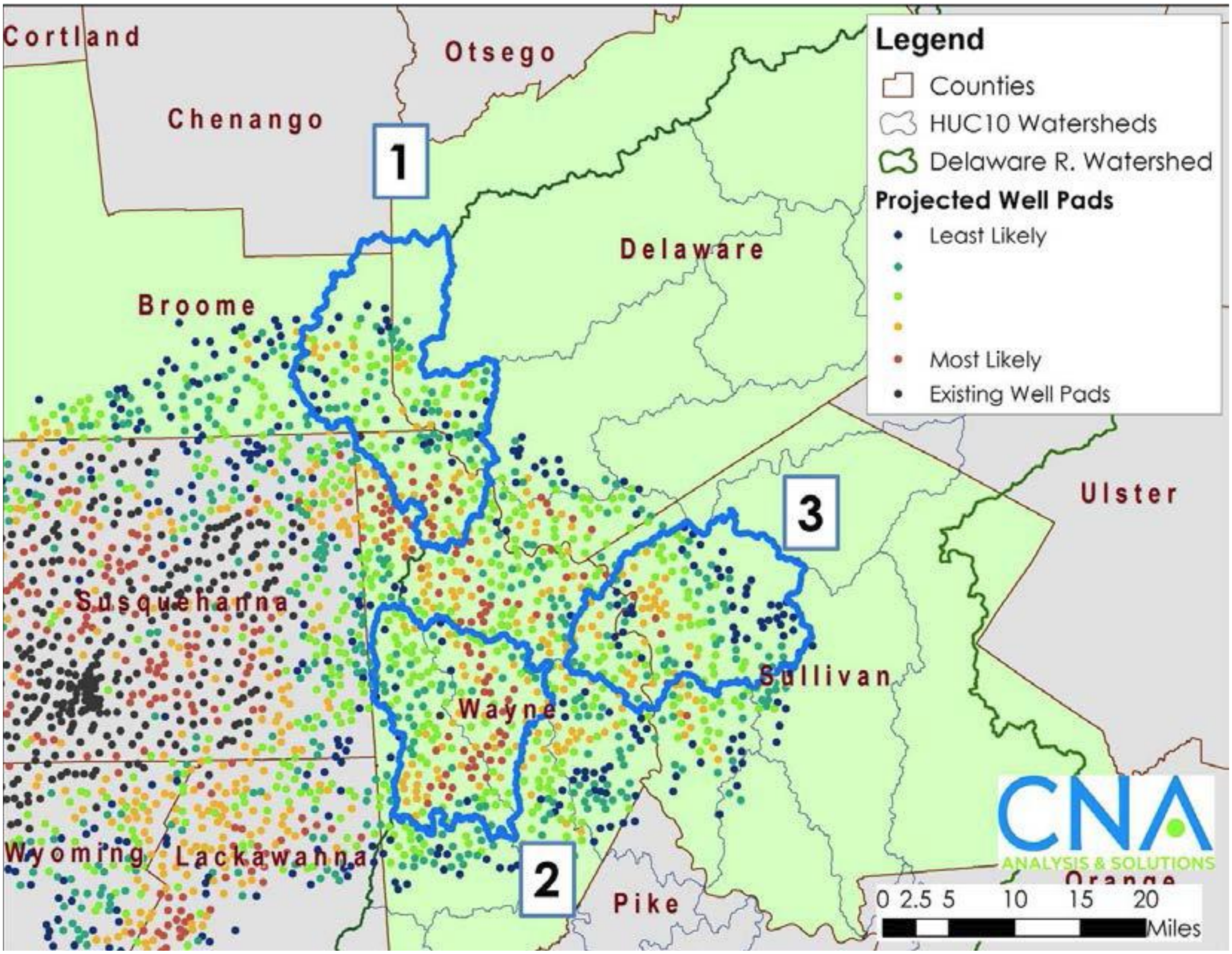

Figure 10. Potential locations for new well pads (projected at 4 wells per pad) in the Upper Delaware River Basin. Three study areas outlined in blue were chosen for analysis from the counties shown in green by Habicht et al. (2015).

proposed WLMG pad lies south of Study Area 1 and north of Study Area 2 on the watershed boundary (**Figure 10**). Study Area 2 is shown in greater detail in **Figure 11**. Habicht et al. (2015) used reasonable assumptions concerning well pad spacing, the available but incomplete wetland and stream information, and probable setbacks from known streams, reservoirs, and buildings. At an average rate of about 20 acres per well pad (74% for gathering line construction, 21% for well pads, and 5% for roads) and 4 wells per pad, the total landscape conversion to industrial uses was estimated at 2 to 3 percent of the total land area (now all consisting of forests and farmlands). In addition to protecting public water supplies, forests in the upper Delaware River Basin today sequester carbon, recharge aquifers, filter clean air, provide habitat for wildlife, maintain fisheries, and encourage eco-tourism. About 1 to 2 percent of total forest land would be lost, and an additional 5 to 10% of the existing interior forest land would be converted to edge forest.[1]

Invasive plants typically spread rapidly onto lands disturbed by gas operations in Pennsylvania (Mulhollem 2018). Habicht et al. (2015) concluded that the amount of land converted to industry by gas development in its Study Area 2 (a roughly 12- by 15-mile area of 162 square miles located just south of the proposed WLMG well pad in central Wayne County) would be comparable to constructing 58 King of Prussia shopping malls there. (King of Prussia Mall is a suburban Montgomery County, Pennsylvania, landmark and one of the largest retail shopping destinations in the United States.) New roads, well pads, and pipelines probably would resemble the landscape shown in **Figure 11**.

Certain aquatic ecosystems, including headwater areas such as where the proposed WLMG well pad is proposed to be located, are highly sensitive to changes in flow regime, which can induce a decrease in species richness, increase in predators, increase in generalist and highly mobile species, and decrease in cold-water specialist organisms (Kaplan et al. 2008, Sweeney and Jackson 2010). There is a 4-acre pond in the Susquehanna River Basin section of the property that WLMG may use for potable water supplies during gas development.

Natural gas wastewaters, including shale brine that flows back to the surface during fracking and long-term gas production, carry highly concentrated salts, dissolved solids, metals, and radioactive materials in addition to the chemicals used to expedite the drilling and fracturing of rock. These wastewaters must be carefully captured, stored, and either treated before release to the environment, injected into permanent disposal wells, or dried and placed in industrial waste landfills. Spills of fuel, chemicals, and wastewater from trucks and pipes occur, and may result in enforcement if fish kills or other consequences are noted (**Figure 12**). For example, fish, salamanders, crayfish, and aquatic macroinvertebrates were killed along three quarters of a mile of tributary stream in Cross Creek Park, Washington County, Pennsylvania, by spilled frackwater in 2009 (Pittsburgh Post-Gazette 2009). Leaks and spills of fracking chemicals and

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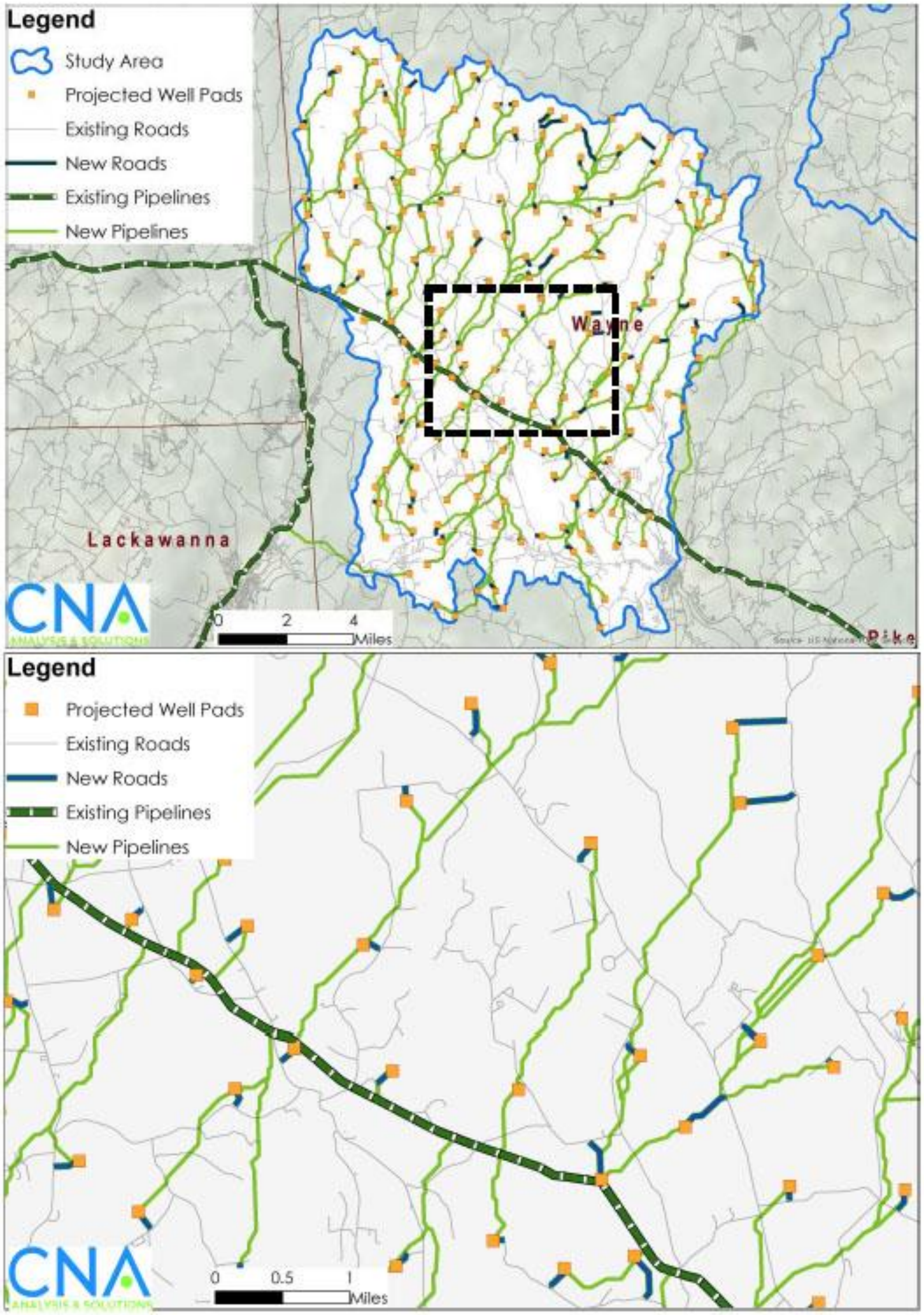
[1] Edge forest is land with trees at least 15 feet tall sited less than 300 feet (~100 m) from non-forested areas such as roads or fields. Edge forest supports many species of relatively common and invasive wildlife, both plants and animals with broad habitat tolerance. In contrast, interior core forest more than 300 feet from edges supports many rare and vulnerable species with specialized requirements seldom met in disturbed areas.



Source: National Park Service (background)

Figure 11. Projected landscape pattern for a section of central Wayne County, based on recent Marcellus Shale gas development in Bradford and Susquehanna Counties (Habicht et al. 2015). The proposed WLMG well pad is about 2 miles north of the northwest section of this No. 2 Study Area (upper graphic) and 2 miles south of No. 1 Study Area (**Figure 10**).

This small frackwater pipeline joint failure caused loss of more than 10,000 gallons of fluid resulting in a fish kill in High Quality Brush Run watershed, Washington County, 2009. Damage to fish, salamanders, frogs, and oligochaetes here was recorded by PADEP.

Figure 12. Actual surface water pollution from shale gas development.

wastes also can affect human health (Crosby et al. 2018), as well as livestock and wildlife (Phillips 2011). Improper discharges of gas wastewater to Pennsylvania streams have generated numerous violations, and any resulting fines represent a minor cost of doing business for the gas industry (Niedbala 2018; Maykuth 2013; Levy 2011). PADEP (2019b) has reported 345 incidents of damage to private well water supplies from oil and gas activities.

The production of natural gas is associated with potential groundwater contamination from casing leaks and by spills, with the introduction of methane and other contaminants into domestic well water and stream water, and with impacts on the health of exposed humans and livestock, all of which can vary locally in response to environmental conditions and construction practices (Woda et al. 2018; Bourzek 2018). Drilling fluids are virtually unregulated in Pennsylvania, but have ample opportunity to contaminate groundwater prior to installation of casing pipes and concrete (Troutman 2019). The kinds and quantities of chemicals added to fracking fluids are not fully disclosed, but are subject to spills and leakage to surface waters and groundwaters (Horwitt 2018, Troutman 2019). Methane can disperse into groundwater, migrate into buildings, and disperse into the atmosphere (Burgos et al. 2017). Stream contaminant inputs are accompanied by loss of forest stream cover in Pennsylvania gas fields, resulting in a decline of aquatic habit quality (Sweeney and Jackson 2013).

WLMG has not identified the location of potential receptors in the vicinity of its well(s) or how it proposes to minimize adverse impacts on neighbors from noise, light, exhaust pollution, airborne particulates, or traffic during well drilling and development. Such impacts on nearby residents as well as on wildlife can be severe. Human mortality in the United States increases with airborne levels of fine particulates ($PM_{2.5}$) and ozone with no evidence for zero-effect thresholds (Di et al. 2017). Airborne wastes are transmitted by precipitation to surface waters. A statistical analysis of the scientific literature on health impacts of fracking available from 2009 to 2015 demonstrated that:

- 69 percent of original research studies on water quality found potential for, or actual evidence of, fracking-associated water contamination,
- 87 percent of original research studies on air quality found significant air pollutant emissions, and
- 84 percent of original research studies on human health risks found signs of harm or indication of potential harm (Hays and Shonkoff 2016).

The followup study showed 90.3 percent of all original research studies published from 2016-2018 on the health impacts of petroleum fracking documented a positive association with harm or potential harm (Ferrar, Jackson, and Malone 2019). Methane leaks from fracked wells increase over time (Yudhowijoyo et al. 2018). Radium levels in drill cuttings from shale are found at significantly high concentrations, but are exempt from federal regulation. The half-life of radium 226 is 1,620 years; of radium 228, about 6 years. Radium concentrations remain at toxic levels even after frack wastewater has passed through industrial waste treatment plants (Swiedler et al. 2019; Lauer et al. 2018). In Pennsylvania elevated concentrations of radium 226 and 228 (at about 200 times background), strontium, and barium, all characteristic of Marcellus Shale gas well return waters, were detected more than 11 miles downstream from a centralized return-water waste treatment plant (Burgos et al. 2017), where the relatively small volumes discharged relative to stream flow were deposited in Conemaugh River Lake, Indiana County. Other contaminants of drinking water associated with chemicals released from produced waters include sulfates, acetone, toluene, and bromide. When bromide reacts with the chlorine commonly used to treat public water supplies, bromates and other brominated compounds (including trihalomethanes, some of which are carcinogenic) can form disinfection byproducts that enter urban drinking waters, from which they are not readily removed, leading to human disease (Huang et al. 2018; Liberatore et al. 2017).

Maximum allowable concentrations of several contaminants in wastewaters are based primarily on known effects on human health for those chemicals that have been studied. Yet the impacts of many industrial chemicals used by the unconventional gas industry have not been studied alone, much less in combination, despite exponential growth in the recent literature on health impacts (CHPNY and PSR 2019; Horwitt 2016, 2018). Stream organisms can be more sensitive than humans when constantly exposed to relatively low concentrations of waterborne chemicals. Contaminants from treated gas production wastewaters discharged to Pennsylvania streams can raise natural background concentrations of certain elements---notably barium and strontium---more than 500-fold during periods of low flow with resulting ecotoxicity (Hammer et al. 2012). Iodide, radium, and ammonium seldom are measured during sampling of brines and flowback waters. Total dissolved solids limits on industrial discharges in Pennsylvania also are ten times higher than typical background concentrations in Upper Delaware River Basin streams, so even the discharges currently allowable by State regulators are likely to entail a decline in water quality. Cement casings in long well bores offer another potential pathway for release of contaminated frackwaters and methane into both underground aquifers and surface waters.[2] Stream pollution in gas production watersheds has been found to be highly variable (Akob et al. 2015), but the links between fracking activity and stream pollution are becoming documented (Heilweil et al. 2015, Darrah et al. 2014).

Land cover changes resulting from unconventional gas production have both short-term and long-term effects on hydrology reflected both in water quality and water quantity. Water quality is affected by greatly increased erosion and sedimentation during pipeline, well, and road development, especially where forest is removed. Total suspended solids concentrations increase. Long-term erosion and sedimentation rates increase significantly from deforested land, especially during the winter months. Carbon sequestration also is lost when forest cover is removed, and the loss of carbon storage from gas field development is more widespread and prolonged than from timber harvest (Young et al. 2018). Best Management Practices for erosion control often fail in steeply sloping terrain in Pennsylvania. Erosion and sediment controls are not easily enforced, inspections by State regulatory staff are few, and violations frequently occur in Pennsylvania gas fields and along pipelines under construction (Delaware Riverkeeper Network 2016a, Zenes 2013). Surface runoff rates increase, along with a decrease in surface infiltration and aquifer recharge. Water temperature increases, to the detriment of trout and other aquatic organisms (Delaware Riverkeeper Network 2016b). The average rate of annual reduction in groundwater recharge per square mile ranged from 0.35 to 2 million gallons in a modeling analysis of northeast Pennsylvania Marcellus Shale gas fields in the Susquehanna River Basin (Habicht et al. 2015). They estimated the consequent potential reduction in groundwater recharge from their Study Area 2 in Wayne County as 140 to 330 million gallons annually, if typical Marcellus Shale gas production were undertaken there. These effects are most likely to be significant locally in the highest elevations of headwaters in the Basin, such as the vicinity of the proposed WLMG well pad, where base flow is of greatest consequence to streams draining small watersheds.

Public health aspects of shale gas extraction in Pennsylvania have begun to receive serious attention only since the unconventional shale gas industry was authorized, and public health concerns still receive minimal, if any, consideration during the review of applications for State permits (Bonnet 2018). The human population of Wayne County is not concentrated near the WLMG well pad in rural Preston Township, but there are half a dozen offsite residences nearby, as close as 750 feet to the proposed pad. The locations and current quality of surrounding domestic water supply wells have not been identified, nor have routes for the primary plumes of polluted air that will leave the pad. WLMG has not evaluated the capability of existing public roads to serve its significant gas drilling and fracking vehicular traffic during the months or years of its well development activities. Because no drilling or fracking water is to be acquired or wastes disposed locally, the maximum generation of heavy industrial truck traffic can be expected from gas development at the WLMG site. In any case, several thousand truck trips would be needed to haul drill rigs, steel pipe, drilling water, frackwater, and wastewater in and out. As mentioned

[2] Immediate cement and casing failures affect about 2% of all unconventional wells. Over time the rate of such failures increases dramatically. In the Marcellus Shale gas fields of northeastern Pennsylvania, the rate of failure is 8.5 times higher than in the rest of the State (Ingraffea et al. 2014; Davies et al. 2014).

above, the quantities of water needed for developing unconventional wells is vastly greater than for conventional shallow oil and gas wells in Pennsylvania (Burgos et al. 2017).

The proportion of congenital heart defects encountered in human infants is dramatically greater for women who live in close proximity to gas wells during early pregnancy, as compared with comparable control populations (McKenzie et al. 2019). These are the most common kinds of birth defects in the United States, and are particularly common near unconventional petroleum well development in rural areas. Such defects are the leading cause of infant mortality in the United States, are associated with failure to thrive and developmental problems, and can lead to brain injury. Computerized databases such as PSE (2019) are beginning to aid in accessing the literature on human health and environmental impacts of shale gas production activities.

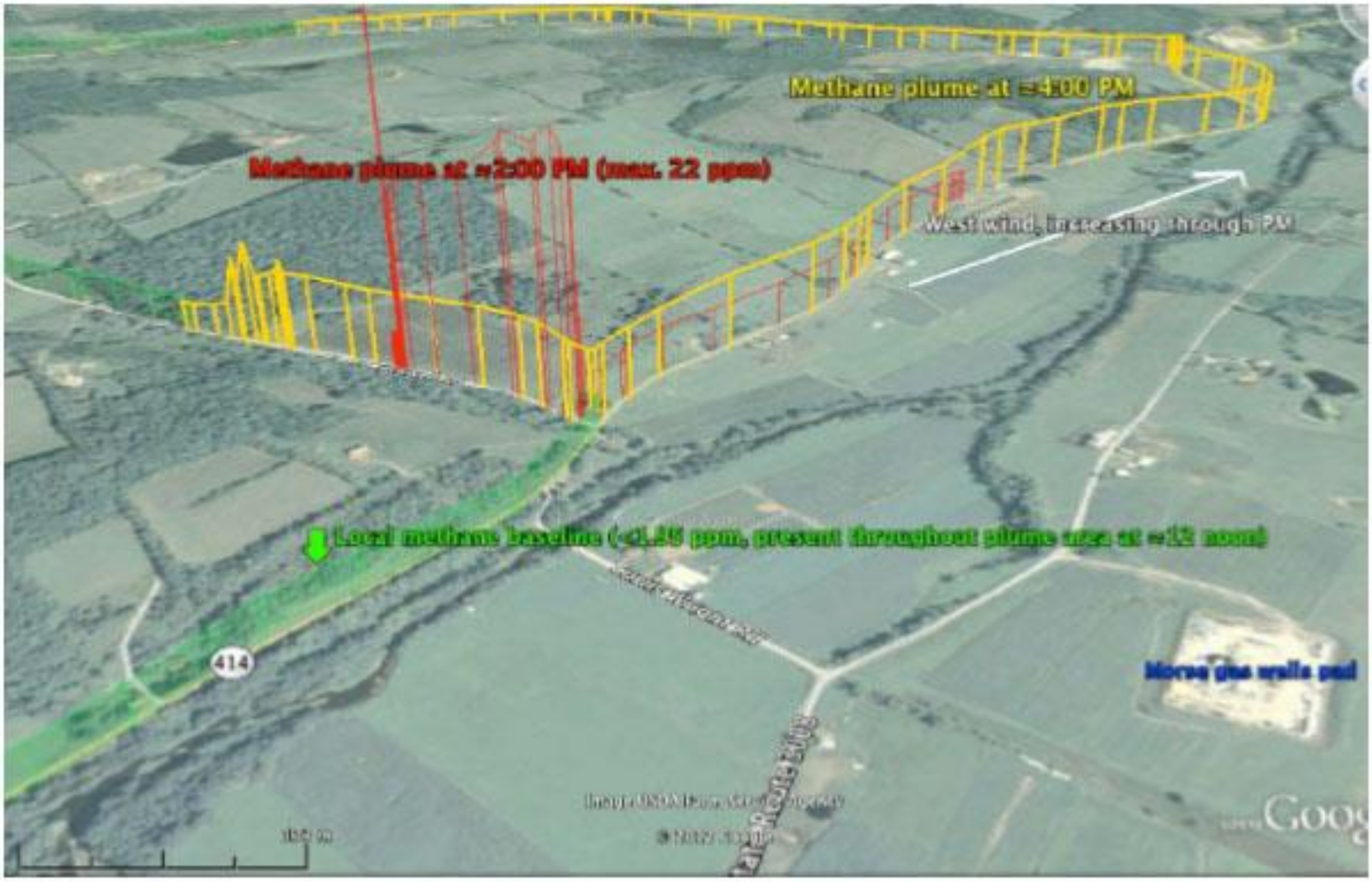
Air quality impacts from unconventional natural gas production vary across the spectrum of gas field activities. Atmospheric concentrations of oxides of nitrogen (NOx), volatile organic compounds (VOCs), and primary fine particulate matter (≤2.5 µm aerodynamic diameter; $PM_{2.5}$) from wellfield activities such as drilling, hydraulic fracturing, compressor stations, and completion venting have been increasing significantly (Anirban, Adams, and Robinson 2016). At present rural Wayne County in general has high quality air. Diesel-powered engine exhausts increase near gas well pads during pad construction, drilling, and fracking and from the transport of equipment, water, chemicals, proppant, and wastes by truck. Ozone and other pollutants in the unconventional well fields attain levels typical of urban environments.

Open ponds for condensate and fracking wastes produce noxious odors as well as contaminant emissions, even when their fluids do not leak. Frackwater storage pits, of course, too often do leak (Hopey 2014). Such facilities may be permitted elsewhere, even if the proposed use of enclosed tanks at the WLMG well pad is reinforced by permit conditions. Long-term emissions of nitrogen oxides will result from the gas compressor exhausts that are necessary to get gas to market, with the estimated 12 needed for Wayne County expected to increase nitrogen oxides in the County by amounts ranging from 66% to nearly 200% of current countywide emissions, should the DRBC moratorium be lifted (Habicht et al. 2015). The emissions equivalent, for each of those compressors, would be that of adding 53,000 vehicles to Wayne County roads for a year. Volatile organic compounds, sulfur compounds, and particulate matter in Wayne County air also would increase measurably.

Unburned methane leaking from wells, valves, and pipes contributes to global warming, because it is a much more potent greenhouse gas than carbon dioxide. The typical average leakage of 6% of total methane from gas production and transport is well above the 3.2% maximum necessary if the burning of natural gas were to provide less greenhouse impact than coal burning for equivalent energy production. Recent measurements of methane leakage in gas fields and at all steps of gas distribution have shown previous estimates of leakage to be far understated (Alvarez et al. 2018; Barkley et al. 2018; Omara et al. 2016; Caulton et al. 2014). Elevated indoor methane levels have been recorded at homes in Marcellus gas production areas of southwestern Pennsylvania (Alawattegama et al. 2015). Indoor radon concentrations also have been on the increase in Pennsylvania areas of Marcellus gas development (Hurdle and Phillips 2015).

Noise levels alongside roads and well pads peak during well development and refracturing activities, but pumping station noise and air pollution along gathering lines continue for years (Shepherd et al. 2010, Hays et al. 2017). Noise levels from gas operations have posed health problems in Pennsylvania (Richburg and Slagley 2018). Long laterals require large engines on well pads to provide the high pressure (to 7,500 pounds per square inch) needed to move well fluids through miles of pipe and to force proppant sand into blasted and natural fractures in the shale. Noise levels also are significant on rural roads carrying heavy industrial gasfield truck traffic.

Health risks would increase as a consequence of unconventional natural gas production of Marcellus and Utica Shales in Wayne County, where some 40% of residents (about 30,000 people) live within 1 mile of likely well pads. Hospitalization rates in Pennsylvania rise with increases in gas wells (Denham et al. 2019). Infant health is significantly impaired where Pennsylvania mothers have spent pregnancy close to gas wells (McKenzie et al. 2019; Hill 2018; Currie et al. 2017; Casey et al. 2016). Rates of depression rise with the intensity of gas development (Casey et al. 2018), as do cases of childhood asthma (Willis et al. 2018). Similarly, hospitalization rates of adults and of senior citizens for asthma, pneumonia, and other respiratory diseases are higher in Pennsylvania counties with fracking operations (Peng et al. 2018; Weinberger et al. 2017; Tustin et al. 2017; Song and Kusnetz 2016). Bladder and thyroid cancers also are increasingly common in the fracking counties (Finkel 2016). Well water, stream, and air contamination by methane, fine particulate matter (Evans et al. 2015), and other gas production-generated pollutants such as ozone (Swarthout et al. 2015) are being experienced by residents of Pennsylvania Marcellus Shale gas fields (**Figure 13**). Gas well contamination can render domestic wells unusable for many months (Gibbons 2014). Most Wayne County residents rely on groundwater wells for potable supplies. Recent studies have shown higher rates of hospital admissions for cardiology and neurology patients in Pennsylvania counties with shale gas production (Jemielita et al. 2015).



Methane concentrations from gas exiting natural faults and fractures in Leroy Township, Bradford County, on 25 July 2012. Green bars show concentrations at background level. Yellow and red bars show elevated concentrations at two times of day (2 pm and 4 pm). This plume encompassed about 1.6 square miles and originated from a gas discharge area occupying at least 30 acres. The red spikes showing maximum concentrations are relatively distant from the presumed originating source at Morse wells 3H and 5H in the lower right corner of the view, 0.4 mile away near the intersection of Curtis Wright Road and Southside Road (State Route 3008), where a casing leak had been reported on 19 May 2012 (Ackley & Payne 2012b). Towanda Creek parallels Route 414 in the center of the oblique photograph.

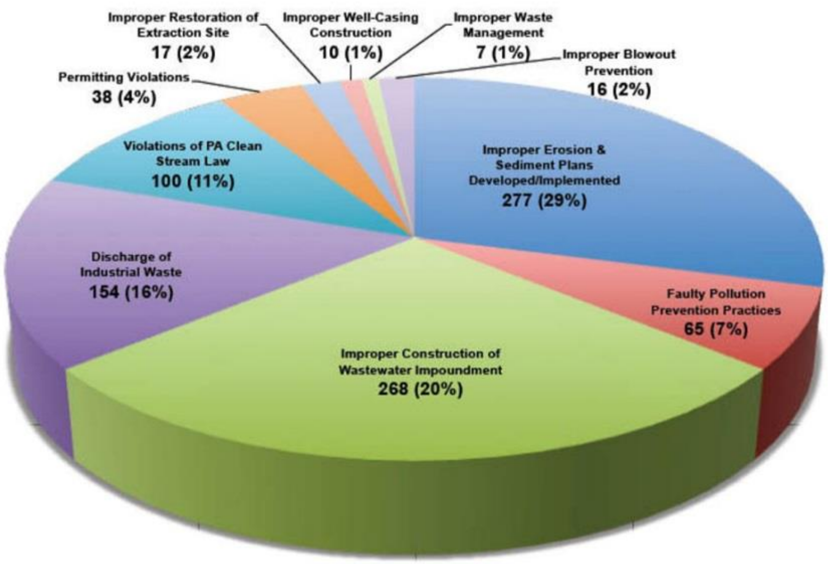
Figure 13. Methane from shale gas production in rural Pennsylvania.

Regulatory Concerns

The DRBC was established in part to protect the quality and quantity of water supplies and to allocate them among the many millions of human users of water in the Delaware River Basin. New York State has determined that, for the foreseeable future, unconventional gas production from Marcellus Shale and similar deposits is too damaging to human health and to the environment to be allowed. In contrast, Pennsylvania has authorized extensive Marcellus gas production outside the Delaware River Basin. Consequently, to date the adverse impacts of this industry have not been experienced within the Delaware River Basin in Pennsylvania.

In Pennsylvania the rhetorical attention given to environmental protection through laws, ordinances, regulations, and permit programs is belied by ineffective implementation. The Pennsylvania Department of Environmental Protection (PADEP) has difficulty protecting both natural resources and the health of people affected by unconventional gas development. PADEP has experienced halving of its budget over the past decade, despite ever growing workloads. It has failed to secure complete, internally consistent permit applications for approval of proposed construction that comply with its published regulations designed to protect water, wetlands, soils, and other ecosystem characteristics, especially for large projects such as coal mines (Schmid & Co., Inc. 2000, 2013a, b, 2015), pipelines (Schmid & Co., Inc. 2014, 2016a, b, 2017a, b), and powerlines (Helbing & Szybist 2014). PADEP gas well approvals have been issued quickly after cursory review (Associated Press 2011/2019). State regulation of encroachments and obstructions into streams and floodways in watersheds smaller than 100 acres is waived [25 Pa. Code §105.12(a)(2)], despite the necessity of maintaining the quality of headwaters if our rivers are to have any chance of protection or restoration (Kaplan et al. 2008).

Superficial, incomplete, and inaccurate inventories of existing features on lands directly impacted by regulated activities render it impossible to avoid or minimize adverse impacts (Schmid 2019). PADEP staff seldom make field determinations of existing use in larger streams where encroachments are proposed, despite the requirement in 25 Pa. Code §93.4c(a)(1). Unrecognized impacts on misidentified resources do not generate permit requirements to attempt compensatory mitigation. Chemicals used in well drilling and fracking are not required to be disclosed, and the identities of some are known only to manufacturers, not even to drillers or gas producers (Horwitt 2018, 2016). Health effects are presumed to be minimal without data, and safety threshold concentrations for many chemicals are simply unknown. Monitoring of compliance with limits on waste discharges is not assured, and public investigation of monitoring records is difficult (Schmid & Co., Inc. 2010; Legere 2013). Agency inspections that reveal violations are not always followed up by enforcement actions to correct unnecessary environmental damage, and penalties for violations are negligible (Woodwell 2016; **Figures 14** and **15**). Self-reporting of violations has not been effective in the gas fields (Hamill 2014). Recordkeeping for fracked-well wastewaters in Pennsylvania is incomplete, and more than one third of such wastes were unaccounted for during the period 1991-2017 (Hill et al. 2019). Air quality monitoring of gas field wastes is seldom performed and methods are not well developed (Brown et al. 2014). Drill cuttings are not defined as solid waste in Pennsylvania, are not analyzed for pollutants, and frequently are disposed onsite in pits (Steinzor and Balzel 2015).



952 “serious” violations of PADEP regulations at shale gas wells by 43 drillers over a 30-month period, 2008-2010.

Figure 14. Violations in PA shale gas wells, 2008-2010.

Total Violations for 2011	1,192
Notice of Violation Issued *(35% of total violations)*	421
Consent Order & Agreements Issued *(0.05% of total violations)*	7
Consent Assessment of Civil Penalties Issued *(6% of total violations)*	80
Violations Receiving No Enforcement Action *(63% of total violations)*	753
Violations Receiving No Fines *(93% of total violations)*	1,105
Total Fines Collected	$2,452,988

Source: PA Department of Environmental Protection website as of May 1, 2012

Figure 15. Violations at Marcellus Shale gas wells summarized from PADEP by Clean Water Action (2012).

Suggested Routine Inspections
At least once during siting a well
At least once during drilling a well
At least once during casing a well
At least once during cementing a well
At least once during completing a well
At least once during altering a well
At least once during stimulating a well.
At least once during, or within 3 months after, the time period in which the owner or operator is required to restore the site, after drilling the well
At least once prior to a well being granted inactive status.
At least once during well plugging
At least once during, or within 3 months after, the period in which the owner or operator is required to restore the site, after the well is plugged or abandoned.
At least once before the bond or other financial security is released.
At least once a year to determine whether compliance with the statutes administered by DEP has been achieved.

Special Inspections
At least once prior to the issuance of a permit, if a waiver or exception is requested by the permit applicant.
At least once in verifying or resolving objections or determining the Department's response to objections, when objections are raised to a permit application.
At least once prior to the authorization to use an alternate method for plugging, casing or equipping the well
At least once during the periods that an alternative method for plugging, casing or equipping the well is being used or installed.
At least once when a well is being reconditioned or repaired or when casing is being replaced.
At least once a year, if there is onsite brine disposal or residual waste disposal subject to the statutes referenced in § 78.902 (relating to policy).
At least twice a year if the well is located in a gas storage reservoir or in a gas storage reservoir protective area.
If there is a violation, at least once to determine whether the violation has been corrected, or whether there is a continuing violation.
At least once, in response to a complaint.

Figure 16. Expected Pennsylvania inspections as set forth in existing regulations (25 Pennsylvania Code §78.901-906. "Inspection Policy Regarding Oil and Gas Wells").

For a comprehensive analysis of enforcement of oil and gas regulations in several States including Pennsylvania, Sumi (2012) tabulated the onsite inspections that any careful reader of PADEP regulations might expect to be performed routinely at gas wells in the Commonwealth (**Figure 16)**. In reality, PADEP inspectors do not perform frequent inspections of shale gas wells. In 2011, there were 8,216 active Marcellus wells to be inspected by 88 inspectors (more than 93 for each inspector), not counting the nearly 70,000 active, conventional, non-Marcellus wells for which the same 88 inspectors were also responsible (those also rarely are inspected). Since 2011 the number of PADEP gas well inspectors has increased slightly, but there are now more than 12,000 active unconventional and 101,000 conventional Marcellus gas wells active in Pennsylvania (PADEP 2019a). The careful analysis for Earthworks Action by Sumi (2012) concluded that Pennsylvania has not adequately enforced laws and regulations that pertain to the oil and gas industry. Virtually no similar requirements apply to gas gathering pipelines, which are virtually never inspected.

If DRBC were to allow this industry within the Pennsylvania section of the Basin, its regulations to reduce in-Basin damage at minimum would need to fill the tremendous regulatory gaps that currently allow widespread damage to waters, other natural resources, and human health in other parts of Pennsylvania (Schmid & Co., Inc. 2018). Unconventional shale gas production in the Basin – particularly without meaningful protective regulations in place and the financial resources and qualified staff necessary for DRBC to perform its own detailed permit review and field inspection -- will lead to inevitable environmental destruction. Among other harms, such unregulated industrial activity will result in lasting harm to the Basin's extraordinary water resources.

Authorship

This report was prepared by James A. Schmid with the assistance of Stephen P. Kunz. Dr. Schmid is a biogeographer and plant ecologist with 50 years of experience in environmental consulting. Both he and Mr. Kunz are certified Senior Ecologists (Ecological Society of America), Professional Wetland Scientists (Society of Wetland Scientists), and Wetland Delineators (US Army Corps of Engineers). Both Dr. Schmid and Mr. Kunz have prepared environmental impact statements and assessments for numerous federal, State, and local agencies.

References

Ackley, Robert, and Payne, B.F. 2012. Report to the Clean Air Council on 8 June 2012 field inspection and methane sampling survey of parts of Leroy, Granville and Franklin Townships, Bradford County, Pennsylvania. Gas Safety, Inc. Southborough MA. 8 p.

Akob, D. M., Cozzarelli, I. M., Dunlap, D. S., Rowan, E. L., and Lorah, M.M. 2015 (in press, corrected proofs online April 20). Organic and inorganic composition and microbiology of produced waters from Pennsylvania shale gas wells. Applied Geochemistry. doi: 10.1016/j.apgeochem.2015.04.011

Alawattegama, S. K., Kondratyuk, T., Krynock, R., Bricker, M., Rutter, J. K., Bain, D. J., and Stolz, J. F. 2015. Well water contamination in a rural community in southwestern Pennsylvania near unconventional shale gas extraction. Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances and Environmental Engineering 50:516-528. doi: 10.1080/10934529.2015.992684

Alvarez, R. A., Zavala-Araiza, D., Lyon, D. R., Allen, D. T., Barkley, Z. R., Brandt, A. R., . . . Hamburg, S. P. 2018. Assessment of methane emissions from the U.S. oil and gas supply chain. Science 361(6398):186-188. doi: 10.1126/science.aar7204

Anirban, A.R., Adams, P.J., and Robinson, A.L. 2016. Air pollutant emissions from the development, production, and processing of natural gas. Journal of the Air and Waste Management Association 64(1):19-37.

Anonymous. 2018. Drilling for miles in the Marcellus: laterals reach new lengths. Journal of Petroleum Technology. 8 August. https://www.spe.org/en/jpt/jpt-article-detail/?art=4465

Associated Press. 2011 (13 April; updated 6 January 2019). Pennsylvania regulators say they spend little time reviewing Marcellus Shale drilling permits. https://www.pennlive.com/midstate/2011/04/pennsylvania_regulators_say_th.html

Balashov, V.N., Engelder, T., Gu, X., Fantle, M.S., and Brantley, S.L. 2015. A model describing flowback chemistry changes with time after Marcellus Shale hydraulic fracturing. American Association of Petroleum Geologists Bulletin 99(1):143-154.

Barkley, Z. R., Lauvaux, T., Davis, K. J., Deng, A., Fried, A., Weibring, P., . . . Dickerson, R. R. 2018. Estimating methane emissions from underground coal and natural gas production in southwestern Pennsylvania. Geophysical Research Letters 46:4531-4540. doi: 10.1029/2019GL082131

Bourzec, K. 2018 (November 21). Chemical clues found for methane leaks caused by fracking. Chemical and Engineering News. Retrieved from https://cen.acs.org/environment/water/Chemical-clues-found-methane-leaks/96/i47

Bonnet, Vera. 2018. Shale gas extraction and public health: a resource guide. League of Women Voters of Pennsylvania. Harrisburg PA. 72 p.

Brown, D., Weinberger, B., Lewis, C., and Bonaparte, H. 2014. Understanding exposure from natural gas drilling puts current air standards to the test. Reviews on Environmental Health 29(4):277-92.

Burgos, William D., et al. 2017. Watershed-scale impacts from surface water disposal of oil and gas wastewater in western Pennsylvania. Environmental Science and Technology 51:8851-8860. doi: 10.1021/acs.est.7b01696

Carpenter, Chris. 2019 (1 February). Revised drilling practices lead to lateral-length gains in Marcellus Shale. Journal of Petroleum Technology. https://www.spe.org/en/jpt/jpt-article-detail/?art=4998

Casey, J. A., Savitz, D. A., Rasmussen, S. G., Ogburn, E. L., Pollak, J., Mercer, D. G., and Schwartz, B. S. 2016. Unconventional natural gas development and birth outcomes in Pennsylvania, USA. Epidemiology 27(2):163–172. doi: 10.1097/EDE.0000000000000387

Casey, J. A., Wilcox, H. C., Hirsch, A. G., Pollak, J., and Schwartz, B.S. 2018. Associations of unconventional natural gas development with depression symptoms and disordered sleep in Pennsylvania. Scientific Reports 8. doi: 10.1038/s41598-018-29747-2

Caulton, D. R., Shepson, P. B., Santoro, R. L., Sparks, J. P., Howarth, R. W., Ingraffea, A. R., . . . Miller, B. R. 2014. Toward a better understanding and quantification of methane emissions from shale gas development. Proceedings of the National Academy of Sciences of the United States of America. doi: 10.1073/pnas.1316546111

CDAC [Pennsylvania Grade Crude Development Advisory Council]. 2019. Second annual report, approved 23 May. [Harrisburg PA]. 20 p.

CHPNY and PSR [Concerned Health Professionals of New York and Physicians for Social Responsibility]. 2019. Compendium of scientific, medical, and media findings demonstrating risks and harms of fracking (unconventional gas and oil extraction) (6th ed.) 361 p. http://concernedhealthny.org/compendium/

Clean Water Action Pennsylvania. 2012. Enforcement of Marcellus shale drilling violations by Pennsylvania Department of Environmental Protection, Jan.1, 2011-Dec.31, 2011. 6 p. www.cleanwateraction.org/pa

Coccodrilli, Curt. 2019. 27 August deposition, Wayne Land and Mineral Group LLC v. Delaware River Basin Commission et al. Veritex Legal Solutions. 336 p.

Crosby, L.M., Tatu, C. A., Varonka, M., Charles, K. M., and Orem, W. H. 2018. Toxicological and chemical studies of wastewater from hydraulic fracture and conventional shale gas wells. Environmental Toxicology 37(8):2098-2111. doi: 10.1002/etc.4146

Currie, J., Greenstone, M., and Meckel, K. 2017. Hydraulic fracturing and infant health: new evidence from Pennsylvania. Science Advances 3(12) e1603021. doi: 10.1126/sciadv.1603021

Darrah, T. H., Vengosh, A., Jackson, R. B., Warner, N. R., and Poreda, R. J. 2014. Noble gases identify the mechanisms of fugitive gas contamination in drinking-water wells overlying the Marcellus and Barnett Shales. Proceedings of the National Academy of Sciences 111(39):14076-14081. doi: 10.1073/pnas.1322107111

Davies, R. J., Almond, S., Ward, R. S., Jackson, R. B., Adams, C., Worrall, F., . . . Whitehead, M. A. 2014. Oil and gas wells and their integrity: Implications for shale and unconventional resource exploitation. Marine and Petroleum Geology 56:239-254. doi: 10.1016/j.marpetgeo.2014.03.001

Delaware Riverkeeper Network. 2016a. Field-truthing and monitoring of the proposed PennEast Pipeline, FERC draft EIS, Docket No. CP15-558. Bristol PA. 54 p.

Delaware Riverkeeper Network. 2016b. Thermal impacts to exceptional value waterbodies in Pennsylvania cut by gas pipeline projects. Bristol PA. 25 p.

Denham, A., Willis, M., Zavez. A., and Hill, E. 2019. Unconventional natural gas development and hospitalizations: evidence from Pennsylvania, United States, 2003-2014. Public Health 168:17-25. doi: 10.1016/j.puhe.2018.11.020

Di, Q., Y. Wang, A. Zanobetti, Y. Wang, P. Koutrakis, C. Choirat, F. Domenici, and Schwartz, J.D. 2017. Air pollution and mortality in the Medicare population. New England Journal of Medicine 376(26):2513-2522.

Evans, R. B., Prezant, D., and Huang, Y. C. 2015. Hydraulic fracturing (fracking) and the Clean Air Act. Chest 148(2):298-300. doi: 10.1378/chest.14-2582

Ferrar, K., Jackson, E., and Malone, S. 2019. Categorical review of health reports on unconventional oil and gas development: impacts in Pennsylvania. FracTracker Alliance Issue Paper. Retrieved from https://www.delawareriverkeeper.org/sites/default/files/FracTrackerAlliance_DRKHealthReview_Final_4.25.19_0.pdf

Finkel, M. L. 2016. Shale gas development and cancer incidence in southwest Pennsylvania. Public Health 141:198-206. doi: 10.1016/j.puhe.2016.09.008

Fitzsimmons, Michael. 2017 (14 December). EQT's 3.7-mile lateral. *Seeking Alpha*. https://seekingalpha.com/article/4131859-eqts-3_2-mile-marcellus-lateral

Frazier, R. 2018 (September 7). Bringing the forest back after shale gas. StateImpact Pennsylvania. Retrieved from https://stateimpact.npr.org/pennsylvania/2018/09/07/bringing-the-forest-back-after-shale-gas/

Gibbons, B. 2014 (February 19). Woman wins case against Chesapeake, Jaqueline Place of Terry Township to receive compensation for well contamination. Thedailyreview.com. Retrieved from http://thedailyreview.com/news/woman-wins-case-against-chesapeake-jaqueline-place-of-terry-township-to-receive-compensation-for-well-contamination-1.1636832

Grant, C. J., Lutz, A. K., Kulig, A. D., and Stanton, M. R. 2016. Fracked ecology: response of aquatic trophic spill structure and mercury biomagnification dynamics in the Marcellus Shale Formation. Ecotoxicology 25:1739–1750. doi: 10.1007/s10646-016-1717-8

Habicht, Steven, Hansen, L., and Faeth, P. 2015. Impact from fracking in the Delaware River Basin. CNA Analysis and Solutions. Arlington VA. 110 p.

Hamill, S. D. 2014 (August 3). Drillers did not report half of spills that led to fines. Pittsburgh Post-Gazette. Retrieved from http://www.post-gazette.com/news/state/2014/08/03/Drillers-did-not-report-half-of-spills-that-led-to-fines/stories/201408020142

Hammer, R., VanBriesen, J., and Levine, L. 2012. In fracking's wake: new rules are needed to protect our health and environment from contaminated wastewater. Natural Resources Defense Council. 12-05-A. New York NY. 113 p.

Hayes, T. 2009. Sampling and analysis of water streams associated with the development of Marcellus Shale gas. Prepared for the Marcellus Shale Coalition. Gas Technology Institute. Des Plaines IL. 210 p.

Hays, J., McCawley, M., and Shonkoff, S.B.C. 2017. Public health implications of environmental noise associated with unconventional oil and gas development. Science of the Total Environment 580:448–456.

Hays, J., and Shonkoff, S.B.C. 2016. Toward an understanding of the environmental and public health impacts of shale gas development: An analysis of the peer-reviewed scientific literature, 2009-2015. PLoS One 11(4), e0154164. doi: 10.1371/journal.pone.0154164

Heilweil, V. M., Grieve, P. L., Hynek, S. A., Brantley, S. L., Solomon, D. K., and Risser, D. W. 2015. Stream measurements locate thermogenic methane fluxes in groundwater discharge in an area of shale-gas development. Environmental Science and Technology 49:4057-4065. doi: 10.1021/es503882b

Helbing, Michael D., and Szybist, M.C. 2014. Letter to K.S. White, PADEP, regarding PPL Corporation-PPL Electric Utilities, Water Obstruction and Encroachment Permit Applications No. E40-759 and E45-590, Jenkins-West Pocono 230 kV Line and 138 kV Connector Lines out of West Pocono Substation. Citizens for Pennsylvania's Future. Wilkes-Barre PA. 20 p.

Hill, E. 2018. Shale gas development and infant health: Evidence from Pennsylvania. Journal of Health Economics 61:134–150. doi: 10.1016/j.jhealeco.2018.07.004

Hill, L. A. L., Czolowski, E. D., DiGiulio, D., and Shonkoff, S.B.C. 2019. Temporal and spatial trends of conventional and unconventional oil and gas waste management in Pennsylvania, 1991-2017. Science of the Total Environment 674:623-636. doi: 10.1016/j.scitotenv.2019.03.475

Hopey, D. 2014 (September 18). Range resources to pay $4.15M penalty. Pittsburgh Post-Gazette. Retrieved from http://www.post-gazette.com/local/2014/09/18/DEP-orders-Range-Resources-to-pay-4-million-fine/stories/201409180293

Horwitt, Dusty. 2018. Keystone secrets: records show widespread use of secret fracking chemicals is a looming risk for Delaware River Basin Pennsylvania communities. Partnership for Public Integrity. 26 p. http://www.pfpi.net/wp-content/uploads/2018/09/PASecretFrackingChemicalsReportPFPI9.10.2018.pdf

Horwitt, Dusty. 2016. Toxic secrets: companies exploit weak US chemical rules to hide fracking risks. Partnership for Policy Integrity. 35 p.

Huang, K. Z., Yuefeng, F. X., and Tang, H. L. 2018. Formation of disinfection by-products under influence of shale gas produced water. Science of the Total Environment 647:744-751. doi: 10.1016/j.scitotenv.2018.08.055

Hughes, D. 2019. How long will the shale revolution last? Technology versus geology and the life cycle of shale plays. Post-Carbon Institute. Corvallis OR. https://shalebubble.org/

Hurdle, J., and Phillips, S. 2015 (April 9). New study raises possible link between gas drilling and radon levels. StateImpact Pennsylvania. Retrieved from http://stateimpact.npr.org/pennsylvania/2015/04/09/new-study-raises-possible-link-between-gas-drilling-and-radon-levels/

Ingraffea, A. R., Wells, M.T., Santoro, R.L., and Shonkoff, S.B. 2014. Assessment and risk analysis of casing and cement impairment in oil and gas wells in Pennsylvania, 2000-2012. Proceedings of the National Academy of Sciences USA 4121786 111(30):10955-60. doi: 10.1073/pnas.1323422111. http://www.ncbi.nlm.nih.gov/pubmed/24982144

IPCC. 2019. Special report on the ocean and cryosphere in a changing climate [H.O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, M. Nicolai, A. Okem, J. Petzold, B. Rama, N. Weyer (eds.)]. Geneva, Switzerland. 1170 p. https://report.ipcc.ch/srocc/pdf/SROCC_FinalDraft_FullReport.pdf

Jacquet, J. B., Junod, A. N., Bugden, D., Wildermuth, G., Fergen, J. T., Jalbert, K., . . . Ladlee, J. 2018. A decade of Marcellus Shale: impacts to people, policy and culture from 2008 to 2018 in the greater Mid-Atlantic region of the United States. Extractive Industries and *Society* 5(4):596-609. doi: 10.1016/j.exis.2018.06.006

Jemielita, T., Gerton, G.L., Neidell, M., Chillrud, S., Yan, B., Stute, M., Howarth, M., Saberi, P., Fausti, N., Penning, T.M., Roy, J., Propert, K.J., and Panettieri, R.A., Jr. 2015. Unconventional gas and oil drilling Is associated with increased hospital utilization rates. PLoS One 10(7). doi: 0.1371/journal.pone.0131093. http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0131093

Kaplan, Louis A., Bott, T.L., Jackson, J.K., Newbold, D., and Sweeney, B.W. 2008. Protecting headwaters: the scientific basis for safeguarding streams and ecosystems. Stroud Research Center. Avondale PA. 20 p. http://www.stroudcenter.org/research/PDF/ProtectingHeadwaters.pdf

Lauer, N. E., Warner, N. R., and Vengosh, A. 2018. Sources of radium accumulation in stream sediments near disposal sites in Pennsylvania: implications for disposal of conventional oil and gas wastewater. Environmental Science and Technology 52:955-962. doi: 10.1021/acs.est.7b04952

LWVPA [League of Women Voters of Pennsylvania]. 2012. Pipelines in Pennsylvania: a case study of Lycoming County. LWVPA. Harrisburg PA. 65 p.

Legere, Laura. 2013. Sunday Times review of DEP drilling records reveals water damage, murky testing methods. http://thetimes-tribune.com/news/sunday-times-review-of-dep-drilling-records-reveals-water-damagemurky-testing-methods-1.1491547

Levy, M. 2011 (May 18). DEP fines Chesapeake $1 million. Pressconnects.com. Retrieved from http://www.pressconnects.com/viewart/20110517/NEWS01/105170345/DEP-fines-Chesapeake-1-million

Liberatore, H. K., Plewa, M. J., Wagner, E. D., VanBriesen, J. M., Burnett, D. B., Cizmas, L. H., and Richardson, S. D. 2017. Identification and comparative mammalian cell cytotoxicity of new iodo-phenolic disinfection byproducts in chloraminated oil and gas wastewaters. Environmental Science and Technology Letters 4(11):475–480. doi: 10.1021/acs.estlett.7b00468

Macey, G. P., Breech, R., Chernaik, M., Cox, C., Larson, D., Thomas, D., and Carpenter, D. O. 2014. Air concentrations of volatile compounds near oil and gas production: a community-based exploratory study. Environmental Health 13(82). doi: 10.1186/1476-069X-13-82

Maykuth, A. 2013 (September 13). Shale criminal charges stun drilling industry. Philly.com. Retrieved from http://articles.philly.com/2013-09-13/news/42012429_1_xto-energy-inc-criminal-charges-attorney-general

McKenzie, Lisa M., Allshouse, W., and Daniels, S. 2019. Congenital heart defects and intensity of oil and gas well site activities in early pregnancy. Environment International. https://doi.org/10.1016/j.envint.2019.104949

Mulhollem, J. 2017 (July 20). Shale gas development spurring spread of invasive plants in Pa. forests. PennState News. Retrieved from http://news.psu.edu/story/475225/2017/07/20/research/shale-gas-development-spurring-spread-invasive-plants-pa-forests

Neuhauser, A. 2014 (October 30). Toxic chemicals, carcinogens skyrocket near fracking sites. U.S. News and World Report. Retrieved from http://www.usnews.com/news/articles/2014/10/30/toxic-chemicals-and-carcinogens-skyrocket-near-fracking-sites-study-says

Niedbala, B. 2018 (January 16). W. Va. company fined $1.7 million for violations at 14 well sites in Greene County [PA]. Observer-Reporter. Retrieved from https://observer-reporter.com/news/localnews/w-va-company-fined-million-for-violations-at-well-sites/article_cc1ce344-faec-11e7-84ca-076df3832f29.html

NYCDEP [New York City Department of Environmental Protection]. 2009. Rapid environmental impact assessment report, impacts assessment of natural gas production in the New York City watershed. New York NY.

Omara, M., Sullivan, M. R., Li, X., Subramanian, R., Robinson, A. L., and Presto, A. A. 2016. Methane emissions from conventional and unconventional natural gas production sites in the Marcellus Shale Basin. Environmental Science and Technology 50. doi: 10.1021/acs.est.5b05503

PADEP [Pennsylvania Department of Environmental Protection]. 2019a. Oil and gas workload report through 13 September. Attachment 2 to October 2019 report to the Citizens Advisory Council. Harrisburg PA. 24 p.

PADEP. 2019b. https://www.dep.pa.gov/DataandTools/Reports/Oil%20and%20Gas%20Reports/Pages/default.aspx

Peng, L., Meyerhoefer, C., and Chou, S.-Y. 2018. The health implications of unconventional natural gas development in Pennsylvania. Health Economics 27:956–983. doi: 10.1002/hec.3649

Phillips, S. 2011 (September 27). Burning questions: Quarantined cows give birth to dead calves. StateImpact Pennsylvania. Retrieved from http://stateimpact.npr.org/pennsylvania/2011/09/27/burning-questions-quarantined-cows-give-birth-to-dead-calves/

Phillips, S. 2016 (February 19). Worker dies in pipeline accident, PUC steps up calls for reform. StateImpact Pennsylvania. Retrieved from https://stateimpact.npr.org/pennsylvania/2016/02/19/worker-dies-in-pipeline-accident-puc-steps-up-calls-for-reform/

Pittsburgh Post-Gazette. 2009 (June 5). Waste from Marcellus shale drilling in Cross Creek Park kills fish. Pittsburgh Post-Gazette. Retrieved, from http://www.post-gazette.com/washington/2009/06/05/Waste-from-Marcellus-shale-drilling-in-Cross-Creek-Park-kills-fish/stories/200906050136

PSE [Physicians, Scientists, and Engineers for Healthy Energy]. 2019. Repository for oil and gas energy research. Oakland CA. https://www.psehealthyenergy.org/our-work/shale-gas-research-library/

Richburg, C. M., and Slagley, J. 2018. Noise concerns of residents living in close proximity to hydraulic fracturing sites in Southwest Pennsylvania. Public Health Nursing 36:3-10. doi: 10.1111/phn.12540

Schmid, James A. 2019. Inaccurate cover classification leads to unnecessary loss of Pennsylvania palustrine wetland forest structure and functions. Wetland Science and Practice 36(1):51-60.

Schmid & Company, Inc. 2000. Wetlands and longwall mining: regulatory failure in southwestern Pennsylvania Prepared for the Raymond Proffitt Foundation, Langhorne, PA. Media, PA. 123 pp. http://www. schmidco.com/Wetlands%20and%20Longwall%20Mining%202000.pdf

Schmid & Co., Inc. 2010. Protection of water resources from longwall mining is needed in southwestern Pennsylvania. Prepared for Citizens Coal Council, Washington PA, with support from The Sierra Club. Media PA. 190 p.

Schmid & Co., Inc. 2013a. Review of Foundation Mine, a new longwall mine. Prepared for Greene County Watershed Association, Waynesburg PA. 60 p.

Schmid & Co., Inc. 2013b. Review of permit applications of Amerikohl Mining Inc. for proposed Walters Mine, Donegal Township, Butler County, Pennsylvania. Prepared for Citizens Coal Council, Bridgeville PA. Media PA. 35 p.

Schmid & Co., Inc. 2013c. Natural gas pipelines in Lycoming County, Pennsylvania: a technical appendix. Prepared for Pennsylvania League of Women Voters, Harrisburg PA, USDOT PHMSA Grant #DTPH56-11-G-PHPT20. Media PA. 110 p. http://www.palwv.org/wp-content/uploads/2014/04/453_Technical-Appendix-Lycoming_Gas_24Jan2013.pdf

Schmid & Co., Inc. 2014a. Analysis of impacts on wetlands and buffers, proposed Williams Transco Leidy Southeast Franklin Loop D Pipeline, Monroe and Luzerne Counties, Pennsylvania Prepared for the Delaware Riverkeeper Network, Bristol, PA. Media, PA. 53 pp. http://www.schmidco.com/Leidy_Final_22_July_2014.pdf

Schmid & Co., Inc. 2014b. The illusion of environmental protection: permitting longwall coal mines in Pennsylvania. Prepared for Citizens Coal Council, Bridgeville PA. Media PA. 138 p.

Schmid & Co., Inc. 2015. Undermining the public trust: a review and analysis of PADEP's Fourth Act 54 Five-year Assessment report. Prepared for the Citizens Coal Council, Bridgeville, PA. Media, PA. 67 pp. http://www.schmidco.com/Undermining_the_Public_Trust_March_2015.pdf

Schmid & Co., Inc. 2016a. The effects of the proposed PennEast Pipeline on exceptional value wetlands in Pennsylvania. Prepared for the Delaware Riverkeeper Network, Bristol, PA. Media, PA. 54 pp. http://www.schmidco.com/PennEast_Wetland_Report_Final_July_2016.pdf

Schmid & Co., Inc. 2016b. Wetland and stream impacts of Sunoco's Mariner East II Pipeline Prepared for the Mountain Watershed Association and Clean Air Council. Media, PA. 22 pp. http://www.schmidco.com/Letter_Report_Mariner_East_II_22_August_2016.pdf

Schmid & Co., Inc. 2017a. Potential impacts of the Atlantic Sunrise Pipeline on exceptional value wetlands and special protection waters in Schuylkill County, Pennsylvania. Prepared for Delaware Riverkeeper Network and Schuylkill Pipeline Awareness. Media, PA. 21 pp. http://schmidco.com/Sunrise_Schmid_Report_26_June_2017.pdf

Schmid & Co., Inc. 2017b. Potential impacts of Mariner East II Pipeline on wetlands, streams, and water supplies in Middletown Township, Delaware County, Pennsylvania. Prepared for Middletown Coalition for Community Safety. Media, PA. 18 pp. http://www.schmidco.com/Comments_on_MEII_Delaware_County.pdf

Schmid & Co., Inc. 2018. Comments on proposed regulations of the Delaware River Basin Commission concerning high volume fracturing to produce oil and gas. Prepared for Delaware Riverkeeper Network. Media PA. 19 p.

Shepherd, D., Welch, D., Dirks, K.N., and Mathews. 2010. Exploring the relationship between noise sensitivity, annoyance and health-related quality of life in a sample of adults exposed to environmental noise. International Journal of Environmental Resources and Public Health 7:3579–3594.

Sitler, Ruth. 2013. Field evaluation of compaction within TGP 300 line upgrade project temporary workspaces. Prepared for Delaware Riverkeeper Network. Meliora Design, LLC. Phoenixville PA. 9 p.

Song, L., and Kusnetz, N. 2016 (July 18). Increased asthma attacks tied to exposure to natural gas production. InsideClimate News. Retrieved from https://insideclimatenews.org/news/18072016/asthma-study-marcellus-shale-pennsylvania-natural-gas-fracking

Souza, Stephen J. 2016. Environmental review of the proposed Millennium Pipeline eastern system upgrade. Prepared for the Delaware Riverkeeper Network, Bristol PA. 15 p.

SPEHP [Southwest Pennsylvania Environmental Health Project]. 2015 (February 24). Summary on compressor stations and health impacts. Retrieved from http://www.environmentalhealthproject.org/wp-content/uploads/2012/03/Compressor-station-emissions-and-health-impacts-02.24.2015.pdf

Steinzor, Nadia, and Balzel, B. 2015. Wasting away: four states' failure to manage oil and gas field waste from the Marcellus and Utica Shale. Earthworks' Oil and Gas Accountability Project. Washington DC. 87 p. http://wastingaway.earthworksaction.org

Subramanian, R., Williams, L. L., Vaughn, T. L., Zimmerle, D., Roscioli, J. R., Herndon, S. C., . . . Robinson, A.L. 2015. Methane emissions from natural gas compressor stations in the transmission and storage sector: measurements and comparisons with the EPA greenhouse gas reporting program protocol. Environmental Science and Technology 49:3252-61. doi: 10.1021/es5060258

Sumi, Lisa. 2012. Breaking all the rules: the crisis in oil and gas regulatory enforcement. Earthworks Oil and Gas Accountability Project. Washington DC. 120 p. http://www.earthworksaction.org/library/detail/breaking_all_the_rules_the_crisis_in_oil_and_gas_regulatory_enforcement

Swarthout, R. F., Russo, R.S., Zhou, Y., Miller, B.M., Mitchell, B., Horsman, E., . . . Sive, B.C. 2015. Impact of Marcellus Shale natural gas development in southwest Pennsylvania on volatile organic compound emissions and regional air quality. Environmental Science and Technology 49:3175-84. doi: 10.1021/es504315f

Sweeney, B.W., and Jackson, J.K. 2010. Expert report on the relationship between land use and stream condition (as measured by water chemistry and aquatic invertebrates) in the Delaware River Basin. Stroud Water Research Center. Avondale PA. http://www.nj.gov.drbc/library/documents/Sweeney-Jackson.pdf

Swiedler, E. W., Muehlenbachs, L. A., Chu, Z., Shih, J.-S., and Krupnick, A. 2019. Should solid waste from shale gas development be regulated as hazardous waste? Energy Policy 129:1020-1033. doi: 10.1016/j.enpol.2019.02.016

Tasker, T.L., et al. 2018. Environmental and human health impacts of spreading oil and gas wastewater on roads. Environmental Science and Technology 52: 7081-7091. http://dx.doi.org/10.1021/acs.est.8b00716

Troutman, Melissa. 2019. Pennsylvania oil and gas waste report. Earthworks. Washington DC. 24 p.

Tustin, A. W., Hirsch, A. G., Rasmussen, S. G., Casey, J. A., Bandeen-Roche, K., and Schwartz, B. S. 2017. Associations between unconventional natural gas development and nasal and sinus, migraine headache, and fatigue symptoms in Pennsylvania. Environmental Health Perspectives 125:189-197. doi: 10.1289/EHP281

Ulrich, N., Kirchner, V., Drucker, R., Wright, J. R., McLimans, J., Hazen, T. C., . . . Lamendella, R. 2018. Response of aquatic bacterial communities to hydraulic fracturing in northwestern Pennsylvania: a five-year study. Scientific Reports 8(1):5683. doi: 10.1038/s41598-018-23679-7

USEPA [United States Environmental Protection Agency]. 2016. Hydraulic fracturing for oil and gas: impacts from the hydraulic fracturing water cycle on drinking water resources in the United States (Final Report). USEPA. Washington, DC. EPA/600/R-16/236F. 666 + 572 p.

USEPA. 2019. Management of exploration, development and production wastes: factors informing a decision on the need for regulatory action. Office of Land and Emergency Management and Office of Resource Conservation and Recovery. Washington DC. 279 p. plus appendices. https://www.epa.gov/hw/management-oil-and-gas-exploration-and-production-waste

USGS [United States Geological Survey]. 2012. Landscape consequences of natural gas extraction in Bradford and Washington Counties, Pennsylvania, 2004-2010. USGS Open File Report 2012-1154.

Veil, John. 2015. U.S. produced water volumes and management practices in 2012. Prepared for the Groundwater Protection Council. Veil Environmental, LLC. Annapolis MD. 119 p. http://www.gwpc.org/sites/default/files/Produced%20Water%20Report%202014-GWPC_0.pdf

Weinberger, B., Greiner, L. H., Walleigh, L., and Brown, D. 2017. Health symptoms in residents living near shale gas activity: a retrospective record review from the Environmental Health Project. Preventive Medicine Reports 8:112-115. doi: 10.1016/j.pmedr.2017.09.002

Willis, M. D., Jusko, T. A., Halterman, J. S., and Hill, E. L. 2018. Unconventional natural gas development and pediatric asthma hospitalizations in Pennsylvania. Environmental Research 166:402-408. doi: 10.1016/j.envres.2018.06.022

Woda, J., Wen, T., Oakley, D., Yoxtheimer, D., Engelder, T., Castro, M. C., and Brantley, S. L. 2018. Detecting and explaining why aquifers occasionally become degraded near hydraulically fractured shale gas wells. Proceedings of the National Academy of Sciences 115(49):12349-12358. doi: 10.1073/pnas.1809013115

Woodwell, C. 2016 (19 October). Pa. regulators fail to protect environment during Marcellus Shale boom. Penn Live. Retrieved from http://www.pennlive.com/midstate/index.ssf/2015/10/state_regulators_fail_to_prote.html

Young, J., Maloney, K. O., Slonecker, E. T., Milheim, L. E., and Siripoonsup, D. 2018. Canopy volume removal from oil and gas development activity in the upper Susquehanna River basin in Pennsylvania and New York (USA): an assessment using lidar data. Journal of Environmental Management 222:66-75. doi: 10.1016/j.jenvman.2018.05.041

Yudhowijoyo, A., Rafati, R., Haddad, A. S., Raja, M. S., and Hamidi, H. 2018. Subsurface methane leakage in unconventional shale gas reservoirs: A review of leakage pathways and current sealing techniques. Journal of Natural Gas Science and Engineering 54:309-319. doi: 10.1016/j.jngse.2018.04.013

Zenes, Joe. 2013. February 8 2013 field visit, Tennessee Gas northeast upgrade project. Prepared for Delaware Riverkeeper Network. Bristol PA. 6 p.

EXHIBIT "3"

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Expert Report

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Anthony R. Ingraffea, Ph.D., P.E.

In the matter of:

WAYNE LAND AND MINERAL GROUP, LLC, Plaintiff *v.* DELAWARE RIVER BASIN COMMISSION, Defendant, and DELAWARE RIVERKEEPER NETWORK, MAYA K. VAN ROSSUM, THE DELAWARE RIVERKEEPER, Intervenors-Defendants;
Civil Action No. 3:16-CV-00897, United States Court for the Middle District of Pennsylvania

Prepared for
Curtin & Heefner LLP
Doylestown Commerce Center
2005 South Easton Road, Suite 100
Doylestown, PA 18901

October 8, 2019

1.0 Personal Background

I am the Dwight C. Baum Professor of Civil and Environmental Engineering, Emeritus, at Cornell University. I hold a PhD in Civil Engineering from the University of Colorado, Boulder, an MS in Civil Engineering from the New York University Polytechnic School of Engineering, and a BS in Aerospace Engineering from the University of Notre Dame. I am a licensed Professional Engineer in the states of Texas, Colorado, and New York.

I have expertise in rock mechanics, rock fracture, hydraulic fracturing for well stimulation, design of high pressure gas pipelines, computational mechanics, experimental rock mechanics, oil/gas well drilling and cementing, and oil/gas well integrity. During the period from 1977-2004, I performed paid consultancy and sponsored research for the oil/gas industry and the federal government, including EXXON, Amoco, Schlumberger, the Gas Technology Institute, the New York Gas Group, and the U.S. Department of Energy.

I have published more than 315 technical journal articles, proceedings papers, and reports during my career. I have written 5 book chapters on computational and experimental geomechanics and hydraulic fracturing. Since 2006, I have been the Co-Editor-in-Chief of *Engineering Fracture Mechanics*, the premier journal in the field of fracture mechanics, which publishes many papers on hydraulic fracturing and rock fracture mechanics. I have won the highest American honor for fracture mechanics, the George Irwin Medal of the American Society for Testing and Materials:

> "The award, given by ASTM Committee E08 on Fatigue and Fracture, honors Ingraffea's pioneering and outstanding contributions to the advanced computational simulation of fatigue and fracture processes and the resulting improved understanding necessary for practical applications of fracture mechanics to the assessment of integrity in engineering structures."

I have also twice (1978, 1991) won the National Research Council/U.S. National Committee for Rock Mechanics award for outstanding research in rock mechanics, the latter specifically for research into hydraulic fracturing.

My professional résumé is attached as Appendix A. My deposition and trial testimony is summarized in Appendix B.

2.0 Retention

In October 2018, I was retained by Curtin & Heefner LLP to provide expert consulting services in this matter. I was asked to review and analyze the following materials relevant to this issue:

- A COMPLAINT by the Wayne Land and Mineral Group (WLMG), LLC against the Delaware River Basin Commission filed by Overstreet & Nestor, LLC, on May 17, 2016.
- A JUDGMENT and OPINION; Wayne Land and Mineral Group (WLMG), LLC, Appellant v. Delaware River Basin Commission, Maya van Rossum; Delaware Riverkeeper Network; United States Court of Appeals for the Third Circuit; No. 17-1800; On Appeal from the United States District Court for the Middle District of Pennsylvania (D.C. No. 3-16-cv-00897); 7/25/2018.
- A LETTER with supplemental attachments from John Holko, President, Lenape Resources, Inc., to A. J. Sandone, WLMG, dated June 18, 2019.
- A LETTER from Christopher R. Nestor, Overstreet & Nestor, LLC, to Mark L. Greenfogel, Warren Environmental Counsel, LLC, dated July 12, 2019.
- DEPOSITION EXHIBITS:

  Coccodrilli Dep. Ex. 5, WLMG 1713 (John Holko email, May 6, 2016)

  Coccodrilli Dep. Ex. 6, WLMG2884-2886 (Don Nevin email chain, May 5, 2016)

  Coccodrilli Dep. Ex. 7, WLMG1712 (Nickens email May 5, 2016)

  Coccodrilli Dep. Ex. 9, WLMG1689-1694 (Holko Letter, April 20, 2015)

  Coccodrilli Dep. Ex. 10, WLMG2908-2910 (Sandone email chain October 9, 2017 and May 16, 2016, with site plan)

  Coccodrilli Dep. Ex. 11, WLMG2898-2899 (Coccodrilli email chain, March 30, 2016)

  Coccodrilli Dep. Ex. 13, WLMG2881-2883 (Peterson email chain May 6, 2016)

  Coccodrilli Dep. Ex. 14, WLMG2887-2890 (Peterson email chain April 11, 2016, with attachment)

  Coccodrilli Dep. Ex. 15, Plaintiff's Supplemental Answers to Defendant's First Set of Interrogatories

Coccodrilli Dep. Ex. 16, WLMG1909-1941 (Chesapeake Energy Presentation)

Coccodrilli Dep. Ex. 17, WLMG2265-2270 (PIOGA document)

Holko Dep. Ex. 1, WLMG2229-2233 (Lenape Resources letter, June 18, 2019)

Holko Dep. Ex. 2, Overstreet & Nestor Letter, July 12, 2019

Holko Dep. Ex. 3, WLMG2872-2874 (Peterson email chain, May 16, 2016, with attachment)

I have been asked to provide:

- Written opinions concerning the processes, equipment, and timelines typically utilized in developing an unconventional natural gas well pad and gas well in the shale regions of the Delaware River Basin, and the impacts from such a pad and well. Specifically, whether development of such a pad would constitute a "project" as defined by the Delaware River Basin Commission, and whether such would have a potential substantial water quality impact on waters classified as Special Protection Waters." 18 C.F.R. § 401.35(b)(18).
- Written opinions concerning the processes, equipment, and timelines typically utilized in developing an unconventional natural gas network, beyond a specific pad site, in the shale regions of the Delaware River Basin, and the impacts from such a network. Specifically, whether development of such a network would constitute a "project" as defined by the Delaware River Basin Commission, and whether such would have a potential substantial water quality impact on waters classified as Special Protection Waters." 18 C.F.R. § 401.35(b)(18).

3.0 Opinions

This matter involves a challenge to the Delaware River Basin Commission's authority to review and approve a natural gas well pad, a gas well, and related facilities and associated activities on WLMG's property in the Delaware River Basin. WLMG claims that its proposed gas development activities do not constitute a 'project' subject to the Commission's project review under Section 3.8 of its Compact.

Section 1.2 (g) of that Compact defines a "project" as:

> "Any work, service or activity which is separately planned, financed or identified by the Commission, or any separate ***facility*** undertaken or to be undertaken within a specified area, for the ***conservation, utilization, control, development or management of water resources*** which can be established and utilized independently or as an addition to an existing facility, and can be considered as a separate entity for purposes of evaluation." (my ***emphasis*** added).

Further, section 1.2 (e) of that compact defines a "facility" as:

> "…any real or personal property, within or without the basin, and improvements thereof or thereon, and any and all ***rights of way, water, water rights, plants, structures, machinery and equipment, acquired, constructed, operated or maintained for the beneficial use of water resources*** or related land uses including, without limiting the generality of the foregoing, any and all things and appurtenances necessary, useful or convenient for ***the control, collection, storage, withdrawal, diversion, release, treatment, transmission, sale or exchange of water; …".***

Based on the following information in this report, the documents and publications I have reviewed, my education, experience, and training, I provide my opinions as follows. I reserve the right to prepare additional reports should additional information become available as this matter proceeds.

OPINION 1:

To a reasonable degree of professional certainty, I conclude that unconventional development of hydrocarbon liquids and gases from a well accessing shale formations from a single pad in the Delaware River Basin is a heavy industrial ***project*** that must, by standard operating practice of the shale gas industry***, utilize, control, develop and manage substantial water resources***. The current average stimulation job for a single shale gas well in Pennsylvania requires nearly 14 million gallons of water which must be acquired, transported, stored, treated, injected, partially recovered, and, in part, re-stored, re-treated, and re-transported.

OPINION 2:

To a reasonable degree of professional certainty, I conclude that a pad and its well(s) constitute a "facility" because, by standard operating practice of the shale gas industry, they will require ***rights of way, water, water rights, plants, structures, machinery and equipment, acquired, constructed, operated or maintained for the beneficial use of water resources.***

OPINION 3:

To a reasonable degree of professional certainty, I conclude that unconventional development of hydrocarbon liquids and gases from a well accessing shale formations from a single pad in the Delaware River Basin will, because of its extensive use of water, cause harmful impacts to the environment and to human health local to such a pad and well. Avoiding such impacts is the responsibility of the Commission which has "…jurisdiction to control future pollution...in the waters of the basin…" §5.2 of the Compact. Further, the Commission has the authority to adopt rules, regulations, and standards "…to protect the public health or to preserve the waters of the basin in accordance with the comprehensive plan…" to protect the public health or to preserve the waters of the basin in accordance with the comprehensive plan." §5.2

OPINION 4:

To a reasonable degree of professional certainty, I conclude that a single well on a single pad accessing a shale reservoir is not standard industry practice for production from such a reservoir, but rather a form of reservoir exploration. As such, it is highly unlikely, of itself, to be a profitable enterprise for WLMG.

OPINION 5:

To a reasonable degree of professional certainty, I conclude that standard industry practice to develop a shale reservoir for large-scale, profitable production requires the use of clustered, multi-well pads, using long laterals and high-volume hydraulic stimulation. Therefore, all impacts concerning water acquisition, transportation, storage, treatment, injection, partial recovered, and, in part, re-storage, re-treatment, and re-transportation would be multiplied by the ultimate number of pads and wells.

OPINION 6:

To a reasonable degree of professional certainty, I conclude that such industry standard practice creates a network of infrastructure elements such as, *inter alia*, gathering and transmission pipelines, compressor stations, material/equipment/waste storage facilities, new roads, processing facilities, and waste disposal facilities. This network itself would require additional volumes of water for construction, operation, cooling, and maintenance and potential disruption of surface waters.

OPINION 7:

To a reasonable degree of professional certainty, I conclude that creation of such a network would have large regional impacts on the environment, on human health and on the viability of the Delaware River Basin as a primary water supply for millions of consumers.

4.0 Unconventional Shale Gas Development: Root Cause of a Heavy Industry Project

There is a root cause for why the unconventional development of shale gas is a heavy industry requiring unprecedented use of water: ultra-low permeability of shale rock. Unlike conventional mineral formations containing natural gas, shale rock has permeability - the ability for fluids to move through the rock - of typically less than 10 nano-darcies (Sakhaee-Pour and Bryant, 2012). This is about a thousand times less permeable than conventional gas-bearing sandstones and carbonates. If shale is so stingy with its hydrocarbons, how can they be produced?

Although some shale formations contain large amounts of shale gas and other hydrocarbons trapped in the *shale rock* itself, such formations can be made to produce these hydrocarbons if they have migrated into naturally existing cracks, joints, bedding planes and faults – discontinuities - in the *shale rock mass*. For example, Figure 1 shows a surface exposure of a *shale rock mass*. Note the many such discontinuities in the rock mass. Over many millions of years, the hydrocarbons being produced in the shale though bio-thermo-mechanical processes can migrate from within the shale rock and occupy these discontinuities. This process and its timeline are depicted in Figure 2.

Figure 1. A surface exposure of a typical, naturally fractured shale *rock mass*.

To extract natural gas and other hydrocarbons trapped in the shale, unconventional, heavy industrial methods, in this instance vertical/horizontal drilling, clustered multi-well pads, and high-volume "hydraulic fracturing", must be employed to access as many of the discontinuities in the shale rock mass as feasible, so that gas and oil will flow from the rock mass to the well. It is a misnomer to use "hydraulic fracturing" as a description of this

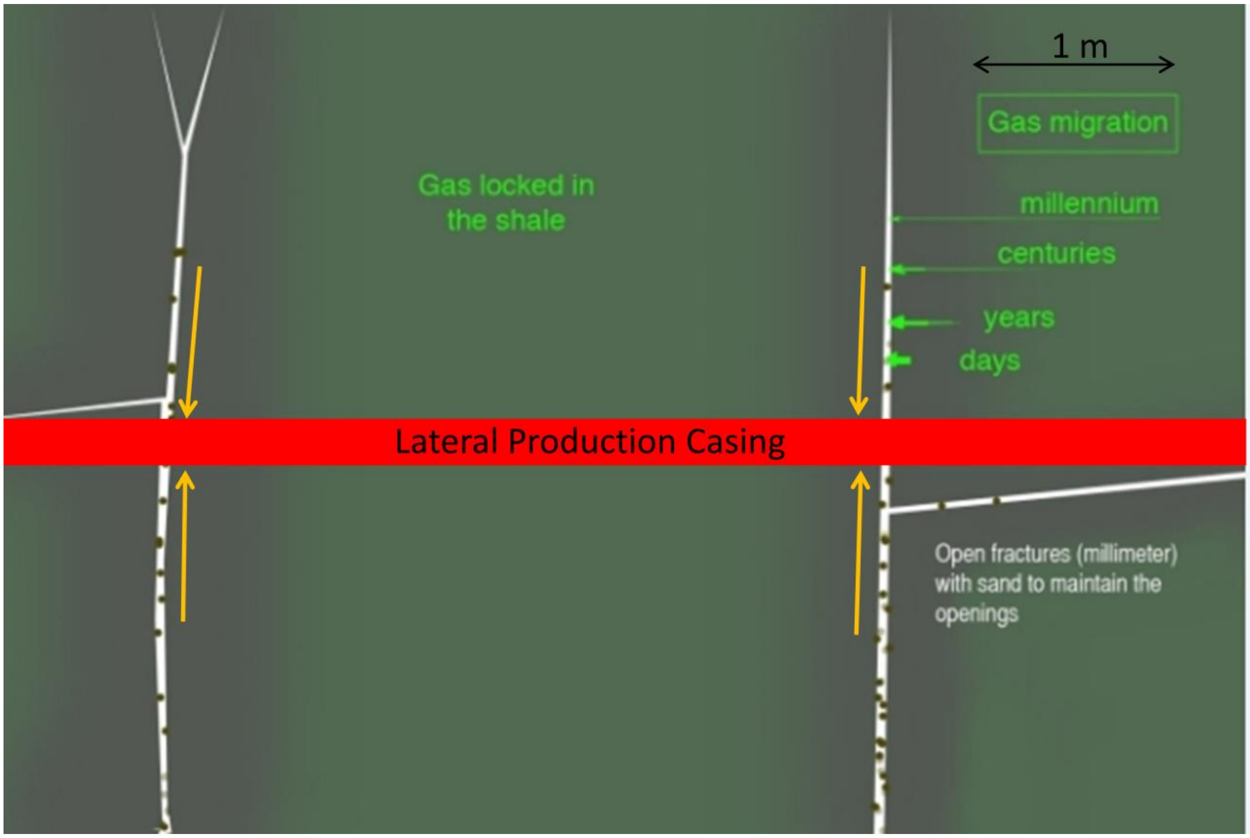

Figure 2. Depiction of how gas can be accessed in a shale rock mass through migration into discontinuities. Courtesy of Prof. Marc Durand.

process, since little actual new fracturing is done. Rather, the purpose of "hydraulic fracturing" in this instance is merely to widen, interconnect, and prop open as many *pre-existing discontinuities* as feasible.

Proof that shale wells initially access the readily available hydrocarbons stored in the natural discontinuities, and then quickly decline in production as implied by Figure 2, is shown in Figure 3. Individual unconventional well production declines quickly. The average Utica shale well declines by 83% over the first three years of well life; the average Marcellus shale well declines by 71% over the same period-of-time; continual drilling is necessary to maintain field production (Hughes, 2019). Such steep declines require that many wells be continually developed to maintain contracted supplies of the targeted hydrocarbon. This overall approach which accounts for near-impermeability and the need to access as many natural discontinuities as feasible, is depicted in Figure 4. This figure shows a clustered, multi-well pad arrangement of

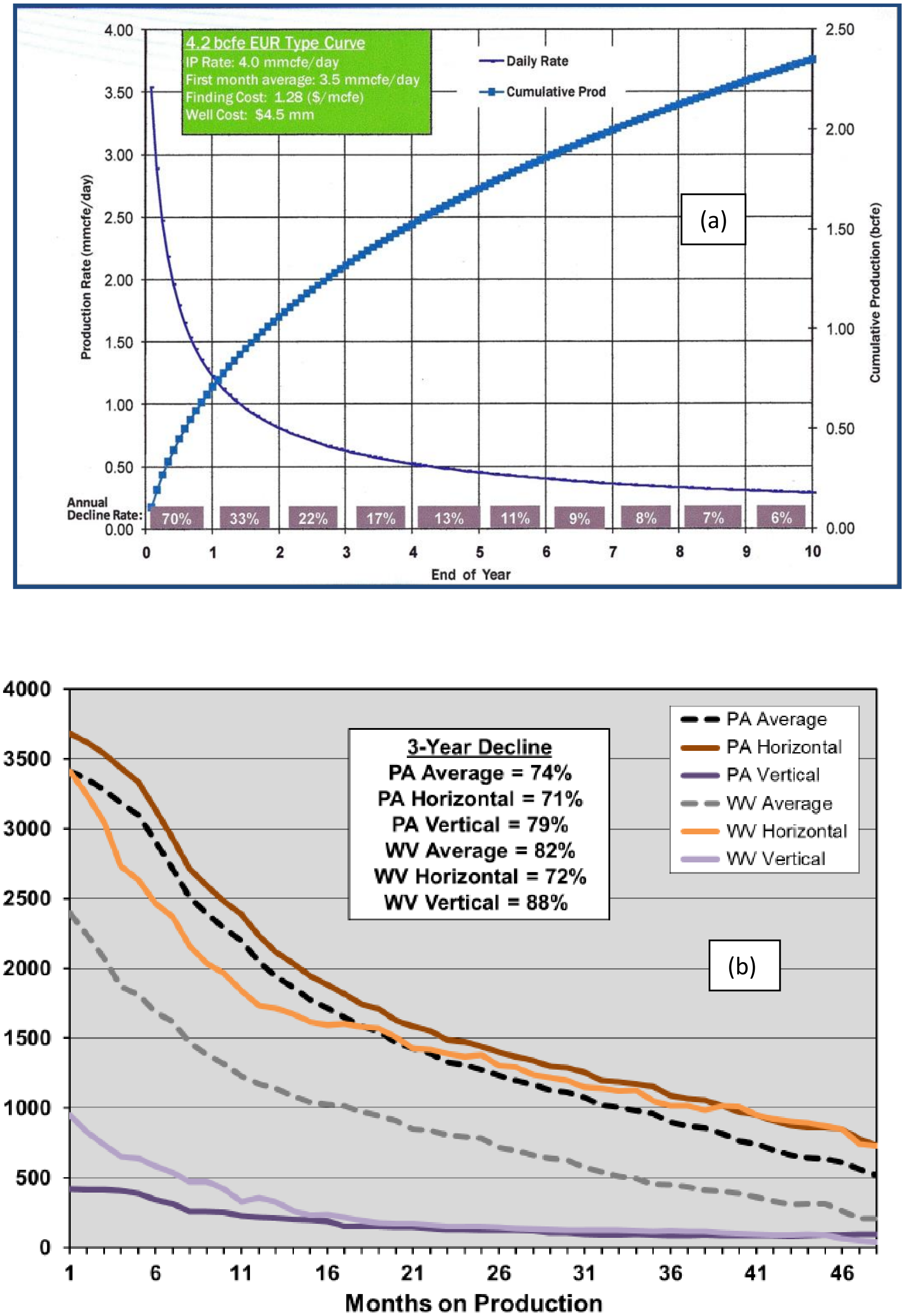

Figure 3. (a) Typical decline curve for shale gas. From: Chesapeake Energy (CHK) published *pro forma* data. (b) Decline curves for Marcellus Field. Data from DRILLING INFO; Hughes (2014).

wells with both vertical and lateral segments, and closely spaced long laterals stimulated by high-volumes of injected fluid and proppant.

In effect, getting hydrocarbons out of a shale formation requires a massive "scaling-up" of industrial operations: more wells, longer wells, more stimulation fluids, more solid and liquid waste, more traffic, more attendant infrastructure, and longer timelines. As will be described in the next section, this "state-of-the-practice" approach requires a myriad of operations typical of heavy industry.

5.0 Unconventional Shale Gas Development Is a Heavy Industry Project: Operations and Facilities Typical for Development of a Single Pad

The process of producing natural gas from shale involves a series of operations before and after stimulation - "hydraulic fracturing"- all of which are industrial in nature, many of which have the potential to impact water supplies and therefore public health and the environment. The following are the principal operations and some of their associated impacts:

1. The initial phase of shale gas development involves obtaining rights-of-way for construction of access roads and well pads in an arrangement like that shown in Figure 4. A well pad must provide a stable base for large rigs, trucks, pumps, diesel engines, storage tanks, separation units and other equipment needed to drill, complete, stimulate, and operate the well. The size of a well pad depends on the number of wells that will be put on the pad. Figure 5 shows most recent data on the number of wells per pad in Pennsylvania. Statewide data show a trend towards an ever-increasing number of wells per pad, so one can expect that the numbers shown in Figure 5 are low-end snapshots in time. This phase is one of the reasons for my **Opinions #2 and #4**. The arrangement shown in Figure 4 is the reason for my **Opinion #5.**

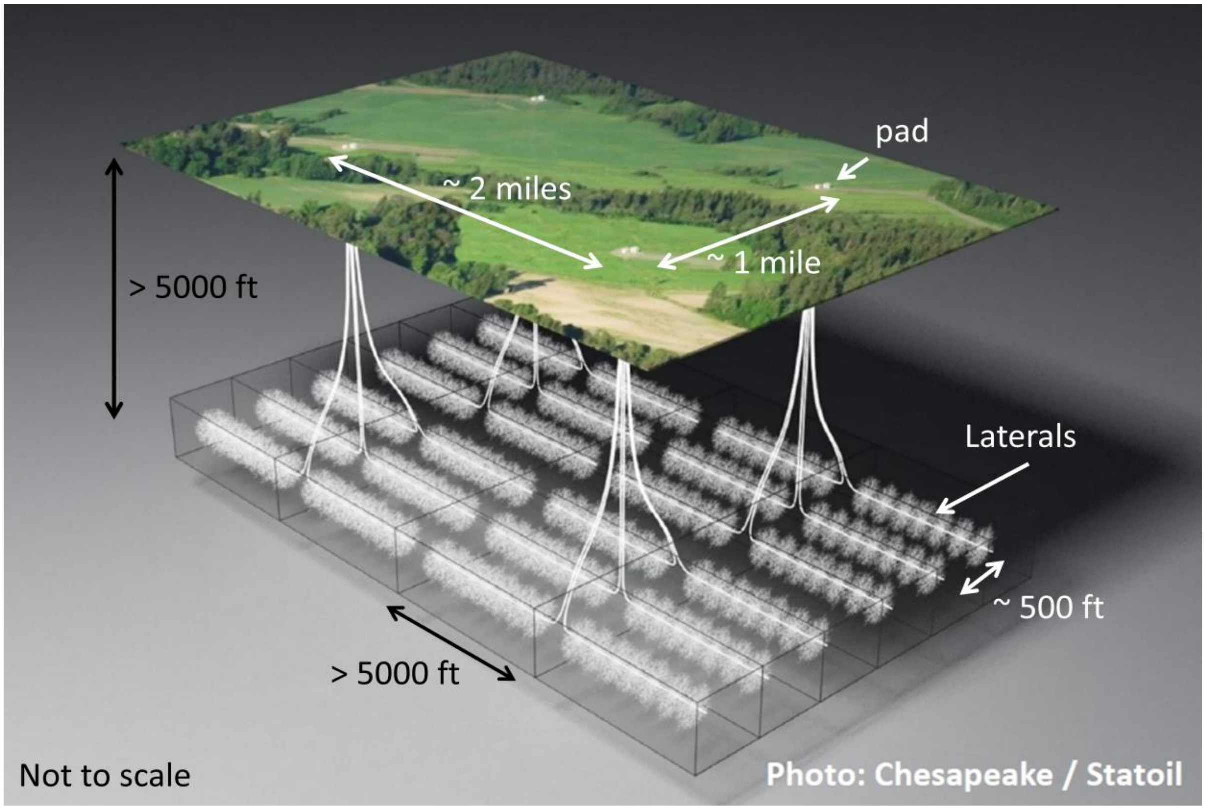

Figure 4. Depiction of industry-standard overall shale hydrocarbon development approach.

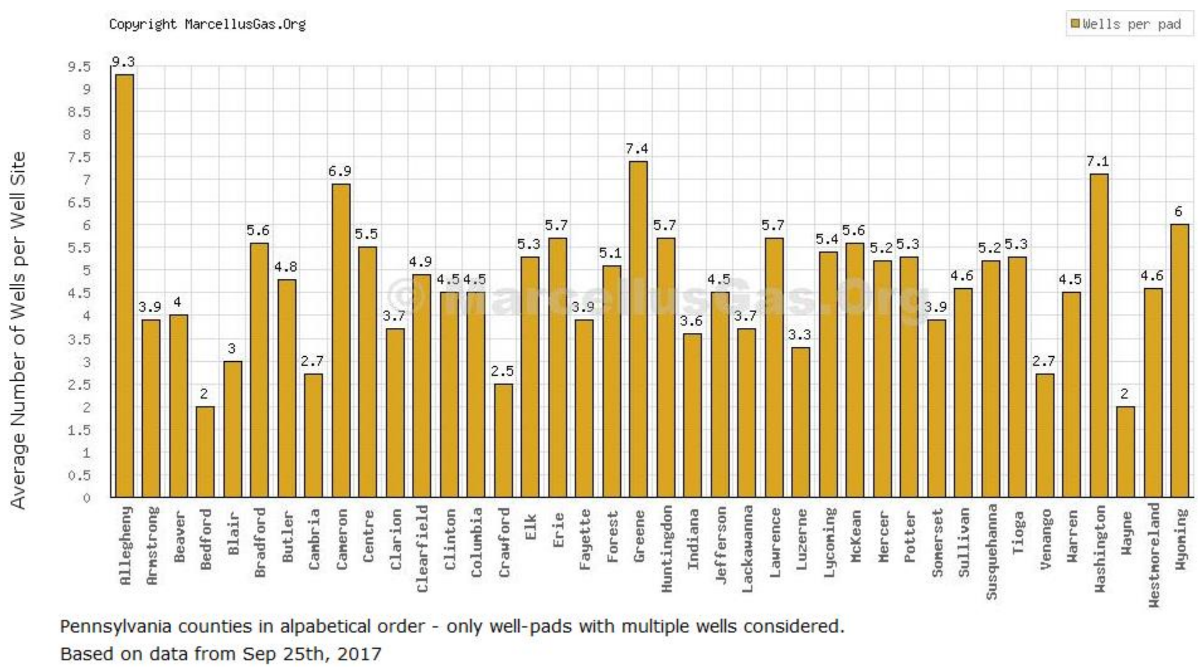

Figure 5. Average number of wells per pad in Pennsylvania by county. Data from https://www.marcellusgas.org/graphs/PA#avgpad

2. Construction of the access road and well pad involves the operation of large, heavy machinery to excavate/backfill, grade and compact the site, transport and place large quantities of gravel on the ground, install an impermeable barrier, and potentially construct a large, lined impoundment for storage of water to be used in hydraulic fracturing. See Figure 6 for examples of pad construction activities. Each well pad, with associated roads and impoundments, consumes about five to fifteen acres of land. This phase is one of the reasons for my **Opinions #1 and #2**.

3. Once the site has been prepared, equipment must be transported to the site and unloaded. Before the horizontal drill rig is assembled and powered up, another smaller rig will be brought on site to drill the starter hole and vertical section of the well. Rigs are transported using specialized heavy trucks. Portions of the vertical well section may be drilled using air, while other portions will be drilled using fluids or mud, to cool the drill bit and circulate rock cuttings to the surface. The mud may be water-based, oil-based or synthetic based fluids, all of which must be stored on site. Drilling the vertical well produces at least 750 tons of drill cuttings per hole. Depending on the drilling technique and depth of wellbore, the cuttings may contain contaminants such as pyrite, which with air and water generate acid mine drainage, high concentrations of chlorides, and other toxic constituents associated with the drilling mud. Drill cuttings must be processed (solids separated from liquids), stored, transported away from the site by heavy truck, and managed as a residual waste. Figure 6(a) shows a multi-well pad in southwest Pennsylvania during the drilling operation. This phase is one of the reasons for my **Opinions #1 and #2.**

4. Thousands of feet of steel pipe, some as drill string others as casing, must be transported, again using heavy trucks, onto the site to drill and case the well. A typical Marcellus shale gas well will need about 20,000 feet of drill string, and 25,000 feet of casing of different diameters. This phase is one of the reasons for my **Opinion #2.**

5. Cementing operations are used on-site to fill the annulus after a casing string has been run, to seal a lost circulation zone, or set a plug before directional tools are used to push off from the vertical section of the well. A cementing crew uses special trucks, mixers and large hydraulic pumps to displace drilling fluids and place cement in the wellbore. Dry materials are ordinarily stored in silos on-site prior to mixing. Water needed to mix the cement slurry is brought to the cite in tanker trucks or by special-purpose pipeline. See Figure 6(A) for views of such silos and green-painted tanker trucks. This phase is one of the reasons for my **Opinions #1 and #2.**

6. The large drill rig used to construct the horizontal portion of the wellbore must be transported in pieces to the site and assembled. The horizontal drilling occurs for another 5,000 to 10,000 feet, or more, usually farther than the vertical portion of the well. The major components of the rig include mud tanks and pumps, the derrick, drawbacks, the rotary table, the drill string, power generation equipment -large electric, diesel or gas-powered engines that drive turbines - and a variety of auxiliary equipment. During drilling of the horizontal section another 750 to 1,000 tons of drill cuttings will be generated, depending on the length of the borehole. Drill cuttings from the horizontal section of the well contain various toxic contaminants, including benzene and naturally occurring radioactive materials such as Radium-226 and Radium-228. The drill cuttings must be stored, transported using heavy trucking, and managed as a residual waste. This phase is one of the reasons for my **Opinion #2.**

7. Well completion refers to the process of perforating the horizontal portion of the well casing, cement and rock with shaped charges to create communication between the discontinuities in the formation and the wellbore, and stimulation of the reservoir to create high permeability pathways for the gas and oil to flow into the wellbore, as described in Section 4.0, above. This phase is one of the reasons for my **Opinion #2.**

Figure 6. (A) Typical Marcellus shale gas multi-well pad during drilling operation. (a) Drill rig; (b) Unlit but venting flare stack; (c) Air compressors; (d) Main high-pressure air-line; (e) Flow line; (f) Separator unit; (g) Water tanks. (B) Typical Marcellus shale gas multi-well pad during stimulation operation. Note large water impoundment, lower center.

8. Stimulation via "hydraulic fracturing" requires large volumes of liquids, on average nearly 14 million gallons of water per well in Pennsylvania, Figure 7. Documents for this case I have reviewed seem to be citing very old data concerning water requirements in the Marcellus: "It is estimated that the fracking process may require up to five million gallons of water per well" (See "Judgment and Opinion," Page 9). Figure 7 clearly shows that the water requirement per well has continually increased over time as longer laterals and more fracking stages are being used as the industry shifts to its so-called second and third generation wells. This observation is a primary basis from my **Opinion #1.**

   This water must be transported to the well pad either by custom-constructed pipeline, or by using 18-wheel, 8,000-gallon tanker trucks. The fracking liquid is pumped down the well under high pressure, typically 10 to 15 thousand pounds per square inch, in order to increase the "effective permeability of the shale rock mass". *The scale-up required for shale gas wells relative to conventional wells is readily seen when one considers that the volume of stimulating liquid needed is about 100-times more in an unconventional shale gas well than in a typical non-shale well.* Use of all this water and the concomitant large volume of liquid waste-water in flowback and produced water has documented environmental and health impacts. An exhaustive compilation (currently over 300 publications) of the peer-reviewed publications concerning water use and quality impacts from shale development can be found at: https://www.zotero.org/groups/248773/pse_study_citation_database/items/collectionKey/Q7GFAPNU. This phase is also a reason for my **Opinion #3.**

9. During stimulation, dozens of pump trucks and containers must be brought onto the well pad. The water is mixed with proppant, either sand or ceramic beads, and a suite of chemicals before being injected into the well. The proppant and chemicals must be brought to, and stored on, the well pad. *Typically, about 2,000 pounds of proppant are used for each 1 foot of stimulated lateral,* Figure 8. Therefore, a typical Marcellus well with a 5,000-foot long lateral will require about 5,000 tons of proppant to be transported to each well. On a 5-well pad, that would be about 15,000 tons of proppant delivered by

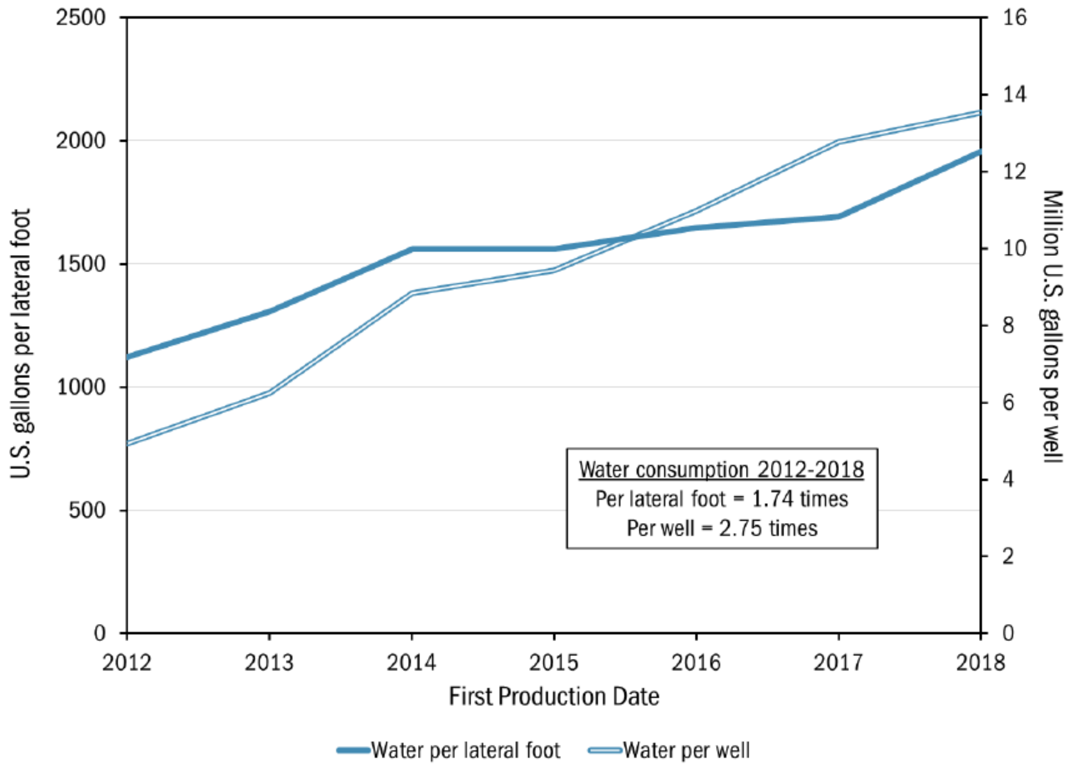

Figure 7. Average water injection per well and per horizontal lateral foot in the Marcellus Play, 2012-2018. From Hughes, 2019.

truck. Figure 6(B) shows a multi-well pad in southwest Pennsylvania during the stimulation operation. This phase is one of the reasons for my **Opinions #1 and #2.**

10. Once stimulation is completed, the internal pressure of the rock formation causes liquid, which is known as "flowback" or "produced water" to return to the surface through the wellbore. This flow cleans the well bore and the formation of debris and stimulation fluid. The flowback contains the injected chemicals and naturally occurring materials, including brines, metals, hydrocarbons and radionuclides. Additional equipment such as separators, sand traps and tanks are used to capture and process the gas and condensate contained in this flowback. The flowback, typically a million of gallons, must be initially stored on-site and then taken off-site using heavy 18-wheel, 8,000-gallon tanker trucks for management as a residual waste. This phase is one of the reasons for my **Opinions #1, #2, and #3.**

11. After a period of flowback and produced water, typically days to weeks, the well is ready to be placed into production. According to my **Opinion #4**, a single well on a single pad accessing a shale gas reservoir is highly unlikely to be profitable. Figure 9 shows that the average cost to drill such a well in the Marcellus formation is about $6.4 million. This does not include necessary additional costs such as leasing, gathering pipelines, corporate overhead, interest on debt, marketing, etc. These costs have been estimated to be about $2 per thousand cubic feet of production (Berman, 2014). To be profitable, such costs would need to be more than offset by the market value of the gas the well produces. The market value depends on the estimated ultimate recovery of gas (EUR) from the well and the price paid to the operator for that volume of gas.

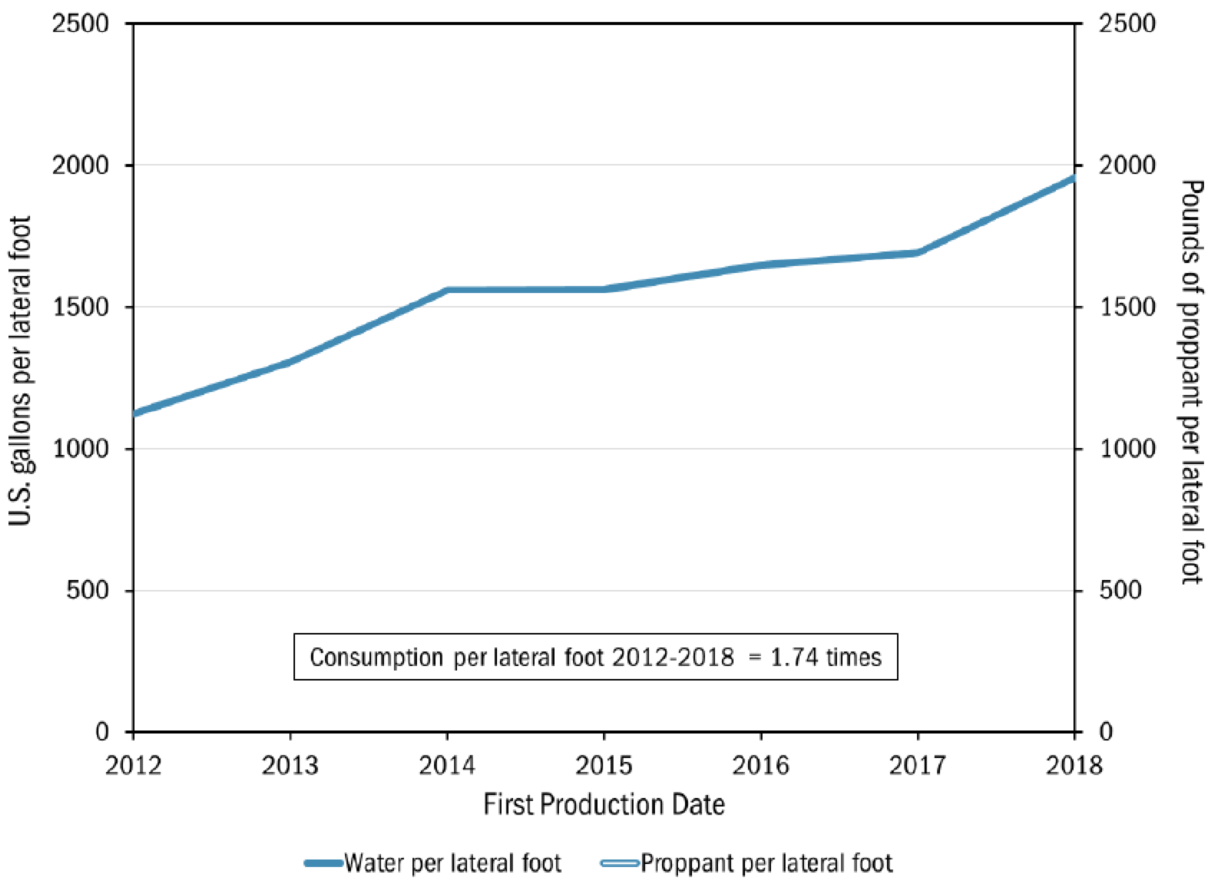

Figure 8. Relationship between water and proppant injection per lateral foot from 2012 to 2018. From Hughes, 2019.

Play	3-year well decline	Field decline 2017	Production OCT-18 (oil, mbd; gas, bcfd)	Wells/ year to offset decline	Wells drilled 2018	Wells to offset decline %	Well cost ($million)	Drilling cost to offset decline ($million)	2018 drilling cost ($million)	Play stage	Prognosis
Shale gas											
Barnett	72.5%	9.5%	2.58	142	101	141.0%	$5.00	$712	$505	Late	Decline
Fayetteville	80.5%	16.6%	1.37	113	3	3760.1%	$5.00	$564	$15	Late	Decline
Haynesville	89.1%	29.4%	7.27	197	306	64.2%	$6.40	$1,258	$1,958	Mature	Growth
Marcellus	72.1%	29.2%	21.04	1251	1320	94.8%	$6.40	$8,008	$8,448	Mature	Growth
Utica gas	83.1%	43.4%	7.33	337	369	91.2%	$6.40	$2,154	$2,362	Early	Growth
Woodford	78.2%	28.5%	2.96	295	459	64.3%	$6.40	$1,889	$2,938	Mature	Growth
Production weighted total	77.6%	30.0%	42.54	2335	2558	91.3%	$6.27	$14,585	$16,226		Growth

Figure 9. Decline rates and drilling costs in major shale gas plays in the U.S. Table 2 in Hughes, 2019.

Because no shale gas wells have ever produced from Wayne County, any EUR for a well there is speculative. However, two reports have shown that Wayne County is well outside the prime Marcellus fairway (Berman, 2014; Acton, 2014). A recent study of EUR for nearly 5,000 Marcellus wells in Pennsylvania produced Figure 10. One would expect that using the median value from this figure of about 5 billion cubic feet for a well in Wayne County would be on the high side, given the data in those two reports. However, using that EUR and the current well-head market price of about $2.50 per thousand cubic feet would yield a gross well income of about $12.5 million. Subtracting the well cost of about $6.4 million and the other costs at $2 per thousand cubic feet - $10 million - would result in a substantial net loss.

6.0 Unconventional Shale Gas Development Is a Heavy Industry Project: Development of Network Facilities Needed to Support Individual Pads

When drilling and completion are complete, drilling and stimulation equipment is removed from the site. There remains on a pad equipment needed for production such as separator units and condensate tanks, both of which vent greenhouse gases. Maintenance vehicles

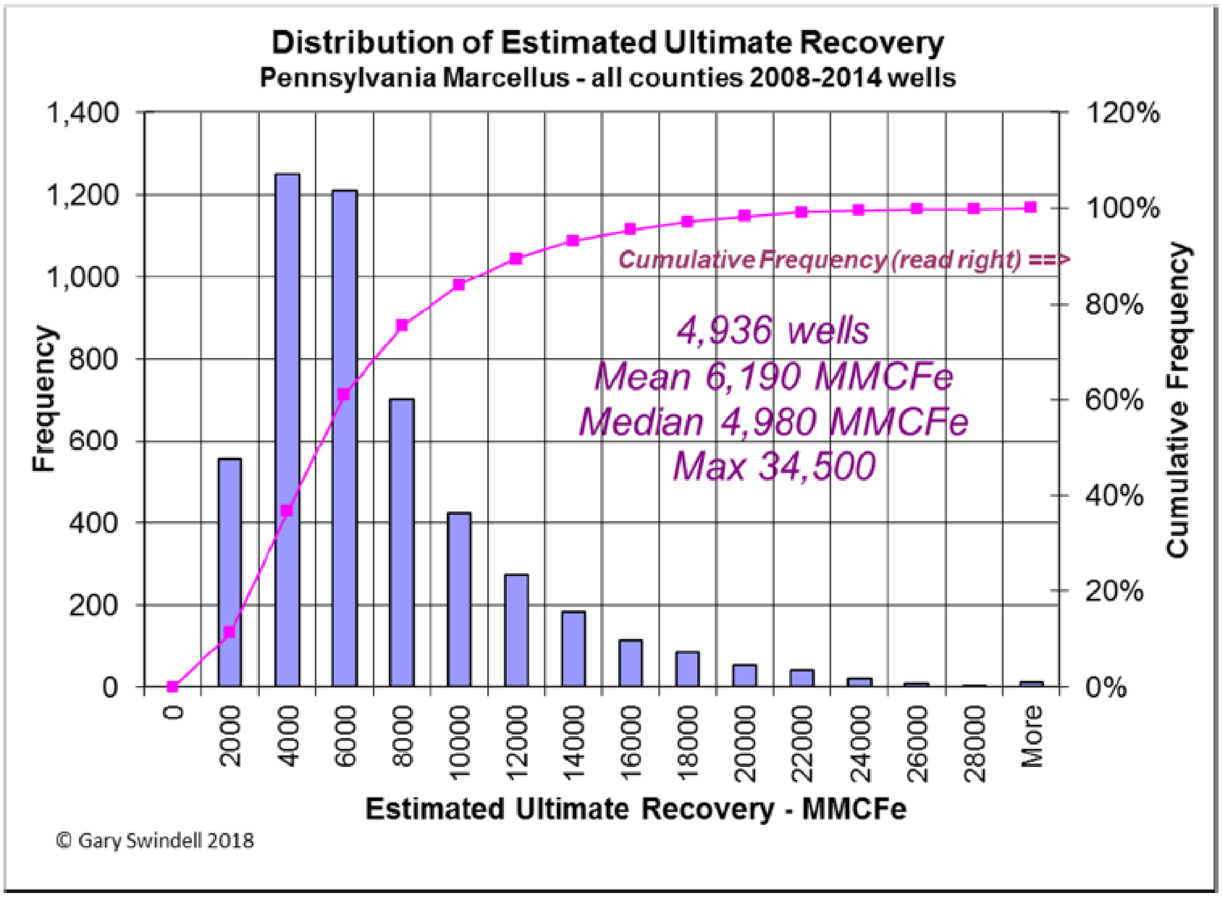

Figure 10. Estimated ultimate recovery (EUR) data from nearly 5,000 Marcellus wells in Pennsylvania. From Swindell, 2018.

must visit the site, and drill rigs will return to add new wells to the pad, or to re-fracture existing wells, again incurring substantial use of water. The existing wells must be tied into pipelines whose construction in NE Pennsylvania inevitably involves crossing of, or burrowing under, water bodies. Other infrastructure is also necessary to convey the gas to market. This infrastructure includes compressor stations, processing plants, and heavy equipment depots. These all require rights-of-way and additional land use; compressor stations and processing plants are point-source consumers of water for cooling and processing, and are also emitters of air/noise/light pollution. In the enumerated sections below, I present materials in support of my **Opinions #5, #6, and #7.**

1. Shale gas development causes noise pollution for persons residing near the well and

along the truck routes that service the well pad. The most intensive noise from well pads will last about a month per well, and will recur when new wells are added, or when wells are reworked. The increased truck traffic associated with well development will impact local residents. Increased noise pollution can contribute to stress and result in physical effects associated with excess stress such as annoyance, irritation, fatigue, headache, unease, and disturbed sleep.

A number of recent peer-reviewed papers have addressed the issue of noise from shale gas development activities. Figure11, taken from Hays *et al.* (2017), depicts the potential non-auditory health outcomes of environmental noise exposure.

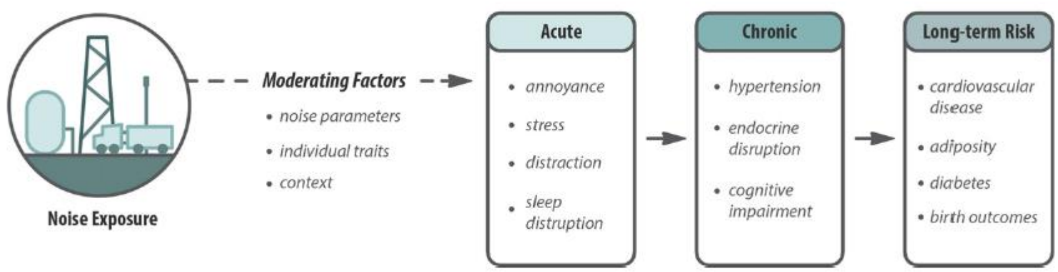

Figure 11. Potential non-auditory health outcomes of environmental noise exposure. This figure is adapted from Shepherd *et al.* (2010) and depicts the relationships between exposure to noise and primary and secondary health effects. Non-physical effects of noise are also mediated by psychological and psycho-physiological processes (Shepherd *et al.*, 2010). The dashed lines indicate the physical effects of noise and the solid lines indicate the non-physical effects. Annoyance and sleep disturbance act as mediators between predisposing factors and secondary health effects, such as quality of life or cardiovascular disease.

Hays *et al*. evaluate the available literature specific to noise from unconventional oil/gas development (UOGD) and conclude the following:

> "…both the nature and duration of noise are relevant to potential health outcomes. Many of the noise levels associated with UOGD are transient in nature and only occur during certain development activities. For instance, some activities, such as well pad preparation, drilling, and hydraulic fracturing will only be encountered prior to the completion of a well. Certain adverse health outcomes usually only result from long-term noise exposure and may be less of a concern with most development activities. On the other hand, some sources, such as compressor

stations, produce chronic noise that will continue for years after wells are put out of production. *Although noise levels may fall under municipal and industrial noise limits, data indicate these limits may not be low enough to protect public health."*

Noise pollution is another reason for my **Opinion #3.**

2. Shale gas development causes air pollution of various types from many sources. Development of a shale gas well typically requires 1,000 to 1,500 heavy diesel truck trips per well installed, which damage roads, emit pollutants, and impact the health of local residents. Trucks typically run on diesel engines, as do the engines that provide electricity to the drill rig and other auxiliary equipment. Diesel-powered vehicles and equipment account for nearly half of all nitrogen oxides (NOx) and more than two-thirds of all particulate matter (PM) emissions from United States transportation sources. PM is comprised of hundreds of chemical elements, including sulfates, ammonium, nitrates, elemental carbon, condensed organic compounds, and carcinogenic compounds and heavy metals such as arsenic, selenium, cadmium and zinc.

A recent peer-reviewed journal article (Anirban and Adams, 2016) evaluated air pollution impacts from shale gas development in Pennsylvania, both retrospectively and prospectively. Its approach and principal findings were (***emphases mine***):

"This paper describes an air emissions inventory for the development, production, and processing of natural gas in the Marcellus Shale region for 2009 and 2020. It includes estimates of the emissions of oxides of nitrogen (NOx), volatile organic compounds (VOCs), and primary fine particulate matter (≤2.5 μm aerodynamic diameter; PM2.5) from major activities such as drilling, hydraulic fracturing, compressor stations, and completion venting. The inventory is constructed using a process-level approach; a Monte Carlo analysis is used to explicitly account for the uncertainty. Emissions were estimated for 2009 and projected to 2020, accounting for the effects of existing and potential additional regulations**. *In 2020, Marcellus activities are predicted to contribute 6–18% (95% confidence***

> ***interval) of the NOx emissions in the Marcellus region, with an average contribution of 12% (129 tons/day). In 2020, the predicted contribution of Marcellus activities to the regional anthropogenic VOC emissions ranged between 7% and 28% (95% confidence interval), with an average contribution of 12% (100 tons/day).*** …The development and production of this gas may emit substantial amounts of oxides of nitrogen and volatile organic compounds. These emissions may have special significance because Marcellus development is occurring close to areas that have been designated nonattainment for the ozone standard. Control technologies exist to substantially reduce these impacts. PM2.5 emissions are predicted to be negligible in a regional context, but ***elemental carbon emissions from diesel powered equipment may be important.”***

Particulate matter irritates the eyes, nose, throat, and lungs, contributing to respiratory and cardiovascular illnesses and even premature death. Diesel exhaust has been classified a potential human carcinogen by the U.S. Environmental Protection Agency (EPA) and the International Agency for Research on Cancer. Diesel emissions of nitrogen oxides contribute to the formation of ground level ozone, which irritates the respiratory system, causing coughing, choking, and reduced lung capacity. An exhaustive compilation (currently 112 publications) of the peer-reviewed publications concerning air pollution from shale and tight gas development can be found at: https://www.zotero.org/groups/248773/pse_study_citation_database/ items/collectionKey/FX6WTII3.

All these air pollution sources and phenomena are enabled by water acquisition and consumption: no water, no emitting equipment and facilities, no air pollution. This is another reason for my **Opinion #3.**

3. Shale gas development causes light pollution, see Figure 12. As with excess noise, the constant illumination of shale gas pads can contribute to stress among those living in areas exposed to constant artificial light from the well pad. Again, water

acquisition/use is an enabler of light pollution. No water, no pad lighting; no stimulation with water, no flares. This is another reason for my **Opinion #3.**

4. Increased heavy traffic caused by shale gas development will have both local and cumulative impacts because of the multiple projects that will be ongoing in the region, all of which will contribute to traffic due to construction, drilling, transport of wastewater, transport associated with hydraulic fracturing, as well as an overlap of development phases on different well pads. Increased heavy traffic is another reason for my **Opinion #2.**

5. Shale gas development may cause surface, drinking water and groundwater contamination. As noted above, numerous polluting substances are transported to and from well pads, stored on well pads, and used in association with shale gas development. The mismanagement of these substances would result in surface or groundwater contamination from spills, leaks or accidents. To date, the Pennsylvania Department of Environmental Protection (PADEP) has received over 4,000 formal complaints concerning potential water impacts from shale gas development in the state. Recently, the PADEP has received about one new complaint for each new shale gas well drilled in the state (PublicHerald, 2017). The PADEP has determined that, to date, 345 incidents of impacts on private water supplies have been proven to be attributed to oil and gas activities (PADEP, 2019). An exhaustive compilation (currently 239 publications) of the peer-reviewed publications concerning water quality impacts from shale and tight gas development can be found at: https://www.zotero.org/groups/248773/pse_study_citation_database/items/collectionKey/DCS54HV7. Water contamination is another reason for my **Opinions #3 and #7.**

Figure 12. Light pollution from flaring and area lighting at night near a home in southwest Pennsylvania.

6. Faulty well construction, such as a bad cement job, can cause groundwater contamination that will affect private water wells, such as that experienced by the residents of Dimock, Pennsylvania. In a comprehensive evaluation of PADEP inspection and violations records for over 41,000 gas and oil wells drilled between 2000 and 2012, Ingraffea et al. (2014) found that risk of faulty well construction was about 50% higher in unconventional wells. They also found that loss of well integrity occurred in over 6% of the unconventional wells developed in the state during that time period. Possible contamination of private water wells and the aquifers in the Delaware River Basin is another reason for my **Opinions #3 and #7.**

7. In addition to well-pads, compressor stations and natural gas processing stations are major industrial operations needed to accompany shale hydrocarbon development.

8. Both these network facilities require substantial, continuous supplies of water for cooling and processing. Figure 13 shows a typical compressor station and a typical processing plant operating in southwest Pennsylvania. Air, noise, and light pollution and their impacts on human health accompany the continuous operation of such infrastructure.

Compressor stations consist of large reciprocating engines, operating at thousands of horsepower, which compress gas in order to transport it through transmission pipelines. Compressor station engines emit nitrogen oxides, volatile organic compounds, particulate matter, carbon monoxide, and other pollutants. When vented, compressor stations emit volatile organic compounds and methane.

Gas processing plants separate natural gas from other longer-chained hydrocarbons and contaminants produced from shale gas wells so that the natural gas complies with pipeline specifications, and the higher order hydrocarbons can be marketed. Processing plants may include fractionators and de-ethanators. Shale gas processing emits greenhouse gases, as well as toxic air pollutants such as benzene, formaldehyde and hexane. Shale gas wells, compressor stations, and processing facilities have a greater impact on more vulnerable populations, such as school-aged children. Air pollutants from all forms of shale gas development may interfere with brain development of children and more easily accumulate in their bodies as children cannot metabolize toxins at the same rate as adults. Pollutants and impacts from shale gas development may also lead to an increased rate of development of asthma and other respiratory diseases in children. An exhaustive compilation (currently 120 publications) of the peer-reviewed publications concerning such human health impacts from shale and tight gas development can be found at: https://www.zotero.org/groups/248773/pse_study_citation_database/ items/collectionKey/FX6WTII3. These human health impacts support my **Opinions #3 and #7.**

Unlike the noise and light emissions from pads, air pollution from compressor stations and processing plants is continuous for as long as such are in operation. Planned and un-planned "blowdowns" and "burnoffs" from such facilities can be dramatic and require emergency evacuations from residences near these heavy industrial sites, Figure 14.

Figure 13. (a) Three Brothers Compressor station in Smith Township. Lat 40;19;40.698. Long 80;23;25.236 (b) New processing plant under construction in Smith Township. Lat 40;25;3.402. Long 80;20;44.951. Photos courtesy of Bob Donnan.

Figure 14. (a) Burnoff at Mark West processing plant, Houston, Pa. Photo courtesy of Bob Donnan. (b) Blowdown at Teel compressor station, Dimock, Pa. Video courtesy of Ron Teel.

6.0 Conclusion

Unconventional development of shale hydrocarbons, anywhere in the world, is a heavy, and heavily polluting, industrial project which requires specialized facilities to be constructed and maintained over a broad region if profitability is sought. The impacts to human health and the environment from such an industrial project and facilities, especially through their impact on water, have now been thoroughly documented in over 1,850 peer-reviewed publications (PSE, 2019). My opinions stated herein are as specific as I can make them, given the vagueness of the testimony and written documents presented by WLMG. Although their proposed shale gas development certainly meets the threshold of a "project", the actual extent of utilization of water remains unknown because of alarmingly vague and uniformed statements such as these from the Coccodrilli deposition:

On Page
79 – WLMG wants to drill as many wells as possible and considers 6 to be "a good starting point."
89 – WLMG intends to use produced water at the site during the completion process.
117-18 – WLMG has not done a pre-drill survey to identify water supplies within 3,000 feet of the proposed well locations.
127 – WLMG did not do a wetland delineation.
156 – WLMG will store water and wastewater on site.
161 – WLMG has an intent to recycle wastewater on site.
216 – WLMG intends to place tanks at the site to haul wastewater.
217 – WLMG seeks to recycle wastewater and then put remaining wastewater into the earth by way of an injection well or place in a landfill.
236 – WLMG states that to have a profitable operation would require about 5,000 acres.
240 – WLMG does not have sufficient information to determine the number of compressor stations that would be needed and where they might need to be located.
253 – The developer would utilize more water the farther out from the well pad the laterals extend, and WLMG does not know how far out that would be.
256 – WLMG has not decided whether it would target the Utica formation.
258 – WLMG does not know how many times the wells might be fracked, either targeting the Marcellus formation or the Utica formation
271 – WLMG did not conduct a delineation of wetlands and water sources.

And these from the Holko deposition:

On Page:
64-65 – WLMG does not know which formation provides the best opportunity to target.
68-69 – WLMG may use pits dikes and surface facilities to accumulate and treat drilling fluids and waste fluids.
73 – The completion site pad would be designed to handle the produced water coming out of the well.
78-83 – There's uncertainty over what water source WLMG would utilize.
87 – WLMG intends to use tanks for cleaning, recirculation and cuttings.
87-89 – The volume of water use is determined by the length of the completion zone, which has not been determined.
91 – WLMG's water management plan has not been finalized, but they anticipate as many as 100 tanks.

92 – WLMG does not know how many wells it would drill.
99 – WLMG has not prepared a waste management plan.
102 – WLMG does not have a list of chemicals that would be used in the fracturing fluid.
104 – WLMG has not developed a wastewater management plan.
109 – WLMG does not have plans for how the wastewater will be disposed or recycled.
144-145 – WLMG does not know how many wells it would develop, or how many times each well would be fracked.
172-173 – WLMG's representative did not know the location of the well pad to any delineated wetlands or surface waters.
179 – WLMG's representative did not know how many acres would need to be in production to make a pipeline feasible.

And, finally, these from the Sandone deposition:

On Page:
98, 100 – WLMG has not given any consideration to which shale formations it wishes to target.
104 – WLMG does not know the number of condensate reclaiming tanks it would use.
112 – WLMG does not know the volume of wastewater to be recovered from its well.
113 – WLMG does not know how many tanks it will need to utilize or the size of the tanks.
114-15 – WLMG's representative does not know of any plans to deal with wastewater, to prevent spills, or to use pipelines.
135 – WLMG's representative does not know the chemical components of the fracturing fluids it intends to introduce into the well bore.
157 – WLMG's representative does not know how many well pads or well holes are required to make it economically feasible to develop a pipeline to get gas to market.

7.0 REFERENCES

Acton J, Wunder B, "Impact of Proposed Environmental and Drilling Regulations on Recoverable Shale Gas Reserves in New York State", (http://www.scribd.com/doc/216907402/New-York-Drilling-Restrictions), 2014.

Anirban R, Adams P, Robinson A. Air pollutant emissions from the development, production, and processing of Marcellus Shale natural gas. *J. Air & Waste Management Association*, 64, 2016.

Berman A, Pittinger L. Resource Assessment of Potentially Producible Natural Gas Volumes From the Marcellus Shale, State of New York. Labyrinth Consulting Services, Inc. 2014.

Hays J, McCawley M, Shonkoff S. Public health implications of environmental noise associated with unconventional oil and gas development. *Science of the Total Environment*, 580 (2017) 448–456.

Hughes D. Drilling Deeper; A Reality Check on U.S. Government Forecasts for a Lasting Tight Oil & Shale Gas Boom. Post-Carbon Institute, 2014. https://www.postcarbon.org/drilling-deeper.

Hughes D. How Long Will the Shale Revolution Last? Technology versus Geology and the Life Cycle of Shale Plays. Special Report, Post-Carbon Institute, 2019. https://shalebubble.org/.

Ingraffea A, Wells M, Santoro R, Shonkoff S. Assessment and risk analysis of casing and cement impairment in oil and gas wells in Pennsylvania, 2000–2012. *Proceedings of the National Academy of Sciences*. doi: 10.1073/pnas.1323422111, June 2014.

PADEP, https://www.dep.pa.gov/DataandTools/Reports/Oil%20and%20Gas%20Reports/Pages/default.aspx, accessed October 1, 2019.

Public Herald, http://publicherald.org/hidden-data-suggests-fracking-created-widespread-systemic-impact-in-pennsylvania/, 2017.

PSE, 2019. https://www.psehealthyenergy.org/our-work/shale-gas-research-library/

Sakhaee-Pour A, Bryant S. Gas Permeability of Shale. *SPE Reservoir Evaluation & Engineering 15(04),* August, 2012.

Shepherd D, Welch D, Dirks KN, Mathews. Exploring the relationship between noise sensitivity, annoyance and health-related quality of life in a sample of adults exposed to environmental noise. *Int. J. Environ. Res. Public Health* 7, 3579–3594, 2010.

Swindell G. Estimated Ultimate Recovery (EUR) Study of 5,000 Marcellus Shale Wells in Pennsylvania. February 2018 Update. *www.gswindell.com › marcellus_eur_study*

APPENDIX A

CV of Dr. Ingraffea

APPENDIX B

Deposition and Trial Testimony

B-1 Depositions

Nolan Scott Ely et al. Plaintiff v. Cabot Oil & Gas Corporation Defendant, Case No. 3:09-cv-02284-MCC, United States District Court, Middle District of Pennsylvania, July 15, 2015.

Robert Andrews et al v. Antero et al., Civil Action No. 14-C-3000. Circuit Court of Ohio County, West Virginia, June 12, 2015.

Cody Murray et al. Plaintiffs v. EOG Resources; Fairway Resources et al., Cause No. 342-284983-16, District Court, Tarrant County, Texas, May 24, 2017.

B-2 Trial

Nolan Scott Ely et al. Plaintiff v. Cabot Oil & Gas Corporation Defendant, Case No. 3:09-cv-02284-MCC, United States District Court, Middle District of Pennsylvania, February, 2016.

Protect PT, Appellant v. Penn Township Zoning Hearing Board, Appellee, v. Huntley & Huntley Energy Exploration, LLC and Apex Energy (PA), LLC and The Township of Penn, Intervenors. Civil Division, No. 3499 of 2017. In the Court of Common Pleas of Westmoreland County, Pennsylvania.

State of Montana, Plaintiff, v. Leonard Higgins. Cause No. TK-16-659. In the Justice Court of Chouteau County, State of Montana.

People of the State of New York, Plaintiffs, v. James Cromwell, Terri Klemm, Pramilla Malick, Naomi Miller, Madeline Shaw, Maureen Murphy-Smolka, Defendants. Docket Numbers 15120561, 16010030,15120476, 15120478,15120477,16010031. State of New York, County of Orange, Town of Waywayanda Justice Court.

EXHIBIT "4"

REPORT ON THE HISTORY OF THE DELAWARE RIVER BASIN COMPACT WITH SPECIFIC FOCUS ON SECTIONS 1.2(G) AND 3.8

by

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October 2, 2019

TABLE OF CONTENTS

I. INTRODUCTION

A. Purpose of Report and Complete Statement of Opinions

1. Purpose of Report

This report has been prepared for use in the civil action encaptioned *Wayne Land and Mineral Group, LLC., v. Delaware River Basin Commission, et al.*, Civil Action No. 3:16-CV-00897-RDM, United States District Court for the Middle District of Pennsylvania.

This report focuses on the creation of the Delaware River Basin Compact ("Compact"), an accord entered into in 1961 by the States of Delaware, New Jersey, New York, and Pennsylvania, and the United States. More specifically, this report discusses the history of the Compact as it pertains to the definition of "Project" as set forth in the Compact's Section 1.2(g) and used in Section 3.8. These sections, along with those defining the terms "Facility" and "Water resources," which are used in the definition of "Project," and sections relating to the "Comprehensive plan," which is used in Section 3.8, are set forth below:

ARTICLE 1: SHORT TITLE, DEFINITIONS, PURPOSE AND LIMITATIONS

1.2 Definitions. . . .

(e) "Facility" shall mean any real or personal property, within or without the basin, and improvements thereof or thereon, and any and all rights of way, water, water rights, plants, structures, machinery and equipment, acquired, constructed, operated or maintained for the beneficial use of water resources or related land uses including, without limiting the generality of the foregoing, any and all things and appurtenances necessary, useful or convenient for the control, collection, storage, withdrawal, diversion, release, treatment, transmission, sale or exchange of water; or for navigation thereon, or the development and use of hydroelectric energy and power, and public recreational facilities; or the propagation of fish and wildlife; or to conserve and protect the water resources of the basin or any existing or future water supply source, or to facilitate any other uses of any of them.

(g) "Project" shall mean any work, service or activity which is separately planned, financed, or identified by the commission, or any separate facility undertaken or to be undertaken within a specified area, for the conservation, utilization, control, development or management of water resources which can be established and utilized independently or as an addition to an existing facility, and can be considered as a separate entity for purposes of evaluation.

(i) "Water resources" shall include water and related natural resources in, on, under, or above the ground, including related uses of land, which are subject to beneficial use, ownership or control.

* * *

ARTICLE 3: POWERS AND DUTIES OF THE COMMISSION

3.2 Comprehensive Plan, Program and Budgets. The commission shall, in accordance with Article 13 of this compact, formulate and adopt:

(a) A comprehensive plan, after consultation with water users and interested public bodies, for the immediate and long-range development and uses of the water resources of the basin;

(b) A water resources program, based upon the comprehensive plan, which shall include a systematic presentation of the quantity and quality of water resources needs of the area to be served for such reasonably foreseeable period as the commission may determine, balanced by existing and proposed projects required to satisfy such needs, including all public and private projects affecting the basin, together with a separate statement of the projects proposed to be undertaken by the commission during such period; and

(c) An annual current expense budget, and an annual capital budget consistent with the water resources program covering the commission's projects and facilities for the budget period.

3.8 Referral and Review. No project having a substantial effect on the water resources of the basin shall hereafter be undertaken by any person, corporation or governmental authority unless it shall have been first submitted to and approved by the commission, subject to the provisions of Sections 3.3 and 3.5. The commission shall approve a project whenever it finds and determines that such project would not substantially impair or conflict with the comprehensive plan and may modify and approve as modified, or may disapprove any such project whenever it finds and determines that the project would substantially impair or conflict with such plan. The commission shall provide by regulation for the procedure of submission, review and consideration of projects, and for its determinations pursuant to this section. Any determination of the commission hereunder shall be subject to judicial review in any court of competent jurisdiction.

* * *

> **ARTICLE 13: PLAN, PROGRAM AND BUDGETS**
>
> **13.1 Comprehensive Plan.** The commission shall develop and adopt, and may from time to time review and revise, a comprehensive plan for the immediate and long-range development and use of the water resources of the basin. The plan shall include all public and private projects and facilities which are required, in the judgment of the commission, for the optimum planning, development, conservation, utilization, management and control of the water resources of the basin to meet present and future needs; provided that the plan shall include any projects required to conform with any present or future decree or judgment of any court of competent jurisdiction. The commission may adopt a comprehensive plan or any revision thereof in such part or parts as it may deem appropriate, provided that before the adoption of the plan or any part or revision thereof the commission shall consult with water users and interested public bodies and public utilities and shall consider and give due regard to the findings and recommendations of the various agencies of the signatory parties and their political subdivisions. The commission shall conduct public hearings with respect to the comprehensive plan prior to the adoption of the plan or any part of the revision thereof.

The term "Project" as it is used in Sections 1.2(g) and 3.8, and how that term informs which actions within the Delaware River Basin ("Basin") are subject to project review jurisdiction of the Delaware River Basin Commission ("Commission"), cannot be fully understood in a vacuum. The Commission's project review authority must be considered in relation to a fuller history of the Compact. This report, therefore, will discuss the drafting history of several Compact provisions as well as how those provisions were understood by historical individuals and groups with immediate interests that would be shaped by any interstate accord.

2. Summary Statement of Opinions

The opinions set forth in this report were developed in accordance with the practices, methods, and standards of a professional, scholarly historian. The opinions offered here are presented to a reasonable degree of professional certainty.

Section 3.2(a) of the Compact requires the Commission to formulate and adopt a comprehensive plan "for the immediate and long-range development and uses of the water resources of the basin." The term "Project" as used in Sections 1.2(g) and 3.8 of the Compact was widely understood by those who negotiated that agreement to mean any planned undertaking or facility that might impact water resources of any type within the Basin and thereby might impair or conflict with the comprehensive plan.

The Compact's drafters understood uses of water resources to encompass all potential present and future such uses, including, for example, for domestic, industrial or other water supply, wastewater assimilation, recreation, hydroelectric power, protection of aquatic life, and industrial activity. Activities and facilities that might render water resources unfit for reuse, or that might cause pollution of streams, groundwater, or other water resources in contravention of the comprehensive plan, were among the activities encompassed by the term "Project." The Compact defined the term "Water Resources" to encompasses water and related natural resources, including related uses of land.

The parties who negotiated the Compact contemplated that the Basin's water resources would be managed by a new kind of agency to be formed by the Compact. This federal-interstate agency, to be known as the Delaware River Basin Commission, would be invested with broad authority not only to develop a multi-use, comprehensive plan for water management, but also to implement and enforce its plan. The function of Section 3.8 of the Compact would be to protect the comprehensive plan from activities and facilities that might impair or conflict with the plan.

Importantly, this understanding about the Compact's meaning was widely communicated to the general public during the drafting process in the late 1950s as well as during Compact deliberations over ratification in 1961. During this period, many concerned individuals and groups provided input or observed the negotiations. After ratification, individuals and groups expressed their views about the Compact's purposes and meaning in statements that were similar to those offered before ratification.

B. Geographical and Chronological Limits of Report

The Compact discussed in this report encompasses the watershed of the Delaware River and its tributaries in the states of Delaware, New Jersey, New York, and Pennsylvania as depicted on the map below.

Delaware River Basin Map. Source: U.S. Geological Survey, 2010, available at: https://www.usgs.gov/media/images/map-delaware-river-basin.

Chronologically, the main focus of this report is on the period from 1959 to 1961 – the time when the accord was being drafted and ratified. Nevertheless, to help understand the genesis of the Compact, a brief background history regarding Delaware River controversies beginning in the early twentieth century is set forth under heading II below.

C. "Materials Considered" and "Materials Relied Upon"

"Materials considered" are all documents, books, reports, articles, or other items reviewed during research for this report. "Materials relied upon" constitute a considerably smaller collection within the universe of "materials considered." The principal materials relied upon and are cited in the footnotes; additional corroborating examples are contained in the materials considered.

D. Research Locations and Sources

A wide variety of historical documents were reviewed and considered for the preparation of this report from the following sources:

- The Delaware River Basin Commission – the basin-wide agency created by the Delaware River Basin Compact – maintains a large collection of historical materials that includes minutes of meetings, annual reports, drafts of the proposed compact, correspondence, memos, reports, news clippings from the period from January 1959 through December of 1961, legislation, documents relating to the Interstate Commission on the Delaware River Basin ("INCODEL"), formed in 1936 to help plan and coordinate interrelated water uses, and documents relating to the Delaware River Basin Advisory Committee ("DRBAC"), which drafted the Compact. The Commission also has obtained related documents from state archives and libraries, the special collections of universities in the four states affected by the Compact, and the John F. Kennedy Presidential Library in Boston, Massachusetts (President Kennedy signed the 1961 federal legislation enacting and ratifying the Compact on behalf of the United States).

- The archives, libraries, and academic institutions within the four Basin states.

- Published U.S. Government records, including Congressional documents and hearings, the *Congressional Record*, and reports by the U.S. Army Corps of Engineers ("Corps"), which began a Basin-wide water resources survey for the Delaware River area before Compact deliberations began. The Corps' survey work helped Compact drafters to fully comprehend the diverse aspects of the Basin and its water resources.

- Relevant published decisions by the U.S. Supreme Court in litigation involving the Delaware River.

- Historical newspapers available from online sources (in addition to the clippings in the files of the Delaware River Basin Commission).

E. Stylistic Notations

One of the principal functions of a historian is to review and accurately summarize large quantities of historical information to yield a detailed and understandable record of the past so others may understand it without the need to read and analyze all of the underlying data. That is the goal of this report. It is also the responsibility of a historian to present the past in an objective manner. For that reason, the underlying documents in this study were used so as to allow the documents to tell their own story. Summaries of documents were sometimes used to condense material into a useable length, yet wherever feasible direct quotations from the underlying documents – especially those of particular importance – were also employed.

F. Expert Witness Qualifications, Testimony, and Compensation

I hold a Ph.D. in American history from the University of California, Los Angeles. I have provided historical consulting and expert witness services for over thirty years in a wide variety of federal and state court cases involving water disputes, water rights, and other environmental issues. These activities include several original jurisdiction cases before the United States Supreme Court, particularly as those actions involved interstate river compacts and litigation. Those cases are *Kansas v. Colorado*, Original No. 105; *Kansas v. Nebraska and Colorado*, Original No. 126; *Nebraska v. Wyoming*, Original No. 108; *Virginia v. Maryland*, Original No. 129; and *Wyoming v. Montana and North Dakota*, Original No. 137. I also have testified, been deposed, and/or provided other consulting services in other federal courts, multiple state courts, and before administrative and regulatory agencies. My detailed curriculum vitae, which lists all cases in which I have participated and/or testified as well as all of my publications, is attached to this report as Appendix A.

With regard to compensation for research and writing this report, I have been paid at a rate of $175 per hour, plus reimbursement for all reasonable out-of-pocket expenses (such as travel costs, photocopying charges, shipping, etc.). For depositions and testimony, I will be paid at a rate of $350 per hour plus out-of-pocket expenses. My research assistants have been paid at a rate of $80 per hour.

II. BACKGROUND TO COMPACT NEGOTIATIONS

A. Early Unsuccessful Compact Talks and Litigation

In 1925, New York City proposed to divert water from the Basin's headwaters out of the Basin to serve the City's then-present needs and projected growth. The States of New York, New Jersey, and Pennsylvania attempted to negotiate a compact establishing the conditions under which the diversion would occur. When negotiations failed, litigation in the U.S. Supreme Court ensued.

In 1931, the Court entered a decree that approved a diversion to New York City while establishing conditions that recognized the close relationship between water supply and other water uses. In light of possible adverse impacts of a diversion on recreation, oyster harvesting, and salinity, the Decree limited New York City's diversion to 440 million gallons per day, and conditioned the diversion on construction of a sewage treatment plant at Port Jervis and the release of water from New York City's Basin reservoirs during low flow conditions. The Decree further provided: "Untreated industrial wastes from plants in said town of Port Jervis shall not be allowed to enter the Delaware or Neversink Rivers."[1]

B. Corps of Engineers' Delaware River "308 Report" and INCODEL

Two years after the U.S. Supreme Court's 1931 ruling, the U.S. Army Corps of Engineers completed the first comprehensive multipurpose study of the Delaware River, a survey known as the "308 report," named for U.S. House of Representatives' Document No. 308 (1928) estimating costs to carry out the work.[2] At Congress' direction, the Delaware River 308 report (and others like it on different rivers) addressed interrelated challenges to water supply, consumptive use, groundwater, wastewater, stream quality, pollution, navigation, hydroelectric power, irrigation, sedimentation, recreation, fish and wildlife, runoff, forestation, hydrology, insects and public health, economics, and salt water intrusion where applicable.[3] In other words,

[1] *New Jersey v. New York,* 283 U.S. 336 (1931).

[2] For the 1926 basis of the 308 reports, see U.S. House of Representatives, *Estimate of Cost of Examinations, Etc., of Streams Where Power Development Appears Feasible*, H. Doc. 308, 69 Cong., 1 sess., April 7, 1926. For federal legislation authorizing the 308 reports, see *An Act Authorizing the Construction, Repair, and Preservation of Certain Public Works on Rivers and Harbors, and for Other Purposes*, 47 Stat. 1010 (1927); *An Act for the Control of Floods on the Mississippi River and Its Tributaries, and for Other Purposes*, 569 Stat. 534 (1928).

[3] U.S. House of Representatives, *Delaware River Basin, New York, New Jersey, Pennsylvania: Letter from the Secretary of the Army Transmitting a Letter from the Chief of Engineers, Department of the Army, Dated April*

these surveys recognized that any one type of water use could have a direct bearing on many others.

Selecting the best institutional mechanism to address the multiple water resources challenges was also considered by the Corps. The Corps' Delaware River 308 report, published early in 1934, concluded that the Basin's planning would best be accomplished by an interstate agency. In 1936, the Basin states formed the Interstate Commission on the Delaware River Basin ("INCODEL")[4] to plan and coordinate interrelated water uses. Much of INCODEL's work, including the water quality standards that it developed, formed the basis for later action by the new Basin-wide agency, the Delaware River Basin Commission.

C. 1951 Compact Proposal and 1954 U.S. Supreme Court Decision

In 1951, a draft interstate compact was proposed by INCODEL, approved by the legislatures of Delaware, New Jersey, and New York and passed by the Pennsylvania House of Representatives.[5] The legislation, however, died in committee in the Pennsylvania Senate. Thereafter, New York City and New York State returned to the U.S. Supreme Court to seek

2, 1962, Together with Accompanying Papers and Illustrations, on a Review of the Delaware River and Tributaries, Requested by a Resolution of the Committee on Public Works, United States Senate, Adopted April 13, 1950, and Other Resolutions of That Committee, and of the Committee on Public Works, House of Representatives, Listed in the Report, 11 vols., H. Doc. 522, 87 Cong., 2 Sess., 1962.

[4] Water Research Foundation, "A Brief Report on the Governmental Organization for the Water Resources of the Delaware River Basin by the Maxwell Graduate School, Syracuse University," 1959, p. 3, Delaware River Basin Commission, West Trenton, New Jersey; Electric Utility Lawyers Group Study of the Provisions of the Proposed Delaware River Compact, "Report of Committee No. 2," March 24, 1960, pp. 1-2, 12-17-18 Production, DRBC, 1960, Delaware River Basin Commission, West Trenton, New Jersey. It is noted that the authors of the Syracuse University study (cited at length in Section II.E. of this report) regarding INCODEL, "The Interstate Commission on the Delaware River Basin . . . from time to time has essayed a variety of functions but has pursued pollution abatement as its primary task." See "The Problem of Water Resources Administration, with Special Reference to the Delaware River Basin, A Report Submitted to the Water Research Foundation of the Delaware River Basin by the Syracuse University Research Group," August 1, 1959, p. 60, Delaware River Basin Commission, West Trenton, New Jersey.

[5] See, for example, "Cannonsville Dam Project Included," *Press and Sun-Bulletin* (Binghamton, New York), Jan. 15, 1951; "Tri-State Commission Proposed," ibid., Feb. 21, 1951; "State House Scene," *Courier News* (Bridgewater, New Jersey), Sept. 22, 1951; "Four States Go It Alone," *Times-Record* (Troy, New York), Nov. 2, 1951.

additional Delaware River diversions. In its 1954 decree, the Court, among other things, allowed increased New York City diversions, required compensating releases from New York City Basin reservoirs during low flow conditions, and mandated that sewage treatment at Port Jervis meet specified effluent reduction requirements. Discharging untreated industrial wastes from Port Jervis remained prohibited.[6]

D. Hurricane Diane, 1955, Initiation of the Corps' Comprehensive Survey, and the Formation of DRBAC

A little over a year after the U.S. Supreme Court Decree, two successive hurricanes, Connie and Diane, struck the mid-Atlantic section of the United States and caused losses exceeding $100 million.[7] Faced with these damages, Congress supplemented funding for the Corps' Delaware River efforts that had begun with the 308 report in 1933, and expanded their scope. As the Chief of Engineers explained in his annual report for 1956, the U.S. Senate directed the Corps to undertake, "a review of plans for flood control and other water resources developments in the Delaware River Basin."[8] The study would include, among many other aspects, regional economic projections and water demand and supply, which was a traditionally non-federal responsibility.[9]

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[6] *New Jersey v. New York*, 347 U.S. 995 (1954); Water Research Foundation, "A Brief Report on the Governmental Organization for the Water Resources of the Delaware River Basin by the Maxwell Graduate School, Syracuse University," 1959, p. 4, Delaware River Basin Commission, West Trenton, New Jersey; Walter M. Phillips, "How We Rescued the Delaware," Sept. 1963, p. 5, Delaware River Basin Commission, West Trenton, New Jersey; Water Association of the Delaware River Basin, "Special Bulletin – WRA-DRB," Feb. 6, 1961, 12-17-18 Production – Pennsylvania – Temple University Special Collections, Delaware River Basin Commission, West Trenton, New Jersey; Electric Utility Lawyers Group Study of the Provisions of the Proposed Delaware River Compact, "Report of Committee No. 2," March 24, 1960, pp. 1-2, 12-17-18 Production, DRBC, 1960, Delaware River Basin Commission, West Trenton, New Jersey.

[7] U.S. Army Engineer District Philadelphia, "Report on the Comprehensive Survey of the Water Resources of the Delaware River Basin," App. A, "History of Investigation," June 1960. P. A-4, copy from Delaware River Basin Commission, West Trenton, New Jersey.

[8] U.S. Army Corps of Engineers, *Annual Report of the Chief of Engineers, U.S. Army on Civil Works Activities, 1956* (Washington, D.C.: U.S. Government Printing Office, 1956), vol. 1, p. 51.

[9] DRBAC, "Annual Report, April 1, 1956 - March 31, 1957," Aug. 14, 1957, p. 2, Delaware River Basin Commission, West Trenton, New Jersey.

The Governors of New Jersey, New York, Pennsylvania, and Delaware, and the Mayors of Philadelphia and New York City responded by forming their own planning group, the Delaware River Basin Survey Commission, not only to identify areas for further research needed for a comprehensive, multi-purpose plan of river development, but also to study issues of legal, fiscal, and governmental structure for administering such a plan.[10] When under Senate directives in the mid-1950s the Corps indicated that it would study every aspect of the river, the question arose whether the Survey Commission should continue in existence.[11] However, as the Delaware River Basin Advisory Committee ("DRBAC") later recounted in its first annual report, "The subject held such vital interest to the states and cities . . . that the Survey Commission did not feel that it should merely abdicate to the Corps[.]" Instead, it determined to support the Corps' undertaking while maintaining continuous review of the federal agency's work. A suggested directive for the six Governors and Mayors was prepared, which, upon its execution in August 1956, established the previous Survey Commission as the Delaware River Basin Advisory Committee.[12]

In their directive to the new DRBAC, the Governors and Mayors focused on the development of a comprehensive water management plan for the region and the means to implement it. They asked the DRBAC not merely to "assemble and evaluate information about the water and related land uses of the Basin," but in cooperation with other agencies performing such studies, to "assist in setting up and obtaining financing for new studies and research which are needed for the completion of a comprehensive, multiple-purpose plan, . . . help in the final formulation of such a plan, . . . and make recommendations to us on fundamental questions of

[10] Ibid., p. 3.
[11] Ibid., p. 3.
[12] Ibid., p. 3.

policy relating to the plan and means of carrying out the developments provided for in the plan." DRBAC was further directed to "aid in the marshalling and dissemination of information necessary for adequate understating of the subject [and] assist in keeping local governments of the Basin advised and alerted to their interests."[13]

E. The Syracuse Study, Its Findings, and Key Recommendations

During its first year of effort, DRBAC established the Delaware River Basin Research Inc. (later renamed the "Water Research Foundation for the Delaware River Basin") to apply for funds with which to undertake such new studies as DRBAC deemed necessary.[14] The Foundation engaged Dr. Roscoe C. Martin, a consultant in public administration and professor at the Maxwell Graduate School at Syracuse University, to assist in the design of a study program for analysis of the "complicated legal, fiscal and governmental organization questions involved in water resource development on an interstate river, with special emphasis on the Delaware River Basin."[15] The plan of study developed by Martin became the basis for a successful application to the Ford Foundation. In April of 1957, the Water Research Foundation engaged the Syracuse University Research Institute to conduct a study "of [the] governmental organization best suited for control and development of the water resources of the Basin in light of the anticipated comprehensive multipurpose plan being prepared by the [Corps of Engineers

[13] Directive to the Delaware River Basin Advisory Committee, in Delaware River Basin Advisory Committee, "Annual Report, April 1, 1956 - March 31, 1957," Aug. 14, 1957, p. 13, Delaware River Basin Commission, West Trenton, New Jersey.

[14] DRBAC, "Annual Report, April 1, 1956 - March 31, 1957," Aug. 14, 1957, pp. 6, 8. For name change, see DRBAC, "Third Annual Report, April 1, 1958 to March 31, 1959," p. 3 (footnote). The updated name is used throughout this report.

[15] DRBAC, "Annual Report, April 1, 1956 - March 31, 1957," Aug. 14, 1957, p. 8.

and other] federal agencies."[16] The study was to be completed in the fall of 1959, around the same time as the comprehensive survey under development by the Corps.[17]

The Syracuse team's 500-page analysis, which later formed the basis of a scholarly book,[18] concluded that "existing government in the Delaware Basin was not adapted to the administration of an integrated, Basin-wide water resources program." The study therefore suggested that a new central agency be created by an interstate-federal compact to provide unified administration over the Basin's water resources.[19] As the report explained, the administrative agency would be empowered to impose "general administrative controls over water use" as a "compromise between the traditional system of riparian rights in the East and the appropriative system of the West."[20] While the Supreme Court apportions water among states, "The issue properly phrased, . . . is not 'Which states shall get how much water?' but rather 'Where or to what user should how much water go?'" This question, the Syracuse team concluded, "is more likely to develop from an administrative process" of an agency that "can offer continuous opportunity to change plans and shift water uses."[21] The basin agency would make administrative allocations of water employing quasi-judicial procedures.[22]

Recognizing that "water and land are so blended as on occasion to defy placement in separate programmatic cells," the Syracuse authors sought through their recommendations "to

[16] DRBAC, "Second Annual Report, April 1, 1957 – March 31, 1958," p. 6, Delaware River Basin Commission, West Trenton, New Jersey.

[17] Letter of transmittal of DRBAC Second Annual Report to the Governors and Mayors, May 15, 1958, in DRBAC, "Second Annual Report, April 1, 1957 - March 31, 1958," Delaware River Basin Commission, West Trenton, New Jersey.

[18] Roscoe C. Martin, *River Basin Administration and the Delaware* (Syracuse, N.Y.: Syracuse University Press, 1960).

[19] Water Resources Association of the Delaware River Basin, "Special Bulletin – WRA-DRB," Feb. 6, 1961, 12-17-18 Production – DRBC – 1959, Delaware River Basin Commission, West Trenton, New Jersey.

[20] "The Problem of Water Resources Administration, with Special Reference to the Delaware River Basin, A Report Submitted to the Water Research Foundation of the Delaware River Basin by the Syracuse University Research Group," August 1, 1959, p. 95, Delaware River Basin Commission, West Trenton, New Jersey.

[21] Ibid., p. 193.

[22] Ibid., pp. 194-195.

blend land and water problems by consigning both to a single agency for administration."[23] As Walter M. Phillips (DRBAC's Executive Secretary and a participant in the compact drafting process) later recounted, the study recommended "a commission with extensive powers over the waters of the entire Delaware River Basin."[24] Central among these powers, according to the study authors, should be: (1) to collect all manner of data regarding "present and potential uses of water" within the Basin and any areas to which Basin water was or might be diverted; (2) to "[p]repare and . . . continually revise and supplement a comprehensive plan for the development of water and water-related resources of the Basin[;]" (3) to "[p]rotect and improve the quality of the waters of the . . . Basin. . . [;]" and (4) to "[d]esign, build, make integrated operating plans for, maintain [and] operate water control structures . . . and related . . . land areas on the main stem and tributaries[.]"[25]

With respect to pollution control, the authors emphasized that the new commission's powers must extend beyond those of INCODEL. They observed:

> Incodel depends purely upon cooperation among officials of the four states – it has no "teeth" with which to prevent or abate serious cases of pollution. Its program has been limited to collecting data, conferring, publicizing, and urging political action. A stricter watch over the quality of water in the Basin will be essential to successful river management in the coming decades.[26]

The Syracuse report and recommendations were presented to the Governors and Mayors at a meeting in Philadelphia on September 30, 1959,[27] and they wasted no time in acting upon it. The following month, they issued a Second Directive to the DRBAC, asking it, "[i]n view of the

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[23] Ibid., p. 316.

[24] Walter M. Phillips, "How We Rescued the Delaware," Sept. 1963, mss. report, Delaware River Basin Commission, West Trenton, New Jersey.

[25] "The Problem of Water Resources Administration, with Special Reference to the Delaware River Basin, A Report Submitted to the Water Research Foundation of the Delaware River Basin by the Syracuse University Research Group," August 1, 1959, pp. 460-474, Delaware River Basin Commission, West Trenton, New Jersey.

[26] Ibid., p. 468.

[27] DRBAC, "Fourth Annual Report, April 1, 1959 to March 31, 1960," p. 1, Delaware River Basin Commission, West Trenton, New Jersey.

need for a unified water resource agency to be charged with important responsibilities in regard to the management and development of certain of the waters of the Delaware River Basin," to prepare for the Governors' and Mayors' review and consideration "a proposed draft of legislation for the creation of a basin agency by interstate-federal compact."[28] The directive further authorized DRBAC "to engage such special counsel as you may deem necessary, call such meetings and hearings as may be useful, and consult with any parties that may be helpful," including with the "legal offices of our respective jurisdictions . . . [and] our various agencies of government dealing with one or another aspect of water."[29]

DRBAC accepted the offer of INCODEL to share in preparation of the draft compact and engaged attorney William P. Miller of Princeton, New Jersey, as special counsel and draftsman.[30]

The product of the DRBAC's work over the ensuing months was an accord creating an interstate and federal agency – the Delaware River Basin Commission – to manage all Basin water resource-related matters. The proposed agency was exceptional in three respects: (1) it would be the first interstate river compact agency charged with governing *all* aspects of water resources; (2) due to the multiple interests of the federal government in the Basin, the United States was to be a compact signatory and equal Commission member with the four basin States; and (3) the Commission was to develop a unified, multi-use, comprehensive plan for all water resources of the Basin. To enable the new agency to fully implement the comprehensive plan it was tasked with developing and administering, the Commission was empowered to review and to

[28] "Second Directive to the Delaware River Basin Advisory Committee," October 1959, contained in DRBAC," Fourth Annual Report, April 1, 1959 to March 31, 1960," as Appendix A, Delaware River Basin Commission, West Trenton, New Jersey.
[29] Ibid.
[30] DRBAC, "Fourth Annual Report, April 1, 1959 to March 31, 1960," p. 1, Delaware River Basin Commission, West Trenton, New Jersey.

approve or reject any proposal – whether public or private – that might have a significant impact on the Basin's water resources. This power was intended to ensure that any such proposal – or "Project," as defined by Section 1.2(g) and used in Section 3.8 of the Compact – did not impair or conflict with the Commission's multi-purpose comprehensive plan for the Basin.

In short, as William Miller later explained, the Compact was similar to a constitution in that the participating governments each relinquished some powers within their respective jurisdictions in exchange for participation in a regulatory body exercising their combined power that would oversee the water resources of the entire Basin.[31]

F. Significance of Concurrent Survey by the Corps of Engineers

As the DRBAC's meeting minutes and annual reports document, the Corps and the DRBAC proceeded in close cooperation from the DRBAC's formation in 1956 through enactment of the Compact in 1961.[32] With the DRBAC's support, the Corps' investigations ultimately addressed nearly all facets of Delaware River water resources – including water supply, consumptive use, groundwater, stream quality, pollution, flood control, navigation, hydroelectric power, irrigation, sedimentation, recreation, fish and wildlife, runoff, forestation, hydrology, insects and public health, economics, and salt water intrusion in the lower Delaware Basin. Information for the Corps' "comprehensive survey" came from its own efforts as well as

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[31] Record of the Meeting of the Delaware River Basin Advisory Committee, Nov. 23, 1959, copy in Feb. 19, 2019, Production, Delaware River Basin Commission, West Trenton, New Jersey.

[32] See for example DRBAC, "First Annual Report," p. 3 (decision was made to support the Corps' undertaking and to have the DRBAC maintain continuous review of the Corps' survey); "Second Annual Report," p. 25 ("Many segments of the federal survey have been thoroughly analyzed and representatives of the Corps of Engineers and other federal and state agencies have attended meetings of the Committee."); "Third Annual Report," p. 4 ("Began preparation of plans for presenting the recommendations of the Corps . . . survey and the Syracuse study to policy-making officials of the States and Cities."); "Fourth Annual Report," transmittal letter (In the course of nine meetings . . . the focus of our attention has remained on the Corps . . . survey of the Delaware basin and on the problem of governmental organization."); and "Final Report," ("The original [Corps] study outline, the content of many of the technical chapters, and the task of obtaining funds to keep the survey moving on schedule were all subjects where the [DRBAC] and its staff were able to make useful contributions."). All DRBAC annual reports are at Delaware River Basin Commission, West Trenton, New Jersey.

data provided by seven federal agencies (the Departments of Agriculture, Commerce, Interior, and Labor as well as the Bureau of the Budget and the Federal Power Commission). Other material provided to the Corps (and then to DRBAC) was produced by state agencies of Delaware, New Jersey, New York, and Pennsylvania, as well as by municipal bureaus of the cities of New York and Philadelphia. All of this information – which eventually resulted in an eleven-volume published work by the Corps consisting of thousands of pages – was considered by the DRBAC during its compact deliberations that led to the formation of the Commission, the agency ultimately charged with managing the Basin's water resources through a comprehensive multi-use plan.[33]

G. Goals Illustrated in DRBAC Annual Reports and Minutes

The DRBAC's first annual report emphasized the multiple aspects of information being incorporated into DRBAC's objectives.

For example, the issue of water use and how that might relate to reservoir storage in the Basin dated back to the 1920s, when New York City announced its reservoir development plans and New York State first attempted unsuccessfully to negotiate an interstate compact with its neighboring states to allocate the waters of the Delaware River. New York City's proposal for the construction of large reservoirs in the Basin's New York headwaters had underlain the U.S. Supreme Court litigation of the 1930s.[34]

[33] U.S. House of Representatives, *Delaware River Basin, New York, New Jersey, Pennsylvania: Letter from the Secretary of the Army Transmitting a Letter from the Chief of Engineers, Department of the Army, Dated April 2, 1962, Together with Accompanying Papers and Illustrations, on a Review of the Delaware River and Tributaries, Requested by a Resolution of the Committee on Public Works, United States Senate, Adopted April 13, 1950, and Other Resolutions of That Committee, and of the Committee on Public Works, House of Representatives, Listed in the Report*, 11 vols., H. Doc. 522, 87 Cong., 2 Sess., 1962.

[34] *New Jersey v. New York*, 283 U.S. 336 (1931); *New Jersey v. New York*, 283 U.S. 805 (1931); *New Jersey v. New York*, 347 U.S. 995 (1954).

Reservoirs remained a central focus of attention in relation to Basin wide water resources management over the following years. The minutes of the nineteenth meeting of the DRBAC on July 8, 1958, reported that the DRBAC "should insist on being informed [by the Corps of Engineers] as to the bases for decision being used by the Corps of Engineers in selecting reservoir sites[.]"[35] Potential reservoir sites figured prominently in the Corps' final eleven-volume report and in the discussion around it.

However, the potential construction of Basin reservoir storage constituted only one piece of the water resource management puzzle the Corps and DRBAC were assembling. DRBAC's first annual report described the work underway by the Corps as "a pioneering approach going beyond traditional ways and means of river basin planning." Where previously the Corps had "been primarily concerned with big flood-control dams and the improvement of navigation," it was for the first time in the case of the Delaware River Basin to produce "a truly comprehensive multi-purpose plan."[36]

The Corps leadership embraced the expansive scope of the Basin survey it was charged with undertaking. At a meeting of DRBAC on October 31, 1957, in the context of a discussion of hydroelectric power, Colonel Allen F. Clark emphasized that unlike previous studies, "this one of the Delaware is under mandate of Congress to be comprehensive, and, therefore, each possible water use must be treated on its own merits and none given only incidental or subordinated study and treatment." The minutes of this meeting added: "[Clark] undertook to go more fully into this subject with his staff and to emphasize with them that point of view."[37]

[35] Minutes of the Delaware River Basin Advisory Committee, 1956-1962, Meeting of Sept. 24, 1958, p. 3, Delaware River Basin Commission, West Trenton, New Jersey.
[36] Delaware River Basin Advisory Committee, "Annual Report, April 1, 1956 - March 31, 1957," Aug. 14, 1957, p. 1 (transmittal letter), Delaware River Basin Commission, West Trenton, New Jersey.
[37] Minutes of the Delaware River Basin Advisory Committee, 1956-1962, Meeting of Oct. 31, 1957, p. 3, Delaware River Basin Commission, West Trenton, New Jersey.

At the same meeting, DRBAC reviewed possible atomic energy power plans and the impact of possible nuclear waste contamination in the watershed. The implications for the watershed of coal power also were considered, including in relation to Pennsylvania's coal fields and coal production – extractive activities that required water – although no specific conclusions were reached at that time.[38]

Minutes for the DRBAC's meeting the following month addressed the work on pollution and water quality among other topics, with commentary by the Corps, the Public Health Service, the U.S. Geological Survey, and INCODEL (functioning in an advisory capacity). The water quality discussion centered on a DRBAC staff report dated November 14, 1957, entitled, "Report on Water Quality in Relation to Comprehensive Water Resource Planning in the Delaware River Basin." The study and related conversation addressed a proposed salt water barrier at the downstream end of the Delaware River to maintain water quality for lower Basin users, issues relating to fish and wildlife, reservoir siltation, as well as physical, chemical, biological, and radiological pollution and other matters that "might be a suitable responsibility of a basin development agency."[39]

Control of pollution ultimately occupied the 238-page "Appendix C – Municipal and Industrial Water Use and Stream Quality" of the Corps' final comprehensive survey.[40] However, in DRBAC's second annual report dated May, 1958, a summary of the federal agencies' survey work completed to date on this subject emphasized that this would not be a definitive or final treatment of the subject: "Their work will partially meet some of the needs,

[38] Minutes of the Delaware River Basin Advisory Committee, 1956-1962, Meeting of Oct. 31, 1957, pp. 3-4, Delaware River Basin Commission, West Trenton, New Jersey.

[39] Minutes of the Delaware River Basin Advisory Committee, 1956-1962, Meeting of Nov. 26, 1957, pp. 2-4, Delaware River Basin Commission, West Trenton, New Jersey.

[40] U.S. Army Engineer District Philadelphia, "Report on the Comprehensive Survey of the Water Resources of the Delaware River Basin," Vol. III, "Appendix C – Municipal and Industrial Water Use and Stream Quality," June 1960, Delaware River Basin Commission, West Trenton, New Jersey.

but water quality research, planning and control will continue to be important functions for many years to come," DRBAC reported. DRBAC further observed:

> Quantity and quality requirements impinge one upon the other, and conflicts between users will increase as population and industrial growth proceeds. Although excellent progress in pollution control has been made in the Delaware over the past two decades, water quality in the Basin will always be a concern because of the constantly changing patterns of water use. For the Delaware many important needs in the water quality field still exist. The collection, evaluation, and integrated use of basic data on water quality need to be extended.

H. Outreach on Need for an Interstate Compact

To inform the public of the recommendations of the Syracuse report and the emerging thinking on the need for an interstate agreement, INCODEL sponsored a conference on October 15, 1959, that included a panel comprised of four individuals directly involved in Basin water resource issues: Wayne Dumont (a State Senator from New Jersey), attorney William P. Miller (in his capacity as a DRBAC consultant and principal compact drafter), Frederick L. Zimmermann (a consultant for New York State's Joint Legislative Committee on Interstate Cooperation), and Irving K. Fox (of Resources For The Future – an American nonprofit organization that conducted independent research into environmental, energy, and natural resource issues). A summary of the event reported that all four panelists "agreed that an agency created by an interstate-federal compact to manage the development of the water resources of the Delaware River Basin appears to be necessary and desirable."[41]

Irving Fox summarized the panelists' views by explaining the need for an agency capable of developing and implementing a comprehensive basin-wide plan:

> Why are we interested in new forms of organization for water resources administration? Some people point to the recent and prospective large increase in demand for water for municipal, industrial, irrigation and recreation purposes. As

[41] INCODEL, "Interstate-Federal Compact for Administration of Delaware Basin Plan – A Panel Discussion," Oct. 15, 1959, p. 1, copy in February 19, 2019, Production, Delaware River Basin Commission, West Trenton, New Jersey.

> important as these increases are, they are only one of the reasons for seeking a better pattern of administrative organization.
>
> A more important reason is that the social and political aspects of water development and management rather than the technical and engineering problems will be of paramount concern in the future. Because of the rapid increase in population, metropolitan growth, industrialization, and the consequent impact upon land and water use, water development must be integrated with land use planning to a degree heretofore unknown. The planning required for this purpose must deal with social and economic problems of a predominantly regional and local nature. National agencies cannot be expected to have the orientation or the incentive to deal with these problems as effectively as one would desire.[42]

The Water Resources Foundation in 1959 published for distribution to policymakers and influencers throughout the Basin, an abbreviated version of the Syracuse University study, entitled "A Brief Report on the Study of Governmental Organization for the Water Resources of the Delaware River by the Maxwell Graduate School, Syracuse University."[43] While conferences such as INCODEL's October 1959 panel discussion informed the public, the Water Research Foundation's "Brief Report" solidified support among those who had played roles in INCODEL and DRBAC for concepts that would become central to the proposed compact.

III. FIRST COMPACT DRAFT, AUGUST 1959, AND RELATED EVENTS

As the drafters of the Syracuse study had recommended and the Governors and Mayors directed, the initial draft of the compact, dated August 26, 1959, provided for the creation of a permanent basin-wide water resource management agency, to include the United States as an

[42] "Summary of Remarks by Irving K. Fox Delaware River Basin Water Resources Conference Pocono Manor, Pennsylvania, October 15, 1959," contained in INCODEL, "Interstate-Federal Compact for Administration of Delaware Basin Plan – A Panel Discussion," Oct. 15, 1959, p. 1, copy in February 19, 2019, Production, Delaware River Basin Commission, West Trenton, New Jersey.

[43] Water Research Foundation, "A Brief Report on the Study of Governmental Organization for the Water Resources of the Delaware River by the Maxwell Graduate School, Syracuse University," 1959, Delaware River Basin Commission, West Trenton, New Jersey.

equal member, and to have broad powers to manage all aspects of the Delaware River Basin's water resources under existing circumstances as well as those which might arise in the future.

The preamble of the draft compact stressed the need for such an agency. The third and seventh "Whereas" clauses in particular, provided:

> WHEREAS, the *development, management and control of water and related resources*, under effective long-range plans with sustained operation and support, is of vital interest to the national government, the states and the citizens which may be served by these water resources, by proper flood control measures, *the preservation and development of water supply sources,* the regulation and improvement of stream flow, and development of recreational opportunities, the propagation of fish and game, *protection and benefit of industry and fisheries dependent upon water resources and the control of the movement of salt water, abatement and dilution of stream pollution,* and the development of water transportation and hydro-electric power potentialities of the river, *under a comprehensive plan for the control and utilization of this natural resource*; and . . .
>
> WHEREAS, 22,000,000 people of the United States live and work in the region of the Delaware River Basin and its potential service area, the government, employment, industry and economic development of the entire region and the health, safety and general welfare of its population are and will continue to be vitally affected by *the use, conservation, management and control of the resources of the Delaware River and its tributaries*. . . . [Emphases added.][44]

Although the initial draft contained few definitions,[45] Article I, entitled "Findings, Short Title, Definitions, etc." expanded on the phrase "development, management and control" used in the third "Whereas" clause of the preamble, to provide that the "*conservation, utilization,* development, management and control" of the Delaware River "are public purposes of the respective signatory states."[46] (Emphasis added). The draft findings further provided that "it is

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[44] "An Act to Create a Regional Agency and Instrumentality of the States of Delaware, New Jersey, New York and Pennsylvania and the Government of the United States for the Development, Management and Control of the Resources of the Delaware River and Its Tributaries, [and] Defining the Functions, Powers and Duties Thereof," Aug. 26, 1959, p. 1, 12-17-18 Production – DRBC – 1959, Delaware River Basin Commission, West Trenton, New Jersey.

[45] These consisted of definitions for "Compact," "Federal government," "Signatory state," "Commission," and "Region." See ibid., pp. 3-4.

[46] Ibid., p. 4, Section 1.3(a).

the need and purpose of this compact to provide for a *joint exercise of* [the] powers of sovereignty [of the signatory states] in the common interests of the people of the region."[47]

Of particular significance for the present dispute, Article III, entitled "Powers and Duties of the Commission, Generally," Section 3.1, "General Purpose and Powers," of the initial draft recognized that the plans of both public and private organizations relating to the Basin's water resources must be consistent with the comprehensive plan developed and administered by the new agency, and further, that the power to review projects would be essential to the agency's ability to implement the comprehensive plan. Although the project review power was limited in the initial draft to the review of projects undertaken by the signatory states involving the main stem of the Delaware River and its tributaries, its scope was later expanded to include all projects having a substantial effect on water resources of the entire Basin. The relevant sections of the initial compact draft, all contained within section 3.1 of "Article III – "Powers and Duties of the Commission Generally" are reprinted below:

> 3.1 General Purpose/ and Powers. The Commission shall:
>
> (a) Develop and effectuate *a comprehensive plan to integrate and coordinate water conservation, use and management under a unified policy for the basin*, and to encourage the planning, development and financing of water and water related activities according to such plan;
>
> (b) Develop and adopt plans and specifications for particular water projects and programs which shall, so far as consistent with the comprehensive plan, incorporate any separate plans of other public *and private organizations operating in the basin* and the decentralized development and administration thereof; [and]
>
> (c) *Review any projects of the signatory states which it deems to have a substantial effect on the main stream or tributaries, and have the power and duty to approve, modify or disapprove any such project*, subject to judicial review; *and no such project shall be undertaken without such approval*; …
>
> (f) *Establish standards of planning, design and operation of structures and programs in the basin which affect its water resources*, including, without

[47] Ibid., p. 4, Section 1.3(b).

> limitation thereto, water waste and treatment plants, stream and lake recreational facilities, trunk mains for water distribution, local flood control protection works, small watershed management programs, and ground water recharging operations; *and upon the establishment of such standards no such structure or program shall be constructed or operated in the basin without the approval of the commission*[.] [Emphases added.][48]

IV. "DRAFT A" OF COMPACT, NOVEMBER 23, 1959, AND RELATED EVENTS

Dated November 23, 1959, and entitled "Delaware River Basin Advisory Committee, Proposed Federal-State Compact," the 59-page-long document captioned "Draft A" evidenced important steps in the evolution of the draft accord.

A. Preamble "Whereas" Clauses

The third "Whereas" clause of the *initial* draft preamble, quoted above, expressed the "vital interest [of] the national government, the states and the cities" in "development, management and control of water and related resources" of the Basin "under a comprehensive plan for the control and utilization of this resource." The clause included a list of the multiple ways in which the nation's states' and cities' interests were served by water resources, beginning with "proper flood control measures" and ending with "hydro-electric power potentialities."

In "Draft A," the third "Whereas" clause was expanded from the initial draft and was split into two clauses. The first of these added "planning, *conservation, [and] utilization* to "development, management and control" (emphasis added), placed these expanded functions squarely "under a comprehensive multi-purpose plan," and declared that doing so "will bring the

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[48] Article III, Section 1, "An Act to Create a Regional Agency and Instrumentality of the States of Delaware, New Jersey, New York and Pennsylvania and the Government of the United States for the Development, Management and Control of the Resources of the Delaware River and Its Tributaries, [and] Defining the Functions, Powers and Duties Thereof," Aug. 26, 1959, pp. 8-9, 12-17-18 Production – DRBC – 1959, Delaware River Basin Commission, West Trenton, New Jersey.

greatest benefits and produce the most efficient service of the public welfare[.]"[49] The second whereas clause from the initial draft, which became a new, fourth "Whereas" clause in Draft A, replaced the list of ways in which water resources would serve the "vital interest" of the nation, states, and cities changing it into a list of *services to be provided by* "a comprehensive plan administered by a basin wide agency." Now an enumeration of services, the list was modified so that, for example, "proper flood control measures" became "effective flood damage reduction" and "the development of recreational opportunities" became "development of recreational facilities in relation to reservoirs, lakes and streams." More importantly, this was expanded to include "*conservation* and development *of ground and surface water supply for municipal, industrial and agricultural uses*; . . . promotion of related forestry, soil conservation, and reclamation projects; . . . and the regulation of stream flows toward the attainment of these goals[.]" The phrase "abatement and control of pollution" remained unchanged, and "protection and benefit of industry and fisheries dependent upon water resources" became "protection *and aid to* fisheries dependent upon water resources."[50] With the exception of a later substitution of "watershed" for "reclamation," these changes carried through to the final compact legislation.

B. Article 1 Provisions Regarding "Facility" and "Project"

In Draft A, the short list of definitions included in the initial draft was modified in important part by the addition of three inter-dependent terms: "facility, "project," and "water resources." Section 1.2(e) defined "facility" broadly to include all types of property, structures, and equipment "necessary, useful or convenient for the control, collection, storage, treatment,

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[49] "Delaware River Basin Advisory Committee, Proposed Federal-State Compact," Nov. 23, 1959 ("Draft A"), 12-17-18 Production – Pennsylvania – Temple University Special Collections, Delaware River Basin Commission, West Trenton, New Jersey.
[50] Ibid.

transmission, distribution, sale or exchange of water, . . . or [to] conserve or protect the water resources of the basin or any existing or future water supply source" as follows:

> "Facility" shall mean any real or personal property, within or without the basin, and improvements thereof or thereon, and any and all rights of way, water, water rights, plants, structures, machinery and equipment, acquired, constructed, operated or maintained by or on behalf of the commission for the beneficial use of *water resources or related land uses* including without limiting the generality of the foregoing any *and all things and appurtenances necessary, useful or convenient for the control, collection, storage, treatment, transmission, distribution, sale or exchange of water,* or for navigation thereon, or the development and use of hydro-electrical energy or public recreational facilities, the propagation of fish and wildlife, *or to conserve and protect the water resources of the basin or any existing or future water supply source,* or to facilitate any other uses of any of them[.][51]

At this stage of the drafting process, "facilities" were limited to "structures, machinery and equipment, acquired, constructed, operated or maintained *by or on behalf of the commission,"* but, as this report discusses in a later section, that limitation was subsequently removed.

Section 1.2(g) of Draft A defined "Project" expansively to encompass "facilities" and more:

> "Project" shall mean any work, service or activity which is separately planned, financed or identified by the commission, or any separate *facility* undertaken or to be undertaken within a specified area, for the control or development of water resources, or of water and related resources, which can be established and utilized independently, or as an addition to an existing facility, and can be considered as a separate entity for purposes of evaluation[.][52]

The definitions of "Facility" and "Project" in Draft A contained the terms "water resources or related land uses" and "water and related resources," respectively. In Section 1.2(i),

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[51] Section 1.2(e), "Delaware River Basin Advisory Committee, Proposed Federal-State Compact," Nov. 23, 1959 ("Draft A"), 12-17-18 Production – Pennsylvania – Temple University Special Collections, Delaware River Basin Commission, West Trenton, New Jersey.

[52] Section 1.2(g), "Delaware River Basin Advisory Committee, Proposed Federal-State Compact," Nov. 23, 1959 ("Draft A"), 12-17-18 Production – Pennsylvania – Temple University Special Collections, Delaware River Basin Commission, West Trenton, New Jersey.

the drafters underscored that they conceived of "water resources" broadly by defining the term to include uses of land as those might relate to water resources:

> "Water resources" shall include water and related natural resources in, on or above the ground, including related uses of land, which are subject to beneficial use, ownership or control.[53]

Section 1.3(c), "Findings," now recognized the interdependency of all water uses in the Basin, including those of private enterprise:

> The water resources of the Basin are functionally inter-related, and the uses of these resources are interdependent. A single administrative agency is therefore essential for effective and economical direction, supervision and coordination of efforts and programs of federal, state and local governments, *and of private enterprise*, and for the planning, conservation, development, management and control of the water and related resources of the Basin. [Emphasis added.][54]

C. Draft A's Article 3 Powers and Duties – Development and Administration of a Comprehensive Plan

In addition to giving the Comprehensive Plan more prominence in the Preamble, Draft A elaborated and expanded on the Commission's powers and duties related to the comprehensive plan in important ways. First, the duty to "[d]evelop and effectuate a comprehensive plan . . . " as set forth in Section 3.1(a) of the initial draft was expanded through the incorporation by reference of a new Article 13 at new Section 3.2, "Comprehensive Plan, Program and Budgets," to include the duty to "from time to time review and revise" the plan. Section 13.1 provided among other things that "[t]he plan shall include all public *and private* projects and facilities which are required, in the judgment of the commission, for the optimum development, use,

[53] Section 1.2(i), "Delaware River Basin Advisory Committee, Proposed Federal-State Compact," Nov. 23, 1959 ("Draft A"), 12-17-18 Production – Pennsylvania – Temple University Special Collections, Delaware River Basin Commission, West Trenton, New Jersey.

[54] Section 1.3(c), "Delaware River Basin Advisory Committee, Proposed Federal-State Compact," Nov. 23, 1959 ("Draft A"), 12-17-18 Production – Pennsylvania – Temple University Special Collections, Delaware River Basin Commission, West Trenton, New Jersey.

conservation, management and control of the water resources of the basin, to meet present and future needs." (Emphasis added.)[55]

Importantly for the current dispute, Section 3.1(c) of the initial draft, establishing the Commission's authority to review "any projects of the signatory states which it deems to have a substantial effect on the main stem or tributaries, . . . " was replaced in Draft A by a new Section 3.5 that expanded this authority and linked it explicitly to protection of the comprehensive plan the agency was charged with developing and implementing. The new section read:

> 3.5 Referral and Review. No project having a substantial effect *on the water resources of the basin* shall hereafter be undertaken *by any person, corporation or governmental authority* unless it shall have first been submitted to and approved by the commission. The commission shall approve each project which it finds and determines to be consistent with the comprehensive plan, and may modify and approve as modified, or may disapprove any such project which is inconsistent with such plan. The commission shall provide by regulation for the submission, review and approval of projects pursuant to this section. Any determination of the commission hereunder shall be subject to judicial review in any court of competent jurisdiction.[56] [Emphasis added.]

In expanding the Commission's review authority to *any project* having a substantial effect on the Basin's *water resources* as the terms "Project" and "Water Resources" were now broadly defined, the drafters recognized that such power was needed to enable the Commission to carry out its duty, set forth at Section 3.1 "Purpose and Policy" of Draft A, to "integrate and coordinate water conservation, use and management under uniform policies for the basin."[57]

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[55] Article 3, Section 3.2(a) and Article 13, Section 13.1, "Delaware River Basin Advisory Committee, Proposed Federal-State Compact," Nov. 23, 1959 ("Draft A"), 12-17-18 Production – Pennsylvania – Temple University Special Collections, Delaware River Basin Commission, West Trenton, New Jersey.

[56] Article 3, Section 3.5, "Delaware River Basin Advisory Committee, Proposed Federal-State Compact," Nov. 23, 1959 ("Draft A"), 12-17-18 Production – Pennsylvania – Temple University Special Collections, Delaware River Basin Commission, West Trenton, New Jersey.

[57] Article 3, Section 3.1, "Delaware River Basin Advisory Committee, Proposed Federal-State Compact," Nov. 23, 1959 ("Draft A"), 12-17-18 Production – Pennsylvania – Temple University Special Collections, Delaware River Basin Commission, West Trenton, New Jersey.

According to the minutes of the November 23, 1959, DRBAC meeting at which Draft A was discussed,

> What he [Miller] had drafted was mid-way between a Statute and a Constitution. It was similar to a Constitution. It was similar to a charter – in this case for the type of organization proposed. He wished to be careful not to throttle the freedom of the organization in those periods beyond the present. His main problem was what to omit from the writing. He had sought to produce a "happy compromise." He recognized that new ground was being broken here and that new questions must arise for solution. He had tried to produce a very flexible arrangement.[58]

D. Proposed Commission's Authority in Draft A Broadly Endorsed, Including by Pennsylvania Officials

The DRBAC chair, John P. Robin, Pennsylvania Governor George Leader's appointed representative on the DRBAC (who continued in his role during Governor David Lawrence's administration) endorsed the powers outlined in Draft A of the proposed compact, as did his DRBAC colleagues.[59]

Other Pennsylvania officials were equally supportive. According to the notes of a meeting that took place on December 21, 1959, covering various aspects of Draft A, Pennsylvania officials including representatives from the Commonwealth's Departments of Health and Agriculture concurred with the general principle that the proposed Commission ought to have broad authority to govern Delaware Basin water resources. The notes of that meeting observed:

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[58] Record of the Meeting of the Delaware River Basin Advisory Committee, Nov. 23, 1959, copy in Feb. 19, 2019, Production, Delaware River Basin Commission, West Trenton, New Jersey. See also *Before Committee on Forests and Waters, Game and Fish Senate of Pennsylvania Public Hearing on Senate Bill No. 350, April 5, 1961,* p. 100, 12-17-18 Production – DRBC – V5, Delaware River Basin Commission, West Trenton, New Jersey, at which William Miller stated, "We have in mind that we are dealing with a matter analogous to a constitution, and that is why some of the matters are stated *in such broad general terms so as to minimize the need for amendments*, but it could be amended at any time the parties agree." (Emphasis added.)

[59] Minutes, Meeting of the Delaware River Basin Advisory Committee, November 23, 1959, p. 2, Delaware River Basin Commission, West Trenton, New Jersey.

> More significant than the [suggested] changes in the draft was the attitude of the [Pennsylvania] state government officials whom [Maurice K.] Goddard [Secretary of Pennsylvania's Department Forests and Waters] brought to the meeting. *There seemed to be complete acceptance of the basic principles of the compact.* Not even the [Pennsylvania] Health Department resisted delegation of powers and functions to the [proposed compact] Basin Agency. [Emphasis added.][60]

The record shows that other officials of the Commonwealth concurred in this view. D. Richard Wenner, Deputy Secretary of Pennsylvania's Department of Agriculture, commented in a letter to Secretary Goddard on February 2, 1960 as follows:

> In general, our conclusion is that, although the powers granted this commission are strong, *broad powers are needed to carry out the program in the Delaware Basin.* Especially important are the powers given to coordinate the activities of the many agencies of the several levels of government. Although there are no direct, democratic controls, the power of removal of commissioners, the proper use of the "Intergovernmental Advisory Committee" and the public hearings as amplified in our comment above should give a fair opportunity for public scrutiny and participation.[61]

V. "DRAFT B" OF PROPOSED COMPACT, FEBRUARY 10, 1960

By early February 1960, suggestions offered by multiple parties resulted in a new compact version, so-called "Draft B." This draft, a copy of which is held by Special Collections at Temple University in Philadelphia, initially took the form of hand-written annotations on the typed version of Draft A, that were later incorporated into a fully typed draft. (A hand-written "B" on the cover page and the new date of February 10, 1960, makes clear this was to be considered a new draft.)

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[60] Memo to files from WMP (Walter M. Phillips, DRBAC representative for Philadelphia) re: Meeting in Harrisburg with Secretary Goddard and His Group on Dec. 21, 1959, 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

[61] D. Richard Wenner to Maurice K. Goddard, Feb. 2, 1960, 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

Much of Draft B remained the same as Draft A, thus demonstrating wide concurrence about powers and authorities proposed for the interstate accord. Nevertheless, there were a few changes that significantly fortified the Commission's authority. Importantly, the definition of "facility" at Section 1.2(e) was significantly expanded by elimination of the phrase "by or on behalf of the Commission." The complete definition, with the mark-up, is shown below:

> "Facility" shall mean any real or personal property, within or without the basin, and improvements thereof or thereon, and any and all rights of way, water, water rights, plants, structures, machinery and equipment, acquired, instructed, operated or maintained ~~**by or on behalf of the commission**~~ for the beneficial use of water resources or related land uses including without limiting the generality of the foregoing to any and all things and appurtenances necessary, useful or convenient for the control, collection, storage, treatment, transmission, distribution, sale or exchange of water, or for navigation thereon, or the development and use of hydro-electrical energy or public recreational facilities, the propagation of fish and wildlife, or to conserve and protect the water resources of the basin or any existing or future water supply source, or to facilitate any other uses of any of them[.][62]

While the definition of "Facility" was broadened, the already expansive definition of "Project" at Section 1.2(g), incorporating the term "facility," continued to read as follows:

> "Project" shall mean any work, service or activity which is separately planned, financed or identified by the commission, or any separate facility undertaken or to be undertaken within a specified area, for the control or development of water resources, or of water and related resources, which can be established and utilized independently, or as an addition to an existing facility, and can be considered as a separate entity for purposes of evaluation[.][63]

The broad definition of "water resources" at Section 1.2(i) also remained unchanged, and Section 3.5, "Referral and Review" was not modified in any material way.[64] The combined

[62] Section 1.2(e), "Delaware River Basin Advisory Committee, Proposed Federal-State Compact," Feb. 10, 1960 ("Draft B"), 12-17-18 Production – Pennsylvania – Temple University Special Collections, Delaware River Basin Commission, West Trenton, New Jersey.

[63] Section 1.2(g), "Delaware River Basin Advisory Committee, Proposed Federal-State Compact," Feb. 10, 1960 ("Draft B"), 12-17-18 Production – Pennsylvania – Temple University Special Collections, Delaware River Basin Commission, West Trenton, New Jersey.

[64] Three immaterial changes that appeared in Draft B of Section 3.5 and were later removed are not shown. In the second sentence, the words "and the water resources program" were added after the term "comprehensive plan" and the words "or program" were added at the end of that sentence. Both phrases were removed in Draft C.

effect of the changes to "facility" and "water resources" was to substantially expand the project review authority established by Section 3.5. Now, regardless of whether a facility was constructed by the Commission or another public or private entity, "any separate facility undertaken or to be undertaken . . . for the control or development of water resources, . . . which can be considered as a separate entity for evaluation," would be among those projects subject to review by the Commission if such facility might have a substantial effect on water resources of the Basin.

In view of the broad definition of "water resources" added in Draft A, the drafters modified paragraph (c) of Section 1.3, "Findings," by amending the phrase "water and related resources" to read simply "water resources." Section 1.3(c), which had been introduced in Draft A to recognize the interdependency of all water uses in the Basin, was further modified in Draft B by the insertion of the word "utilization" to make the language broader.[65] Thus, Section 1.3(c) (using bold for additions and strikethrough for deletions) now read:

> The water resources of the Basin are functionally inter-related, and the uses of these resources are interdependent. A single administrative agency is therefore essential for effective and economical direction, supervision and coordination of efforts and programs of federal, state and local governments, and of private enterprise, and for the planning, conservation, **utilization,** development, management and control of the water ~~and related~~ resources of the Basin.

In the last sentence, the phrase "as to its reasonableness" was inserted immediately after "judicial review." Although this phrase carried forward to Draft D, it was dropped in the final draft.

[65] The changes to Section 1.3(c) and 13.1 may be traced to the letter dated February 2, 1960, from D. Richard Wenner, Acting Deputy Secretary of the Pennsylvania Department of Agriculture, to Maurice K. Goddard, Secretary of the Pennsylvania Department of Forests and Waters, in which Wenner stated that the resulting "descriptive phrase of functions [as] suggested in our first comment above [relating to a then-proposed short title of the compact legislation], strikes us as the best and most comprehensive of all the variants found throughout the draft. We would suggest its use here in par. (c) and other points to be noted. The words 'and related land' can be eliminated from this paragraph since the definition of water resources includes this." D. Richard Wenner to Maurice K. Goddard, Feb. 2, 1960, p.1. 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

Notably, the description of the Comprehensive Plan set forth at Section 13.1, which is incorporated by reference in the enumeration of the Commission's powers set forth at Section 3.2(a), was likewise modified by the addition of the term "utilization." The changes to Section 13.1 are shown in bold and strikethrough as follows:

> … The plan shall include all public and private projects and facilities which are required, in the judgment of the commission, for the optimum **planning, conservation, utilization,** development, ~~use, conservation,~~ management and control of the water and related resources of the basin, to meet present and future needs. . . .

A. Comments on Draft B

1. DRBAC Response

The DRBAC held a meeting on March 2, 1960, at which Draft B was discussed. Those attending proposed no substantive changes to the powers of the Commission except to eliminate the agency's authority over navigation in the Delaware River Basin's lower tidal estuary – a power that was exclusively exercised by Congress under its Constitutional authority to regulate interstate commerce.[66]

In a memo dated March 17, 1960, DRBAC staff member W. Brinton Whitall, who helped shape the draft compact as a member of the DRBAC staff, discussed issues pertaining to New York City's water supplies. Although focused on addressing some of the City's concerns, Whitall's memo articulates the view that a Commission with unified authority to administer the Basin's water resources would benefit each of the signatory states:

> Less tangible but no less important, are the benefits that will flow to each of the states from the unified management of the Basin's water resources. The locus of responsibility and decision making (at least on all important matters) will be centralized, rather than scattered among numerous independent jurisdictions and agencies. Projects and plans for downstream areas that might affect New York

[66] Minutes of the Delaware River Basin Advisory Committee, 1956-1962, March 2, 1960, Delaware River Basin Commission, West Trenton, New Jersey; Whitall's Notes on Discussion at Advisory Committee Meeting at Princeton Inn on March 2, 1960, ibid.

> will be known well in advance as a result of *continuous* planning, instead of being subject to the uncertainties that stem from "one-shot" surveys. Each of the four states will know well in advance what the other states and the Federal government will, and will not, do in the future. And each jurisdiction will share in *all* determinations of what is to be done, and how. [Emphases in original.][67]

2. Pennsylvania's Comments on "Draft B," March 28, 1960

On April 14, 1960, Pennsylvania Deputy Attorney General Lois G. Forer wrote to attorney William Miller regarding the typed version of Draft B dated March 28, 1960, and on April 28, 1960, a copy of her letter was forwarded to the DRBAC's Executive Secretary Walter Phillips. Forer queried whether the drafters had left out language that might have regulated facilities owned by public bodies or utilities. With regard to "Section 15 [*sic* – she meant *page* 15], Section 3.8(e)," she wrote, "Is the commission intentionally excluded from controlling and regulating facilities in the basin owned by other public bodies or utilities?" Phillips, apparently referring to then-Section 3.5 "Referral and Review," wrote in the margin "No. See referral power."[68]

Forer also asked, "Do you or do you not mean to give the commission authority to supersede a state agency in the control of pollution where that agency either fails to act or does not have sufficient authority to do so?" Here, Phillips wrote in the margin "Do."[69] Indeed, that the drafters intended for the Commission to have wide authority and discretion to address issues of wastewater and pollution, regardless of whether a particular state was exercising its own authority, is confirmed by notes of Walter Phillips dated January 15, 1960, on his meeting in Harrisburg the previous month "With Secretary Goddard and his Group." Phillips wrote:

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[67] WBW memo, Benefits to New York from Current Delaware Basin Proposals, March 17, 1960, 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

[68] Lois G. Forer letter to Miller, April 14, 1960 (enclosed with a copy of a letter from Walter Phillips dated April 28, 1960), 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

[69] Ibid.

> Lyons [identified in the list of attendees as "Walter Lyons – Health Department"] inquired whether the draft requires the Basin Agency to first invoke state law before setting its own standards and itself bringing enforcement. To this Miller replied, "No." He would not want to spell out such a procedure, as the best course of action would largely depend on the particular case, the particular waters affected, etc.

VI. DRAFT C OF PROPOSED COMPACT – THE CONSENSUS VERSION

Dated May 1960, Draft C of the proposed compact took the form of a hand-annotated version of typed Draft B.

A. Section 1.2(g), Definition of "Project"

In Draft C, the definition of the term "Project" was modified to track the description of the compact's scope that Pennsylvania cabinet-level reviewers of Draft B deemed the "most comprehensive of all the variants found throughout the draft."[70] With additions to the Draft B version shown in bold and just one minor deletion (for grammatical purposes) in strikethrough, Draft C read:

> (g) "Project" shall mean any work, service or activity which is separately planned, financed or identified by the commission, or any separate facility undertaken or to be undertaken within a specific area, for **the conservation, utilization,** ~~or~~ control, development **or management** of water resources, or of water and related resources, which can be established and utilized independently or as an addition to an existing facility, and can be considered as a separate entity for purposes of evaluation[.][71]

The phrase "or of water and related resources," was retained in this version, even though it became superfluous after the definition of the term "Water Resources" was added in Draft A. The phrase was ultimately deleted.

[70] Letter from D. Richard Wenner to Maurice K. Goddard, Feb. 2, 1960, p.1. 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

[71] Section 1.2 (g), Draft C (hand-annotated version of Draft B), "Delaware River Basin Advisory Committee, Proposed Federal-State Compact," Feb. 10, 1960, 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

No changes to the definitions of "Facility" and "Water Resources" or to Section 3.2, "Comprehensive Plan, Program and Budgets," were made in Draft C. The changes to Section 13.1, "Comprehensive Plan" consisted in relevant part of a change providing that before the adoption of a comprehensive plan or any revision to such plan, the commission must "consider and give due regard to the findings and recommendations of the ~~planning~~ **various** agencies of the signatory parties and their political subdivisions."[72] This change had the effect of expanding the input from agencies of the signatory parties and their political subdivisions beyond those agencies charged with "planning."

An earlier draft had expanded the scope of the Commission's project review authority in Section 3.5 to cover projects "by any person, corporation or governmental authority" that might have "a substantial effect on the [broadly defined] water resources of the basin." These changes were retained. New changes to this section clarified that the purpose of Section 3.5 was to avoid impairment or conflict with the comprehensive plan and resulted in the text of Section 3.5 as adopted in the final Compact. With the revisions to Draft B shown in bold for additions and strikethrough for deletions,[73] the Draft C version read as follows:

> 3.5 <u>Referral and Review.</u> No project having a substantial effect on the water resources of the basin shall hereafter be undertaken by any person, corporation or governmental authority unless it shall have been first submitted to and approved by the commission. The commission shall approve ~~each~~ **a** project ~~which~~ **whenever** it finds and determines **that such project would not substantially impair or conflict** ~~to be consistent~~ with the comprehensive plan and may modify and approve as modified, or may disapprove any such project **whenever it finds and determines that the project would substantially impair or conflict** ~~which is inconsistent~~ with such plan. The commission shall provide by regulation for the **procedures of** submission, review and ~~approval~~ **consideration** of projects, **and for its determinations** pursuant to this section. Any determination of the

[72] Ibid.

[73] Two immaterial changes that had appeared in Draft B of Section 3.5 and were removed in Draft C are not shown. In the second sentence, the words "and the water resources program" had been added after the term "comprehensive plan" and the words "or program" had been added at the end of that sentence. Both phrases were removed in Draft C.

commission hereunder shall be subject to judicial review in any court of competent jurisdiction.

B. Comments on Draft C by Pennsylvania

Like earlier versions of the proposed compact, Draft C was scrutinized by reviewers, including Pennsylvania Deputy Attorney General Lois G. Forer. Referencing Section 7.4 of Draft C, "Participation in Federal Programs," which provided that the Commission could "qualify as a sponsoring agency under federal legislation . . . to provide financial and other assistance for watershed protection or flood prevention," she asked Walter Phillips, "Why limit commission participation to watershed protection or flood prevention? I suggest that the words 'or other water-related programs' be added."[74]

VII. DRAFT D OF PROPOSED COMPACT, FINAL DRAFT, AND ENACTED COMPACT

The sections of the Compact that are most relevant to the meanings of "Project," "Facility," and "Water Resources" were almost completely resolved by the drafters prior to the creation of Draft D, dated August 12, 1960, and a "Final Draft" dated December 16, 1960. In Draft D, the Final Draft and enacted compact, the definitions, findings, referral and review provision and comprehensive plan sections tracked throughout this report remained largely as they appeared in Draft C. However, paragraphs of Section 3.3, "General Powers," were modified and re-sequenced, as described below, to clarify the Commission's authority with respect to the projects and facilities undertaken by entities other than itself.

[74] Lois G. Forer to Walter M. Phillips, June 9, 1960, 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

A. Revisions to Definitions in Draft D and Final Draft

The definition of "Project" was finally modified in Draft D by elimination of the phrase "or of water and related resources," which had been rendered superfluous by the inclusion of a broad definition of "Water Resources" in Draft A.[75] With the exception of a comma (shown in brackets below), which was removed in the Final Draft, the definition of "Project" in Draft D read as it does in the final compact legislation:

> "Project" shall mean any work, service or activity which is separately planned, financed, or identified by the commission, or any separate facility undertaken or to be undertaken within a specified area, for the conservation, utilization, control, development or management of water resources[,] which can be established and utilized independently or as an addition to an existing facility, and can be considered as a separate entity for purposes of evaluation[.]

B. Changes to "General Powers" in Draft D, Final Draft, and Enacted Compact

Paragraph 3.3(a) of Draft C empowered the Commission to adopt plans and specifications for "particular water projects and programs" and, so far as consistent with the comprehensive plan, to incorporate any separate plans of other public and private organizations.[76] Draft D modified this provision to focus on "particular water resource projects and facilities."[77] By changing "water projects" to "water resource projects" and "programs" to "facilities," the drafters expanded the authority the Commission would have to ensure that the plans of public or private entities to utilize the water resources of the Basin were consistent with

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[75] It is noted that a similar change was never made to the definition of "Facility," which in the final compact legislation contains the phrase, "of water resources or related land uses."

[76] Section 3.3(a), Draft C (hand-annotated version of Draft B), "Delaware River Basin Advisory Committee, Proposed Federal-State Compact," Feb. 10, 1960, 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

[77] Section 3.3(a), "Proposed Federal-State Compact, Delaware River Basin Advisory Committee, Draft D, August 12, 1960," 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

the comprehensive plan. This provision ultimately became section 3.9(c) of the Compact as adopted.[78]

In contrast, section 3.3 of Draft D, as in previous drafts, continued to afford the Commission only the power to establish standards of planning, design, and operation of "structures and programs in the basin which affect its water resources."[79] This language, however, was modified in the final draft of the Compact by changing "structures and programs" to "projects and facilities." Once again, this change illustrated the drafters' intent to expand the Commission's authority to all projects and facilities, not merely structures and programs, affecting the water resources of the Basin. This provision became paragraph 3.6(b) of the Compact as adopted.[80]

Importantly, these provisions are distinct from those that authorize the Commission to undertake its own projects. For example, in earlier drafts, what became paragraph 3.3(e) of Draft C authorized the Commission to "plan, design, acquire, construct, . . . operate and maintain any and all facilities for the purposes of this compact, including all properties, activities and services determined by the commission to be necessary, convenient or useful."[81] Draft C added "projects" to the list of authorized Commission activities, and this provision became paragraph 3.6(a) of the Compact as adopted.[82] In this manner, the Commission was limited to undertaking

[78] Section 3.9(c), *Delaware River Basin Compact*, 75 Stat. 688 (1961).

[79] Section 3.3, "Proposed Federal-State Compact, Delaware River Basin Advisory Committee, Draft D, August 12, 1960," 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

[80] Section 3.6(b), *Delaware River Basin Compact*, 75 Stat. 688 (1961).

[81] Section 3.8(b), "Delaware River Basin Advisory Committee, Proposed Federal-State Compact," Feb. 10, 1960 ("Draft B"), 12-17-18 Production – Pennsylvania – Temple University Special Collections, Delaware River Basin Commission, West Trenton, New Jersey.

[82] Section 3.6(a), *Delaware River Basin Compact*, 75 Stat. 688 (1961); Section 3.3(e), Draft C (hand-annotated version of Draft B), "Delaware River Basin Advisory Committee, Proposed Federal-State Compact," Feb. 10, 1960, 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

projects "for the purposes of this compact," while the projects of other entities over which it could establish standards included all of those "which affect its water resources."[83]

C. Comments on Draft D Support Commission Authority

Various individuals offered their opinions about Draft D after its distribution on or around August 12, 1960. In general, these comments aimed at further buttressing the powers invested in the Commission.

Comments by Alan Sommerville, Chief Water Resources Development Engineer for the Pennsylvania Department of Forests and Waters, transmitted by Walter Phillips to William Miller on September 19, 1960, suggested eliminating the use of the word "land" from the definition of "Facilities" on grounds that the term might be construed as limiting the Commission's authority, presumably to land uses *to the exclusion of* water resources. Referring to Section 3.4 "Ground Waters" of Draft D, Sommerville also queried, "Why was the jurisdiction of the commission over the use, conservation, development and control of ground water deleted from this section? Unless some measure of control, etc., over the ground waters of the basin exists, any plan formulated cannot be truly comprehensive."[84] It is unclear why Sommerville thought Section 3.4 of Draft D, which read, "The jurisdiction of the commission shall include the use, conservation, development and control of ground water within the basin,"[85] had been removed. Retained in Draft D, the Section was removed only from the "Final Draft," likely

[83] Notably, the Compact confers the power to establish standards of planning design and operation regardless of whether the effect of a single project on water resources is "substantial."

[84] Walter M. Phillips to William Miller, Sept. 20, 1960 (with enclosure), 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

[85] Section 3.4, "Proposed Federal-State Compact, Delaware River Basin Advisory Committee, Draft D, August 12, 1960," 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

because groundwater was clearly included in the definition of "Water Resources" provided in Article 1.

Multiple other suggestions from a variety of sources – nearly all of which pertained to either strengthening the compact or simply clarifying wording – took place over the next couple of months.[86]

VIII. CONTEMPORANEOUS UNDERSTANDINGS BY THE EARLY 1960S

As the final version of what would become the Delaware River Basin Compact was being considered over the next few months, contemporaneous understandings of what the agreement accomplished could be seen in multiple documents created at that time. There are many such records; these are just a few representative examples.

Roscoe C. Martin, who had overseen the Syracuse University study that provided the underlying principles of the Compact, noted in his book, *River Basin Administration and the Delaware* (published in 1960 around the time the Compact was nearing completion), that no previous states' attempts at compact formation had been successful at reaching an interstate agreement as sweeping in scope as the Delaware River Basin Compact. Unlike many previous river compact proposals, Martin observed, the Delaware agreement involved creating a new type of agency that would oversee the development of a multi-use far-reaching Basin plan – an organization empowered to decide which projects were consistent with its overall program. Martin described how unique the Delaware River Basin Commission would be:

[86] See, for example, Minutes of the Delaware River Basin Advisory Committee, 1956-1962, Oct. 17-18, 1960, Delaware River Basin Commission, West Trenton, New Jersey; Minutes of the Delaware River Basin Advisory Committee, 1956-1962, Nov. 14, 1960, ibid.; Minutes of the Delaware River Basin Advisory Committee, 1956-1962, Dec. 9, 1960, ibid.; Staff Discussion at October 17-18, 1960, meeting of Delaware River Basin Advisory Committee, contained in Minutes of the Delaware River Basin Advisory Committee, 1956-1962, Oct. 17-18, 1960, ibid.; Staff Summary of Discussion at November 14, 1960, Meeting of Delaware River Basin Advisory Committee, Nov. 21, 1960; ibid.

> The central fact about creation of a core agency for [Delaware] river basin development by interstate compact is that the utility of the compact for this [wide-ranging Basin administrative] purpose remains speculative, for there is no instance of its employment to plan comprehensive water development or to set up a multiple-purpose agency for water."[87]

At a meeting with officials of the Department of Interior in April of 1961, William Miller emphasized the utility of "one agency dealing with reference to one plan," within which "all can operate," because "nature is not particularly interested in the division of subject matter or jurisdiction." Miller later noted, "There are no new powers in this Compact," because, as he explained, it amounts to "an organization of powers bringing to bear all the various Federal agencies operating within the basin, the various departments of the states operating within the basin and any private interests that may be there, so they will have one guide; namely – and this is the test, and you will find it in the Compact set forth in full – that everybody conforms to a 'comprehensive plan.'"[88]

Another individual with direct knowledge of the Compact's background and meaning was Walter Phillips of the DRBAC, who, as noted previously in this report, had helped draft the accord's provisions. In August 1960 – around the time that negotiators were placing the final touches on the proposed agreement, the *Journal of American Institute of Planners* printed an article by Phillips that described the sweeping powers that would be given to the new agency:

> The governmental goal proposed by [the 1959] Syracuse [University report] calls for a small commission of five members, one appointed by each of the four governors and one appointed by the President of the United States. This commission would be a basin agency and have bestowed upon it all of the powers relating to water which are now the province of their respective governments. This means that the new agency would have administrative powers relating to flood control and navigation, which are two of the principal federal functions, and

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[87] Roscoe C. Martin, et al., *River Basin Administration and the Delaware* (Syracuse, N.Y.: Syracuse University Press, 1960), pp. 133-134.

[88] Vol. 1 Official Report of Proceedings Before the Department of the Interior in the Matter of Delaware River Compact Meeting, April 13, 1961, p. 38-39, 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

> it would have jurisdiction over water-quality control and water supply, now two very important activities of the state and local governments. The development of hydropower, which presently can be an activity of either federal or state government, would also be given to the commission, without any restrictions as to how the power should be marketed.[89]

Phillips's statement that the Commission would have "all of the powers relating to water" of the Basin states and federal government evidences the Compact drafters' intent to grant the Commission the full powers of each of the Compact parties over water resources in its geographic area of the Basin. By sharing and jointly exercising their sovereign powers through the Commission, the Basin states and federal government would manage water resources on a uniform basis throughout the Basin without regard to political boundaries.

An important area in which federal, state and local governments were exercising their separate authorities was pollution control. Because the main stem and certain tributaries of the Delaware River are waters shared by multiple states, pollution control was an important area for the Commission to establish uniform policies and employ its various authorities to improve water quality throughout the Basin. In February 1961, shortly after Phillips's article had been published, the Water Resources Association of the Delaware River Basin issued a *Special Bulletin* (a copy of which is available in Special Collections at Temple University in Philadelphia). The *Special Bulletin*, published as the Compact was being submitted to the States and the federal government for ratification, summarized for its readership the Compact's provisions, including that "[t]he heart of the proposed new [Delaware River Basin] agency lies in Section 3.8 [Referral and Review]." In addition, with regard to one aspect of the Compact's oversight – pollution control – the *Special Bulletin* explained:

> Generally, the commission is given the power to "undertake investigations and surveys, and acquire, construct, operate and maintain projects and facilities to

[89] Walter M. Phillips, "Water Resources: The Delaware Basin," *The Journal of American Institute of Planners* 26 (Aug. 1960), p. 214.

> control potential pollution and abate or dilute existing pollution of the water resources of the basin." It may also "invoke as complainant the power and jurisdiction of water pollution agencies of the signatory states." More specifically, *the "commission may assume jurisdiction to control future pollution and abate existing pollution in the waters of the basin,* whenever it determines after investigation and public hearing upon due notice that the effectuation of the comprehensive plan so requires. *The standard of such control shall be that pollution by sewage or industrial or other waste originating within a signatory state shall not injuriously affect waters of the basin as contemplated by the comprehensive plan. . . .*" [Emphases added.][90]

As the final version of the compact was being considered, the general public also was being kept informed about the proposed interstate agreement. The *Delaware County Daily Times* (published in Chester, Pennsylvania) notified its readers on February 1, 1961, that the Governors of the four basin states had gathered in Philadelphia to consider the accord, and the *Times* observed that the Governors "were expected to give quick approval to the compact[.]" The newspaper also explained to its readers that "[b]etter flood control, improvement of water quality, and development of water supplies for all purposes are among the objectives."[91]

Three days later – after the Governors had approved the Compact – the Wilmington, Delaware, *News-Journal* reported on that action to its readers. The *News-Journal* further explained the Compact's purpose. Observing that the accord would address concerns over water supply and pollution, the paper stated:

> Moreover, water supply and pollution aren't the only vital considerations that make good partnership the goal [of the Compact]. There is modern science – natural and political – called watershed management, which coordinates and develops such things as soil conservation and fish and wildlife habitat. The compact recognizes, also, man's use of streams and bodies of water in sports and recreation. A "Delaware River Basin Commission" could set standards, and approve or disapprove local plans. . . . In brief, what this very carefully drafted treaty does is to extend the same kind of yardsticks and standards to all water resources that the U.S. Corps of Engineers exercises over navigation in the river and bay. . . . The whole thing makes sense. It deserves prompt consideration and,

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[90] Water Resources Association of the Delaware River Basin, "Special Bulletin," Feb. 1961, 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

[91] "River Basin Plans Gain Support," *Delaware County Daily Times* (Chester, Pennsylvania), Feb. 1, 1960.

> we believe, enactment by the four states and Congress. Certainly no better concept is likely to come along before the confusion of today becomes the chaos of tomorrow.[92]

With the four Governors backing the Compact, other officials from the four states lobbied Congress for approval. The *Asbury Park Press* (published in Asbury Park, New Jersey), reported on March 9, 1961, that:

> representatives of New Jersey, New York, Pennsylvania, and Delaware called on the federal government yesterday to approve a plan for comprehensive development of the Delaware River basin. . . . The four states agreed earlier this year to set up the Delaware River basin compact for development of water supplies, pollution control, flood protection, watershed management, recreation, power, and regulation of water diversion in the river basin.[93]

The *Press* also explained to its readers that Congressman Francis E. Walter from Pennsylvania had sponsored a resolution in the U.S. House of Representatives "to have the federal government take a hand in the compact, . . . [and Walter] called the proposed compact 'the single most important water resources development in the history of the Delaware River basin.'"[94]

Two weeks later, William Miller, who as noted previously had been a principal drafter of the compact, testified before a committee of the Pennsylvania Legislature regarding the meaning and purpose of the proposed agreement. Miller's March 28, 1961, testimony during hearings on the State's proposed ratification measure is particularly revealing that the Compact was intended to cover all possible water resource issues whether known at the time or that might arise in the future. In his answer to a legislator's series of questions about the effect of the Compact on

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[92] "Big Voice for a Little State," *News-Journal* (Wilmington, Delaware), Feb. 4, 1961.

[93] "4 States Ask U.S. Approval of Basin Plan," *Asbury Park Press* (Asbury Park, New Jersey), March 9, 1961.

[94] Ibid.

private industry, Miller referenced Section 3.8. The colloquy between the two is reprinted below:

> Senator [Leonard C.] Staisey – Mr. Miller, if one of the industries in the Basin decides to expand and has been and is a water user, I assume they would have to submit plans for approval to the Commission.
>
> Mr. Miller – If those plans called for any substantial effect on the resources of the basin. *There is a provision under Section 3.8 of the Compact.*
>
> Senator Staisey – I make reference to that since one of the hopes of the Commission's concept is to induce the expansion of existing industries and *introduction of new industries.*
>
> Mr. Miller – Yes. I think that is a major factor. You have to submit plans but this is also an insurance policy. Everyone else will have to do the same thing. [Emphases added.][95]

The Berks County, Pennsylvania, Planning Commission offered a similar assessment in its July 1961 "Information Bulletin Number 8" (a copy of which is at the Pennsylvania State Archives). The Planning Commission explained to its readership that the proposed Delaware River Basin Compact agency would have extraordinary authority to manage all aspects of water resources in the Basin through the provisions of Sections 1.2(g), defining "Project," and Section 3.8, "Referral and Review":

> The key major power, however, is one of referral and review. This requires that any person, corporation, or governmental authority, *before undertaking any project having a substantial effect on the water resources of the basin*, must refer such plans to the Commission for its approval. The Commission must approve such projects if they do not impair or conflict with the comprehensive plan or may refuse approval; disapproval is, of course, subject to judicial review. [Emphasis added.][96]

[95] Legislative Committee Hearing on Delaware River Basin Compact, March 28, 1961, 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

[96] Berks County, Pennsylvania, Planning Commission, "Information Bulletin Number 8," July 1961, p. 4, 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

IX. LEGISLATIVE HISTORY OF FEDERAL RATIFICATION

Multiple statements during the federal government's ratification process underscored that the new Delaware River Basin Compact was comprehensive and multi-purpose in scope. In fact the very title to the hearings on the U.S. Senate bill to ratify the Compact in 1961 directly declared the Compact's multi-purpose objectives: *Hearing Before a Subcommittee of the Committee on Public Works, United States Senate, Eighty-Seventh Congress, First Session, on S. 856, A Bill to Create a Regional Agency by Intergovernmental Compact for the Planning, Conservation, Utilization, Development, Management, and Control of the Water and Related Natural Resources of the Delaware River Basin for Beneficial Purposes, Defining Its Functions, Etc.*[97]

At those hearings, U.S. Senator Clifford P. Case, whose State of New Jersey was one of the signatories, declared:

> Congress should, I believe, welcome the initiative the States have shown in working out a structure to deal effectively with improvement of navigation, reduction of flood damage, regulation of water quality, control of pollution and development of water supply, hydroelectric energy, fish and wildlife habitat, and public recreation facilities in this great four-State basin area. . . . In the recent past, water problems have arisen to plague millions of residents of the Delaware Valley. During World War II, Philadelphia's water supply was endangered by pollution and its harbor suffered seriously adverse effects. . . . *Only a multi-purpose plan for the development of the Delaware can cope successfully with such diverse problems*. [Emphasis added.][98]

New York City Mayor Robert F. Wagner concurred with Senator Case. Declaring that "[i]t is important to understand that the compact envisages the comprehensive development of the river," he added, "In addition to providing water for people and industry the compact agency

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[97] *Hearing Before a Subcommittee of the Committee on Public Works, United States Senate, Eighty-Seventh Congress, First Session, on S. 856, A Bill to Create a Regional Agency by Intergovernmental Compact for the Planning, Conservation, Utilization, Development, Management, and Control of the Water and Related Natural Resources of the Delaware River Basin for Beneficial Purposes, Defining Its Functions, Etc.* (Washington, D.C.: U.S. Government Printing Office, 1961).

[98] Ibid., p. 23.

would have authority to plan and build for flood control, to supply the needs of irrigation, to create and promote expanded recreational facilities, to control pollution, to conserve natural resources, and to improve the conditions essential to fish and wildlife."[99]

Philadelphians agreed. Speaking for his City at the U.S. Senate hearings, Mayor Richardson Dilworth told the Senate Subcommittee that:

> Our major concern in Philadelphia is that the water of the Delaware arrives at our doors in satisfactory quality. We, of course, are not alone in this desire. Other communities in our metropolitan area and indeed, communities throughout the basin, especially those in areas of suburban expansions, have the same concern. . . . Water quality and quantity must be planned and managed together with the view of guaranteeing good water in adequate amounts at all times, including periods of drought. Other activities also need to be planned in harmony with quality and quantity control. Indeed, no aspect of water resources development is beneficial in and of itself. Only the coordinated whole is truly beneficial to society.[100]

Hearings before a Subcommittee of the House of Representatives' Committee on the Judiciary echoed the statements before the Senate Subcommittee. Pennsylvania Representative Francis E. Walter, the Chairman of the Subcommittee, stated that the "demands on the basin not only for water but for dams, reservoirs, pollution control, flood control, watershed management, soil conservation, erosion control, land reclamation, hydroelectric power, recreational facilities, and a whole host of other functions are mounting rapidly."[101]

Also appearing before the House Subcommittee was a representative of the National Rural Electric Cooperative Association in Opposition to Article 9 of a Proposed Interstate Compact to Govern the Control of the Waters of the Delaware River. This organization, which opposed the Compact, nonetheless acknowledged following discussions at the hearings that

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[99] Ibid., p. 54.
[100] Ibid., p. 65.
[101] *Hearings before Subcommittee No. 1 of the Committee on the Judiciary, House of Representatives, Eighty-seventh Congress, First Session, on H.J. Res. 225, A Bill to Grant the Consent of Congress to the Delaware River Basin Compact and to Enter into Such Compact on Behalf of the United States, and for Related Purposes, March 8, 1961, Serial No. 2* (Washington, D.C.: U.S. Government Printing Office, 1961), p. 24.

included Section 3.8 that the Commission had the authority to regulate all aspects of Basin water resources: "It appears to us, therefore, that save for exceptions not related directly to hydroelectric power development, the *Commission established by the proposed compact is given absolute control over development of the Delaware River Basin*." (Emphasis added.)[102]

X. FEDERAL APPROVAL OF COMPACT FOLLOWS THE STATES

Ultimately, the Delaware River Basin Compact was ratified less than eight months after the final draft was submitted to the four basin states' legislatures and Congress. With the states' ratification laws taking effect between March and July 1961,[103] President John F. Kennedy signed the federal legislation – the last step necessary for the Compact to take effect – on September 25, 1961.[104] Shortly before Kennedy's signature was affixed to the agreement, Secretary of the Interior Stewart L. Udall explained the accord's significance to Congress. Speaking about President Kennedy's approach to river basin management, Udall stated that the Delaware River Basin Compact was consistent with Kennedy's general approach "to the important problem of planning for comprehensive river basin development." Udall continued regarding Senate Bill S. 856 (the proposed ratification measure that Kennedy was about to sign) that while he, Udall, had some reservations about giving the proposed federal-interstate commission such broad powers, the greater importance of settling all issues involving complete basin water resources management overcame his reluctance to support approval.[105]

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[102] Ibid., p. 51.

[103] 53 Delaware Laws, Chapter 71, Approved May 26, 1961; New Jersey Laws of 1961, Chapter 13, Approved May 1, 1961; New York Laws of 1961, Chapter 148, Approved March 17, 1961; Pennsylvania: Acts of 1961, Act No. 268, Approved July 7, 1961.

[104] *Delaware River Basin Compact*, 75 Stat. 688 (1961); Walter M. Phillips, "How We Rescued the Delaware," Sept. 1963, pp. 22-23, Delaware River Basin Commission, West Trenton, New Jersey.

XI. THE FINAL COMPACT

A. "Whereas" Clauses

Without a doubt, the final Delaware River Basin Compact conferred extraordinary authority to the Commission. Its lengthy history, multiple drafts, and input from many concerned parties had demonstrated this intent over the years prior to its ratification. The accord's "whereas" clauses reflected this desire to convey such powers – clauses that were remarkably similar to previous drafts. The water resources of the Basin would be managed in accordance with a comprehensive master plan under the direction of a basin-wide agency. The plan, and the Delaware River Basin Commission's powers to implement it, were to included oversight and approval of flood control; ground and surface water; municipal, industrial and agricultural uses; recreational facilities, fish and game; forestry, soil conservation, and watershed projects; fisheries dependent upon water resources; hydroelectric power; improved navigation; saltwater intrusion; and pollution control. The "whereas" clauses clearly articulated these goals.[106]

B. "Project" as That Term is Used in Sections 1.2(g) and 3.8

Not only did the "Whereas" clauses underscore the Commission's authority, but so too did the long history of the evolution of Sections 1.2(g) and 3.8 as described throughout this report. The term "Project," it was now understood, meant any planned undertaking that might have an impact on water resources of the Basin and thereby impair or conflict with any aspect of the comprehensive plan for the management of all water resources in the entire Basin. This covered private as well as public actions, and all levels of government. Moreover, Section 3.8 empowered the Commission to review, and approve, approve with conditions, or disapprove any

[106] Preamble "Whereas" clauses, *Delaware River Basin Compact*, 75 Stat. 688 (1961).

undertaking having a substantial effect on the water resources of the Basin that may impair or conflict with the comprehensive plan[107] and thereby preclude or place conditions on projects that conflicted with the objectives of full basin water resources planning and management.

XII. POST-RATIFICATION STATEMENTS

A. Participants' Statements

Like pre-ratification statements, those made after the Delaware River Basin Compact's approval confirmed that all planned activities and facilities were covered by the interstate accord. For instance, in January 1963, Walter Phillips prepared a manuscript for possible publication about the formation of the Delaware River Basin Compact. Phillips sent a copy of his article to Roscoe Martin. (A copy of this letter and its enclosure are available at Special Collections of Temple University in Philadelphia.) Phillips asked Martin to review his (Phillips's) understandings of the Compact's provisions, including Phillips's view of the Compact's complete authority over water resources in the Basin – an aspect that made the Compact different from many other interstate compacts. "Made the Comprehensive Plan Enforceable," Phillips wrote. He continued:

> This was accomplished by giving the Commission power to prevent or require the modification of any proposed water use or development which it found inconsistent with the plan. Thus, every new project substantially affecting the waters of the basin must be submitted to the Commission for approval, whether the project is sponsored by a private or public body, whether local, state, or Federal.[108]

James F. Wright, the Executive Director of the newly-formed Delaware River Basin Commission, added his own assessment of the Commission's authority in an address he gave to the Natural Resources and Power Subcommittee of the House of Representatives Committee on

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[107] Section 1.2(g) and Section 3.8, *Delaware River Basin Compact*, 75 Stat. 688 (1961).

[108] Walter M. Phillips to Roscoe C. Martin, Jan. 8, 1963 (with enc.), copy in 12-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

Government Operations on August 9, 1963. Speaking to the Congressmen, Wright made it clear that the Delaware River Basin Commission had been established to make sure its long-range plan for the Basin was comprehensive:

> Aside from its actual water quality branch operation, the Commission has an additional water quality safeguard apparatus within its organization. I refer to the project review branch, also in the planning division, which was established in accordance with section 3.8 of the Compact. Designed to protect the integrity of this Commission's long-range comprehensive plan, this section bestows upon the Commission the authority to insure the harmonious development of water-connected projects proposed by others, private or public, within the purposes of the comprehensive plan.[109]

Wright made the same point in a June 28, 1965, letter to U.S. Senator Edmund G. Muskie for a Congressional hearing on water and air pollution. The Delaware River Basin Compact, according to Wright, gave the Commission sweeping powers to regulate all kinds of water resources in the Basin, including pollution:

> First, the compact charges the Commission specifically with considering all aspects of water resources – pollution, water supply, stream flows, flood control, water-based recreation, fish and game enhancement, and hydropower. No other river basin has a single agency equipped to bring all these interdependent water resources matters under both unified planning and management.
>
> Second, the compact is both State law and Federal law. It confers upon the Commission a range of legal authorities broader than those that could be possessed by either a wholly Federal or wholly non-Federal agency. We believe this sharing of sovereignty represents a realistic adaptation of government to the problems of river basin development, and that it is a logical extension of American federalism.
>
> The comprehensive planning powers of the Commission and signatory agencies, both built into the compact, provide great capability for integrating pollution control measures with those dealing with other resource problems. Water quality is but a single part of the comprehensive resource development picture of this basin. Single-purpose pollution control agencies lack the flexibility – granted to

[109] "Statement of James F. Wright, Executive Director, Delaware River Basin Commission, to the Natural Resources and Power Subcommittee of the U.S. House of Representatives Committee on Government Operations, at Trenton, New Jersey, August 9, 1963," Pennsylvania State Archives, copy in 12-17-18 Production – DRBC – Pennsylvania, Delaware River Basin Commission, West Trenton, New Jersey.

the Commission – for supplementing pollution abatement by means such as flow augmentation.[110]

In a statement before the Senate Subcommittee on Air and Water Pollution the following year, Wright also explained:

> It is by this process of amendment and revision that the Commission establishes standards and priorities; guides the sequence of project development by other agencies; *screens out possible incompatible water uses*; apportions water among regions of the Basin; and thus coordinates the wide range of fast-paced events that affect the water resources of the Basin. [Emphasis added.]

Walter Phillips echoed these post-ratification views. In 1965, he recalled in a report to Penjerdel (an organization, according to its web site, that was "dedicated to informing and educating the business community in the tri-state region by leading and supporting issues and projects affecting the infrastructure, mobility, sustainability and growth") that the Commission had extraordinary authority to oversee a Basin-wide water resources plan:[111]

> This Commission has over-riding powers in that it is charged with making and enforcing a comprehensive plan for water resources development. *No public or private body can take any action which materially effects the water resources of the Basin until such action has been certified as consistent with the plan.* [Emphasis added.][112]

B. Press Statements

The news media helped to disseminate to the public some of the characterizations made by those involved with drafting and enacting the compact. *The Morning Call* of Allentown, Pennsylvania, for example, reported on March 9, 1961, on the testimony offered at the U.S. House Judiciary Subcommittee hearing on the Compact. The newspaper reported that Francis E.

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[110] *Hearings Before a Special Subcommittee on Air and Water Pollution of the Committee on Public Works, United States Senate, Eighty-ninth Congress, First Session, Part 2* (Washington, D.C.: U.S. Government Printing Office, 1965), p. 365, copy in 2-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

[111] http://penjerdel.org/, accessed Sept. 4, 2019.

[112] Walter J. Phillips, "A Future for Penjerdel," New Jersey State Library, copy in 2-17-18 Production – DRBC – 1960, Delaware River Basin Commission, West Trenton, New Jersey.

Walter (a member of the House from a district in Pennsylvania who had introduced the federal Compact legislation) had stated that the Compact "has the wholehearted approval and support of the governors of the four states and the mayors of the cities of Philadelphia and New York." *The Morning Call* continued:

> Walter noted that at present Delaware Basin Water problems "are dealt with by a multiplicity of agencies – federal, state, and [local] – with a confused splintering of responsibilities." "Of course," Walter continued, "the Delaware River respects only its own natural boundaries and not manmade political boundaries. It is only common sense to me that there is a need for a single coordinated agency which can transcend manmade boundary lines and which can coordinate the functions of the federal, state and local governments and give unified answers to river basin problems."[113]

The Morning Call article also noted that Governor David Lawrence of Pennsylvania informed the House subcommittee:

> In pooling our energies and our capabilities with the federal government, we recognize the proper spheres of responsibility for each in solving a common problem . . . the highest aim of good government. The citizen cares not who does the job so long as it gets done and done well. It is our intention in Pennsylvania to see that the job gets done, and in league with others, done well.[114]

Similarly, according to *The Morning Call* article, Philadelphia Solicitor David Berger noted that water quality and water quantity "must be planned and managed together with the view of guaranteeing good water in adequate amounts at all times, including periods of drought."[115]

The Compact's grant of authority to the Commission to exercise the rights of the signatory parties to the Compact was also publicly discussed. In a April 24, 1961, article, *The Morning Call* reported that U.S. Secretary of State Stewart Udall intended to recommend that

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[113] "F.E. Walter and Gov. R.E. Meyner Take Lead," *The Morning Call*, March 9, 1961; "Support Heavy," ibid.

[114] Ibid.

[115] Ibid.

President Kennedy veto the Compact legislation because "the federal government by entering into the compact would be surrendering rights in fields such as navigation and irrigation in which it was given exclusive power by the Constitution. . . ." Yet as discussed above, Udall eventually supported consolidating broad powers in the Commission. According to *The Morning Call* article, Pennsylvania State Senator Wayne Dumont, the sponsor of the Compact legislation in the Pennsylvania Senate, stated "he was advised that the compact has not been held definitely unconstitutional because 'this is a brand new pioneering area' in the law."[116]

Thus, the news media disseminated the understanding that the Commission would be a new form of agency vested with the sovereign powers of federal, state, and local governmental bodies to enable the Basin states and federal government to jointly manage the water resources of the Basin.

The news media also spread the understanding that the proposed agency would manage uses of water resources within the Basin. *The Morning Call* stated in March of 1961 that "the compact is a proposal that a commission be established to govern future use of Delaware River waters."[117] That same language was repeated again a month later by the same newspaper.[118] In May of 1961, another newspaper, *The News-Journal* of Wilmington, Delaware, stated that "the object [of the Compact] is simply the fairest, safest, most beneficial use of the basin's water resources."[119] This language was repeated by this newspaper in an article published after the Compact was passed in September of 1961.[120] Thus, the understanding that the proposed Commission would govern future uses of water resources was not only understood by the

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[116] "Sen. W. Dumont Supports Compact," *The Morning Call*, April 24, 1961.
[117] "Mayor J.T. Gross to Testify," *The Morning Call*, March 27, 1961.
[118] "Sen. W. Dumont Supports Compact," *The Morning Call*, April 24, 1961.
[119] "What's Good for New Jersey" (editorial), *Trenton News-Journal*, May 3, 1961.
[120] "A Water Treaty Ready to Work," *Trenton News-Journal*, Sept. 29, 1961.

drafters, but also the news media and likely many of the people who consumed such news at the time.

XIII. SUMMARY AND CONCLUSION

In short, the lengthy history leading up to the drafting of the Delaware River Basin Compact and in the period after its ratification demonstrated that concerned parties all intended to create a new type of agency – today's Delaware River Compact Commission – that would implement a plan for administering all of the water resources of the entire Basin. The evolution of the Compact itself underscored that desire as did statements during ratification and following the Commission's formation. All of this history clearly demonstrates that the term "Project" as used in the Compact's Sections 1.2(g) and 3.8 meant any planned undertaking by private entities or any level of government that might have a significant effect on water resources of the Delaware River Basin and that might potentially impair or conflict with the Commission's comprehensive plan.

Appendix A: Curriculum Vitae of Douglas R. Littlefield

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Ph.D. American history. University of California, Los Angeles, 1987. Dissertation: "Interstate Water Conflicts, Compromises, and Compacts: The Rio Grande, 1880-1938." Fields: history of California and the American West, water rights history, legal history, environmental history.

M.A. American history. University of Maryland, College Park, 1979. Master's thesis: "A History of the Potomac Company and Its Colonial Predecessors." Fields: business history, colonial history, early republic history, trans-Appalachian West history, British history.

B.A. English literature. Brown University, 1972.

CONSULTING AND EXPERT WITNESS EXPERIENCE:

2017-2018: Research historian and consultant for Nelson & Fraenkel LLP of Los Angeles (attorneys: Stuart R. Fraenkel and Carlos F. Llinás Negret). Provided historical research and court declaration for use in *Esra Sever, et al., v. Ion Aircraft, Inc.*, Case No. 4:18-cv-00584-HSG, United States District Court Northern District of California in Admiralty.

2015-present: Research historian and consultant for the City of Paso Robles (attorneys: Jeffrey Dunn and Eric Garner of Best, Best & Krieger). Provided historical research and documentation regarding surface and groundwater rights in *Steinbeck Vineyards, et al., v. County of San Luis Obispo, et al.*, Case No. 1-14-CV-265039, Santa Clara County, California, Superior Court. Deposed and testified in court.

2014-2016: Research historian and consultant for Quapaw Tribe of Oklahoma (attorneys: Marzulla Law, LLC, Washington, D.C.). Provided historical research, documentation, and expert report in relation to three breach-of-trust cases in the United States Court of Federal Claims, which were brought by the Quapaw Tribe of Oklahoma (the O-Gah-Pah) and its members against the United States of America (*Goodeagle v. United States*, No.

12-43 1L, *Quapaw Tribe of Oklahoma v. United States*, No. 12- 592L, and *Bear v. United States*, 13- 51X). Deposed; cases settled before trial.

2014-Present: Research historian and consultant for clients in San Joaquin River Delta, California (attorney: S. Dean Ruiz of Harris, Perisho & Ruiz, Stockton, California). Provided historical research, documentation, and expert report on riparian and appropriative water rights in San Joaquin River Delta, California, for use in *Modesto Irrigation District v. Heather Robinson Tanaka, State Water Resources Control Board, et al.*, Sacramento County Superior Court, Case No.: 34-2011-00112886. Deposed and testified in court.

2014-Present: Research historian and consultant for Coachella Valley Water District, Palm Desert, California (attorney: Gene Tanaka of Best, Best & Krieger, Walnut Creek, California). Providing historical research, documentation, and expert report on water rights in the Palm Springs, California, area for use in *Agua Caliente Band of Cahuilla Indians v. Coachella Valley Water District*, U.S. District Court, Central District of California, Eastern Division, Case No. ED CV 13-00883, JGB SPX.

2013-2014: Research historian and consultant for Gallo Cattle Company, Merced, California (attorneys: Marshall C Whitney and Ben Nicholson of McCormick, Barstow & Sheppard, Fresno, California). Provided historical research, affidavits, deposition, and testimony regarding the history of the water rights and uses in the vicinity the Merced Irrigation District and the "Livingston Drain" for use in *Gallo Cattle Company v. Lincoln White Crane Hunter, Merced Irrigation District, et al.*, Merced County Superior Court Case No. CV001051.

2008-2010: Research historian and consultant for McAfee & Taft in Tulsa, Oklahoma (attorney Robert Joyce). Provided historical research, written report, depositions, and testimony regarding lead and zinc mining and land use in northeastern Oklahoma for use in *Quapaw Tribe of Oklahoma, et al., v. Blue Tee Corp, et al.*, U.S. District Court for the Northern District of Oklahoma, Civil Action No. 03-CV-486-CVE-PJC.

2007-2015: Research historian and consultant for a consortium of southern California municipalities (counsel: Best, Best & Krieger of Los Angeles). Provided historical research and expert witness testimony regarding declining groundwater levels in *Antelope Valley Groundwater Cases*, Los Angeles County (California) Superior Court, Judicial Counsel Coordination Proceeding No. 4408.

2006-Present: Research historian and consultant for State of Montana. Providing historical research, reports, affidavits, and testimony in *Montana v. Wyoming and North Dakota*, No. 137 Original, U.S. Supreme Court.

2006-2007: Research historian and consultant for Loeb & Loeb in Los Angeles (attorney Anthony Murray). Provided historical research and deposition testimony regarding the history of natural disasters (mudslides, floods, fires, earthquakes, etc.) in Southern

California for use in *Dane W. Alvis, et al., v. La Conchita Ranch Company, et al.*, Ventura County (California), Superior Court Case No. CIV 238700.

2005-2009: Research historian and consultant for the Stinson Beach County Water District in Marin County, California (counsel: Hanson, Bridgett, Marcus, Vlahos & Rudy of San Francisco). Provided historical research on the history of the water rights of the District.

2005-2006: Research historian and consultant for Salt River Project, Phoenix, Arizona (attorney: Mark A. McGinnis of Salmon, Lewis & Weldon of Phoenix, Arizona). Provided historical research and report on the history of public domain lands, land grants to Arizona, and water rights for use in *In re: General Adjudication of All Rights to the Use of Water in the Gila River System and Source*, and *In re: General Adjudication of All Rights to the Use of Water in the Little Colorado River System and Source*, Apache and Maricopa Superior Court Case No. CV 6417-100.

2005: Research historian and consultant for the Lake Arrowhead Community Services District (counsel: Best, Best & Krieger of Riverside, California). Provided historical research and documentation on the history of water rights associated with Lake Arrowhead in southern California. Testified before the California State Water Resources Control Board concerning the District's pre-1914 water rights claims (and post-1914 claims).

2004 – 2006: Research historian and consultant for City of Santa Maria, California (counsel: Best, Best & Krieger of Riverside, California). Provided historical research, deposition, and court testimony on the history of water rights of the U.S. Bureau of Reclamation's Santa Maria Project (California) for use in *Santa Maria Valley Water Conservation District v. City of Santa Maria, Southern California Water Company, City of Guadalupe, et al.*, Santa Clara County (California) Superior Court, Case No. CIV 770214.

2004 – 2008: Research historian and consultant for City of Pocatello, Idaho (counsel: Beeman & Associates of Boise, Idaho, and White & Jankowski of Denver, Colorado). Provided historical research, documentation and affidavit testimony on the history of Pocatello's water rights for use in Snake River Basin Adjudication (*In Re: the General Adjudication of Rights to the Use of Water From the Snake River Drainage Basin Water System, State of Idaho v. United States; State of Idaho; and all unknown claimants to the use of water from the Snake River Drainage Basin Water System*, County of Twin Falls (Idaho) District Court, Case No. 39576. Provided affidavit testimony.

2003 – 2004: Research historian and consultant for U.S. Bureau of Reclamation (Mid-Pacific Region). Provided historical research and report on the history of the water rights of the Friant Unit of the Bureau's Central Valley Project (California).

2002: Research historian and consultant for the Alameda County Water District (counsel: Hanson, Bridgett, Marcus, Vlahos & Rudy of San Francisco). Provided historical research and report on the history of the water rights of the District.

2001 – 2007: Research historian and consultant for Paloma Investment Limited Partnership (counsel: Mesch, Clark & Rothschild of Tucson, Arizona). Provided historical research and deposition regarding whether the Gila River was commercially navigable in 1912 when Arizona became a state for use in *Flood Control District of Maricopa County v. Paloma Investment Limited Partnership* and *Paloma Investment Limited Partnership v. Flood Control District of Maricopa County*, Maricopa County (Arizona) Superior Court, Case No. CV97-07081.

2000 – 2001: Research historian and consultant for Salt River Project, Arizona (counsel: Salmon, Lewis & Weldon of Phoenix, Arizona). Provided historical research and documentation on Zuni Indian water rights and land claims in Arizona and New Mexico for use in *In re the General Adjudication of All Rights to Use of Water in the Little Colorado River System and Source*, Apache County (Arizona) Superior Court, Case No. 6417.

2000 – 2001: Research historian and consultant for the Maryland Attorney General. Provided historical research and affidavit testimony on the 1785 "Mount Vernon" interstate compact between Maryland and Virginia for use in U.S. Supreme Court case of *Virginia v. Maryland*, No. 129 Original.

1998 – 2000: Research historian and consultant for the Idaho Attorney General. Provided historical research on whether the Salmon River and selected tributaries were commercially navigable in 1890 when Idaho became a state.

1998 – 1999: Research historian and consultant for the Idaho Coalition, a landowners' group (counsel: John K. Simpson of Rosholt, Robertson & Tucker of Boise, Idaho, and Shawn Del Ysura of J.R. Simplot Company of Boise, Idaho). Provided historical research, and affidavit testimony on the impacts of various dams in the Columbia River and Snake River watersheds on anadromous fish for use in Snake River Basin Adjudication (*In Re: the General Adjudication of Rights to the Use of Water From the Snake River Drainage Basin Water System, State of Idaho v. United States; State of Idaho; and all unknown claimants to the use of water from the Snake River Drainage Basin Water System*, County of Twin Falls (Idaho) District Court, Case No. 39576.

1998 – 2000: Research historian and consultant for Sacramento Municipal Utility District of California (counsel: Ronald Aronovsky of Alden, Aronovsky & Sax of San Francisco). Provided research on toxic waste and land site history for use in *Sacramento Municipal Utility District v. California Department of Transportation, Sacramento Housing and Redevelopment Agency, et al.*, Sacramento County (California) Superior Court, Case No. 96AS04149.

1997 – Present: Research historian and consultant for City of Las Cruces, New Mexico (counsel: Stein & Brockmann of Santa Fe, New Mexico). Provided historical research, documentation, and affidavit testimony on the city's water rights for use in *State of New Mexico v. Elephant Butte Irrigation District*, Dona Ana County (New Mexico) District

Court, Case No. CV 96-888. Also testified in court regarding United States' priority rights claims.

1997 – 2003: Research historian and consultant for Fort Hall Water Users' Association, Idaho (counsel: Richard Simms of Hailey, Idaho). Provided historical research and report the Association's water rights in relation to the Shoshone and Bannock Indian land cessions on the Fort Hall Indian Reservation in Idaho for use in *Fort Hall Water Users' Association, et al., v. United States of America*, U.S. Court of Federal Claims, Case No. 01-445L.

1997 – Present: Research historian and consultant for Kern Delta Water District (counsel: McMurtrey, Hartsock & Worth of Bakersfield, California). Providing historical research and report on Kern Delta's water rights for use in *North Kern Water Storage District v. Kern Delta Water District, et al.*, Tulare County (California) Superior Court, Case No. 96-172919. Testified in that case as an expert witness historian for ten days in the initial trial, which was remanded for additional testimony and evidence. Provided additional research and written reports on water rights for the remanded trial. Also providing research for use in water rights hearings before the California Water Resources Control Board.

1996 – 1998: Research historian and consultant for Idaho Attorney General. Provided historical research on water rights in relation to the Deer Flat National Wildlife Refuge for use in Snake River Basin Adjudication (*In Re: the General Adjudication of Rights to the Use of Water From the Snake River Drainage Basin Water System, State of Idaho v. United States; State of Idaho; and all unknown claimants to the use of water from the Snake River Drainage Basin Water System*, County of Twin Falls (Idaho) District Court, Case No. 39576.

1995 – 1998: Research historian and consultant for U.S. Department of Justice. Provided historical documentation on the history of water rights on the Santa Margarita River at U.S. Marine Corps Base, Camp Pendleton, in southern California.

1995 – Present: Research historian and consultant for the Salt River Project (counsel: Salmon, Lewis & Weldon of Phoenix, Arizona). Providing historical documentation and reports on whether the Salt, Gila, and Verde rivers were commercially navigable in 1912 when Arizona became a state. Testified multiple times between 1995 and 2014 before the Arizona Navigable Stream Adjudication Commission regarding the navigability of the Salt, Verde, and Gila rivers. Testified on the same subject in 1998 and 1999 before the Arizona State Legislature.

1995 – 2001: Research historian and consultant for Nebraska Department of Water Resources (counsel: Simms & Stein of Santa Fe, New Mexico). Provided historical documentation and report on water rights and the history of *Nebraska v. Wyoming*, 325 U.S. 589 (1945), for use in U.S. Supreme Court case of *Nebraska v. Wyoming*, Original No. 108, regarding the apportionment of the waters of the North Platte River. Deposed in that case, but the case was settled before trial.

1993 – 1994: Research historian and consultant for Simms and Stein, attorneys specializing in water law in Santa Fe, New Mexico. Provided historical documentation and affidavit testimony on Arapaho and Shoshone land claims and cessions along the Wind River in Wyoming for use in *In Re: the General Adjudication of All Rights to Use Water in the Big Horn River System and All Other Sources, State of Wyoming*.

1991 – 2003: Research historian and consultant for Legal Counsel, Division of Water Resources, Kansas State Board of Agriculture (counsel: Montgomery & Andrews of Santa Fe, New Mexico). Provided historical research on water rights and history of apportionment of the Republican River and its tributaries among Kansas, Nebraska, and Colorado for use in U.S. Supreme Court case of *Kansas v. Nebraska and Colorado*, No. 126 Original, regarding the interstate apportionment of the Republican River. Provided affidavit testimony.

1991 – 1993: Research historian and consultant for Nickel Enterprises (Bakersfield, California; counsel: Anthony Murray of Carlsmith, Ball, Wichman, Murray, Case, Mukai & Ichiki of Long Beach, California. Provided historical documentation and report on the navigability of the Kern River for use in *Nickel Enterprises v. State of California*, Kern County (California) Superior Court, Case No. 199557. Testified as an expert witness historian in this case for eleven days.

1989 – 1990: Research historian for Pacific Enterprises, Los Angeles, California. Directed historical research for and coauthored a corporate history of this southern California holding company entitled *The Spirit of Enterprise: A History of Pacific Enterprises, 1867-1989* (1990).

1988 – 1989: Research historian and consultant for Water Defense Association, Roswell, New Mexico (counsel: Simms & Stein of Santa Fe, New Mexico). Provided historical documentation of water rights claims along the Bonito, Hondo, and Ruidoso rivers in southeastern New Mexico for use in *State v. Lewis*, Chaves County (New Mexico), Case Nos. 20294 & 22600, Consolidated.

1986 – 1990: Research historian and consultant for Legal Counsel, Division of Water Resources, Kansas State Board of Agriculture (counsel: Simms & Stein of Santa Fe, New Mexico). Provided historical documentation, report, deposition, and testimony on water rights and interstate apportionment of the Arkansas River between Kansas and Colorado for use in U.S. Supreme Court case of *Kansas v. Colorado*, October Term 1985, Original No. 105, regarding the interstate apportionment of the Arkansas River. Testified as an expert witness historian in court for twelve days.

1986 – 1989: Research historian and consultant for Legal Counsel, State Engineer Office, State of New Mexico. Provided historical documentation and report on water rights in the Carlsbad Irrigation District in southeastern New Mexico for use in *State v. Lewis*, Chaves County (New Mexico) Case Nos. 20294 & 22600, Consolidated.

1986 – 1987: Historical consultant for *National Geographic Magazine*. Advised editors on June 1987 article, "George Washington's Patowmack Canal."

1984 – 1986: Research historian and consultant for Legal Counsel, State Engineer Office, State of New Mexico. Provided historical documentation and report on the history of water rights on the Rio Grande and interstate apportionment disputes between New Mexico and Texas for use in *El Paso v. Reynolds*, U.S. District Court, Civ. Case No. 80-730-HB.

AWARDS AND OTHER PROFESSIONAL EXPERIENCE:

2014: Faculty lecturer for Continuing Legal Education (CLE) International, New Mexico Water Law Conference. Taught course on "The Compromise of 1904 and the First Congressional Apportionment of an Interstate River: The Rio Grande, 1905."

2008: Winner of the National Council on Public History's Consultant Award.

July 1, 2007 – 2012: Member, Board of Directors, California Supreme Court Historical Society.

2006: Faculty lecturer for Continuing Legal Education (CLE) International, Arizona Water Law Conference. Taught course on "Historians and Water Rights – The Role of Historians in U.S. Supreme Court Interstate Stream Litigation."

1999: Gave keynote address at New Mexico Water Resources Institute's 44th Annual New Mexico Water Conference on "The History of the Rio Grande Compact of 1938."

January 1992 – 1994: Member of Board of Editors of *Western Historical Quarterly*.

1991 – 1995: Lecturer, Department of History, California State University, Hayward. Taught courses on California and U.S. history as well as a graduate seminar on environmental history.

1980 – 1984: Editorial Assistant, *Pacific Historical Review*. Edited scholarly articles and book reviews.

1979 – 1979: Lecturer, University of Maryland's University College off-campus program. Taught courses on the history of the American West and U.S. History surveys at the Pentagon and at a military base.

PUBLICATIONS:

Books:

Ruling the Waters: California's Kern River, the Environment, and the Making of Western Water Law. University of Oklahoma Press (Forthcoming, 2020).

Conflict on the Rio Grande: Water and the Law, 1879-1938. University of Oklahoma Press (2008).

The Spirit of Enterprise: A History of Pacific Enterprises, 1867-1989 (Coauthor, 1990).

Articles:

"Transportation and the Environment: Early Efforts to Transform the San Joaquin Valley's Swamplands," *California History* (2017).

"Jesse W. Carter and California Water Law: Guns, Dynamite, and Farmers: 1918-1939," *California Legal History* (2009).

"History and the Law: The Forensic Historian in Court," *California Supreme Court Historical Society Newsletter* (2008).

"The History of the Rio Grande Compact of 1938," in Catherine T. Ortega Klett, ed., *44th Annual New Mexico Water Conference – Proceedings – The Rio Grande Compact: It's the Law* (Las Cruces: New Mexico Water Resources Research Institute, 2000).

"The Forensic Historian: Clio in Court," *Western Historical Quarterly* (1994).

"The Rio Grande Compact of 1929: A Truce in an Interstate River Apportionment War," *Pacific Historical Review* (1991).

"Eighteenth Century Plans to Clear the Potomac River: Technology, Expertise, and Labor in a Developing Nation," *Virginia Magazine of History and Biography* (1985).

"The Potomac Company: A Misadventure in Financing an Early American Internal Improvement Project," *Business History Review* (1984).

"Water Rights During the California Gold Rush: Conflicts over Economic Points of View," *Western Historical Quarterly* (1983).

"Maryland Sectionalism and the Development of the Potomac Route to the West, 1768-1826," *Maryland Historian* (1983).

Book Reviews:

Sarah S. Elkind, *Bay Cities and Water Politics: The Battle for Resources in Boston and Oakland* (Lawrence: University Press of Kansas, 1998), in *Environmental History* (2000).

David C. Frederick, *Rugged Justice: The Ninth Circuit Court of Appeals and the American West, 1891-1941* (Berkeley: University of California Press, 1994), in *Pacific Historical Review* (1995).

Daniel Tyler, *The Last Water Hole in the West: The Colorado - Big Thompson Project and the Northern Colorado Water Conservancy District* (Niwot, Colorado: University Press of Colorado, 1992), in *Montana: The Magazine of Western History* (1994).

Lloyd Burton, *American Indian Water Rights and the Limits of Law* (Lawrence: University Press of Kansas, 1991), in *Journal of the West* (1994).

Zachary A. Smith, ed., *Water and the Future of the Southwest* (Albuquerque: University of New Mexico Press, 1989), in *Western Historical Quarterly* (1991).

F. Lee Brown and Helen Ingram, *Water and Poverty in the Southwest* (Tucson: University of Arizona Press, 1987), in *The Public Historian* (1990).

David J. Eaton and Michael Andersen, *The State of the Rio Grande/Rio Bravo: A Study of Water Resource Issues Along the Texas/Mexico Border* (Tucson: University of Arizona Press, 1987), in *New Mexico Historical Review* (1988).

Pat Kelley, *River of Lost Dreams: Navigation on the Rio Grande* (Lincoln: University of Nebraska Press, 1986), in *Pacific Historical Review* (1988).

Marc Reisner, Cadillac Desert: The American West and Its Disappearing Water (New York: Viking Penguin, Inc., 1986), in *Environmental History Review* (1987).

Thomas F. Hahn, *The Chesapeake and Ohio Canal: Pathway to the Nation's Capitol* (Metuchen, N.J.: Scarecrow Press, Inc., 1984), in *Business History Review* (1987).

PROFESSIONAL AFFILIATIONS:

American Historical Association, American Society for Environmental History, California Committee for the Promotion of History, California Historical Society, California Supreme Court Historical Society, National Council on Public History, Ninth Judicial Circuit Court Historical Society, Organization of American Historians, Western History Association.

EXHIBIT "5"

Report on the Deliberate Utilization, Management, and Conservation of Water Resources During Natural Gas Development and Production Activities

Respectively Submitted to Warren Environmental Counsel, LLC

October 9, 2019

Paula J. Mouser, P.E., Ph.D.

Report on the Deliberate Utilization, Management, and Conservation of Water Resources During Natural Gas Development and Production Activities

Paula J. Mouser, P.E., Ph.D.

Background

Oil and gas (O&G) production from unconventional reservoirs, including black shale, coalbed methane, and tight sand formations, involves the coupling of two enabling technologies: directional or "horizontal" drilling with "hydraulic fracturing" well completion strategies[1]. This report focuses on natural gas development and production activities involving horizontal drilling and hydraulic fracturing technologies in black shale formations. Hydraulic fracturing (HF) projects begin with construction of access roads leading to the site and preparation of the well pad, culminate in well drilling and hydraulic fracturing site activities, then continue for decades with the collection, handling, and management of petroleum products and produced water on- and off-site. Site operators deliberately utilize, manage, and conserve water resources throughout the natural gas development and production process.

The highest intensity activity occurs during well development and involves four main steps: (i) vertical drilling to above or within the shale formation with installation of multiple protective casings, (ii) horizontal drilling within the shale to lengths up to several thousand meters, (iii) staging the horizontal borehole with perforated casings (Figure 1) enclosed in small regions (~300 feet or 90 m) by packers (Figure 2) for focused fracture stimulation, and (iv) hydraulic fracturing of the shale in isolated stages by positively surging a fluid or fluid/gas mixture containing chemical modifiers under high pressure (up to 12,000 psi or 80 MPa) into the formation[1-4]. Horizontal drilling maximizes contact between the drilled borehole and the shale formation, while hydraulic fracturing (HF) propagates a network of fractures several hundred meters around the borehole into the shale, extending the volumetric region for which O&G can escape from the low-permeability formation[3].

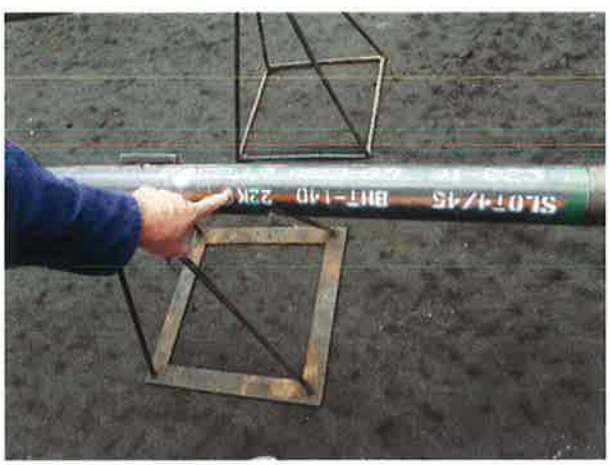

Figure 1. Example perforated casing containing spiraled charge detionation points for focused fracture stimulation. Mouser photo.

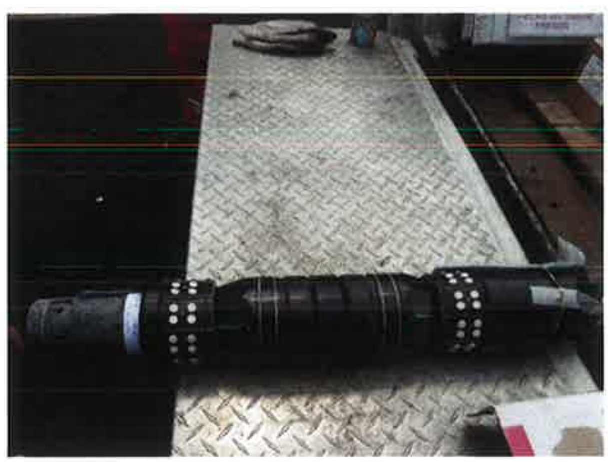

Figure 2. Example packer used to separate sections of the horizontal borehole for focused fracture stimulation. Mouser photo.

Once hydraulic fracturing is completed, the packers are removed from the borehole and flowback of the fracture fluid to the surface begins[5]. Flowback volume diminishes within days to weeks after packer drillout, and production activities commence[6]. In the months to years that follow the initial HF activities and any repeat fracture stimulations, natural gas returns to the surface with produced water, a wastewater comprised of remaining fracture fluids, well maintenance fluids, and formation brine[2, 6]. Formation brine is wastewater that derives from the black shale and consists of numerous geogenic constituents, including salts (e.g., sodium, potassium, chloride, bromide), naturally occurring radioactive materials (NORM), petroleum compounds (e.g., benzene, toluene, ethylbenzene, and xylenes, or "BTEX"), and kerogen, among others (e.g., barium, strontium, sulfate)[7-10]. Continued activity at the well pad for the next one- to two decades includes: separation of petroleum products and produced water; diversion of natural gas to pipelines; storage and off-site transport of any liquid condensate/oil; management, storage, treatment, recycling, off-site transport or disposal of produced water; equipment maintenance and replacement; and possible fracture re-stimulation[2, 11].

Although the volume of water used in fracture stimulation fluids can vary dramatically by formation and technology[12, 13], for the purposes of this report and consistent with the definition adopted by the State of New York[14] and the definition proposed by the Delaware River Basin Commission (DRBC) in its pending rulemaking[15], high volume hydraulic fracturing (HVHF) refers to application of these technologies where more than 300,000 gallons (1.1×10^6 L) of water is used during the drilling and well completion processes. The following sections describe in more detail the deliberate utilization, management, and conservation of water resources during HVHF projects, the equipment used for water and wastewater management during HVHF activities, and engineered solutions for water and wastewater management during HVHF activities, including potential malfunctions of equipment, and efforts to conserve water resources during HVHF activities.

Deliberate Utilization, Management, and Conservation of Water Resources During HVHF Projects

Water sources and their availability for HF projects vary as a function of geography, climate, season, site design, and site development timeline[16, 17]. Freshwater used in HF projects can derive from public water supplies or untreated surface or subsurface sources such as lakes, rivers, reservoirs, or groundwater aquifers[2]. Minimally-treated recycled wastewaters including flowback or produced fluids from nearby well sites or fluid from other industrial applications (e.g., acid mine drainage, municipal wastewater) may supplement freshwater resources for certain site functions, such as fracture fluid formulations[16]. Regardless of the water's origin, in a HVHF project there are four main planned activities at a well pad site, each of which is designed to utilize, manage, and conserve water resources. Water use, management and conservation commences (i) during the preparation and maintenance of access roads and the well pad, and extends through (ii) vertical and horizontal drilling, (iii) well completion activities including hydraulic fracturing, and (iv) flowback/produced water handling and disposal[18]. The timeline for these activities may range from four months to more than a year depending upon site location, complexity (e.g., depth, type of formation), and scale of activities (e.g., number of wells drilled and stimulated at the site)[2]. As noted above, with respect to wastewater, activities for water resource management and conservation continue for years to decades after the well is put into production because of the ongoing need for collection, storage, transport, and disposal of produced water.

Preparation and Maintenance of Access Roads and the Well Pad. The first water use application in HF projects involves dust control during access road and well pad preparation. Additionally, depending on the time of year for which the HF project is active, de-icing and stabilization of access roads and the well pad occurs, and commonly involves water-based fluids. When the site is being prepared for HF activities, dust particles are generated during ground work, subbase construction, levelling, surfacing of access roads leading to the well pad, and surfacing of the well pad itself. Water for site preparation is typically withdrawn from a local source, hauled to the site in water tanker trucks equipped with sprayers, and misted across work areas several times per day to reduce the potential for air and water pollution due to dust particle migration. Water misting is also used to control for dust during well pad construction and to reduce ice during wet, freezing temperatures. Dust suppression involves an average of two 2,000-gallon tanker trucks daily for each acre under construction (0.5 gal/yd^2). The longer the access roads and the larger the well pad, the larger the volume of water needed during construction. Although water itself is an effective dust suppressant, chemical modifiers including salts, natural organic products (vegetable oil, guar gum), or clay particles are sometimes added to further reduce particle migration[19]. Additionally, the Pennsylvania Department of Environmental Protection (PADEP) allows the beneficial use of brine from oil and gas wells for dust control, road stabilization, and deicing - provided the brine (1) does not originate from shale formations (i.e., unconventional well brine is prohibited), and (2) spreading is conducted in accordance with DEP guidelines[20].[i]

The volume of water used for site preparation, de-icing, and road stabilization is much less than the volume used for drilling and HF[18]. However, access roads leading to HF projects are typically unlined and unimproved; therefore, contaminants associated with water-based fluids used for dust-suppression, de-icing, or road/pad stabilization will move from road surfaces into ditches, be transported with surface waters, and/or migrate through soils after application. Construction of roads and the well pad may also mobilize soils, alter stormwater runoff rates and volume, or impact wetlands. As a result, the HF project's erosion and sedimentation control plan to manage stormwater and sedimentation, and other plans for the management of water-based fluids applied on access roads and the well pad are critically important to protecting water resources as they represent a possible and continued source of water resource pollution during construction and throughout the lifetime of the well[21, 22].

Drilling. The second planned water resource utilization occurs during vertical and horizontal drilling activities. In HF projects, the "spud" or vertical borehole is drilled first, extending from the ground surface to a subsurface depth above or within the shale formation (Figure 3). In the Marcellus Shale, the spud borehole depth could range from 0.5 to 2.5 km below ground surface (bgs)[23]. Direct rotary drilling is used to generate a continuous vertical borehole, and involves the circulation of either air or water down the drill pipe and back up to the surface to collect and move drill cutting from the drill bit out of the borehole[24]. Typically, the borehole size is telescoped from 24" to 5-1/2" in diameter as multiple protective casings are cemented in place with advances in depth[24]. Three to five protective casings may be used including a conductor (approx. 24"), surface (approx. 13-3/8"), intermediate (approx. 9-5/8"), and production casing

[i] 25 Pa. Code § 78a.70; 25 Pa. Code § 78a.70a; 25 Pa. Code § 78.53; Pennsylvania Department of Environmental Protection: Approval of Brine Roadspreading Plans (1998), http://www.depgreenport.state.pa.us/elibrary/GetDocument?docId=8085&DocName=APPROVAL%20OF%20BRINE%20ROADSPREADING%20PLANS.PDF%20%20%3Cspan%20style%3D%22color%3Agreen%3B%22%3E%3C%2Fspan%3E%20%3Cspan%20style%3D%22color%3Ablue%3B%22%3E%3C%2Fspan%3E.

(approx. 5 1/2")[2]. Proper installation and cementation of casings requires water, and is a critical activity performed for protecting surface and subsurface water resources from the migration of stray gases, formation brines, and stimulation fluids containing contaminants[25-27]. Surface casings must extend through and a specific distance below fresh groundwater aquifers, while cemented intermediate/production casings must be cemented at depths to several hundred feet below ground and meet pressure, strength, and chemical resistivity requirements[27].[ii] Drinking water on the Wayne Land and Mineral Group (WLMG) property is currently supplied by a groundwater well, and up to six additional groundwater wells are present on neighboring properties within 1/2 mile of the proposed site[iii] indicating a drinking water quality aquifer is located below the site.

When water-based fluids are used as the drilling circulation material, "mud" rotary drilling generates wet drill cuttings that are collected at the surface, dewatered, and disposed of through permitted means (Figure 3). Water is often mixed with specialized drilling agents (including bentonite clay, biocides, weatherizers, organic lubricants, etc.) to adjust the density of the drilling fluids and to protect the borehole[24, 28]. WLMG expects to use a drilling fluid composed of water mixed with bentonite and a coagulant at the proposed site[29,iv]. In Pennsylvania, pits are no longer allowed for the storage of drill cuttings that have been mixed with regulated substances, including drilling chemical modifiers, fracture stimulation fluids, or formation brines[27].[v] Therefore, cuttings are collected and temporarily stored before dewatering, chemical characterization, and off-site disposal as "residual waste". Drill water may be re-used after separating fluids from solids; this on-site fluid handling activity is allowed without a permit provided secondary containment is used (see Figure 3)[27].[vi] Although air rotary drilling does not require the use of water, it is often not feasible to use this approach if there is risk of contacting formation fluids, petroleum products (e.g., oil), or highly fractured formation zones[24].[vii]

Once the spud is completed, the drilling rig is moved offsite, and a new, often larger drill rig is set up over the borehole (Figure 4). Horizontal drilling then commences whereby the vertical borehole is extended from the spud termination point to the end of the lateral borehole within the target formation. The length of the lateral can extend from 5,000 to more than 10,000 feet (~1,500 m to 3,000 m) with average lateral lengths increasing every year as a function of improved drilling technologies[30]. Lenape Resources, Inc. expects to drill a lateral length between 4,000 and 5,000 feet at the proposed WLMG site, although the laterals may be of greater length and extend onto neighboring properties if these property owners join in the project [31].[viii]

[ii] 25 Pa. Code § 78a.83(c); 25 Pa. Code § 78a.83c(c); 25 Pa. Code § 78a.84(b); 25 Pa. Code § 78a.85(a)(4).
[iii] Coccodrilli Dep. 79:14-20, Aug. 27, 2019.
[iv] Holko Dep. 85:4-19, Aug. 28, 2019.
[v] 25 Pa. Code § 78a.57(b).
[vi] 25 Pa. Code § 78a.58(b)(3); 25 Pa. Code § 78a.58(c); 25 Pa. Code § 78a.57(a).
[vii] Letter from John C. Holko, President, Lenape Resources, Inc., to A.J. Sandone, CEO, Wayne Land & Mineral Group, LLC (June 18, 2019) (WLMG2231-2232).
[viii] Letter from John C. Holko, President, Lenape Resources, Inc., to A.J. Sandone, CEO, Wayne Land & Mineral Group, LLC (June 18, 2019) (WLMG2231-2232) ("Initially, the lateral to be drilled will be between 4,000 to 5,000 feet with a final length dictated by the well pad layout after the well is surveyed and permitted."); Holko Dep. 87:23-89:13 (acknowledging that laterals can be 20,000-25,000 feet long).

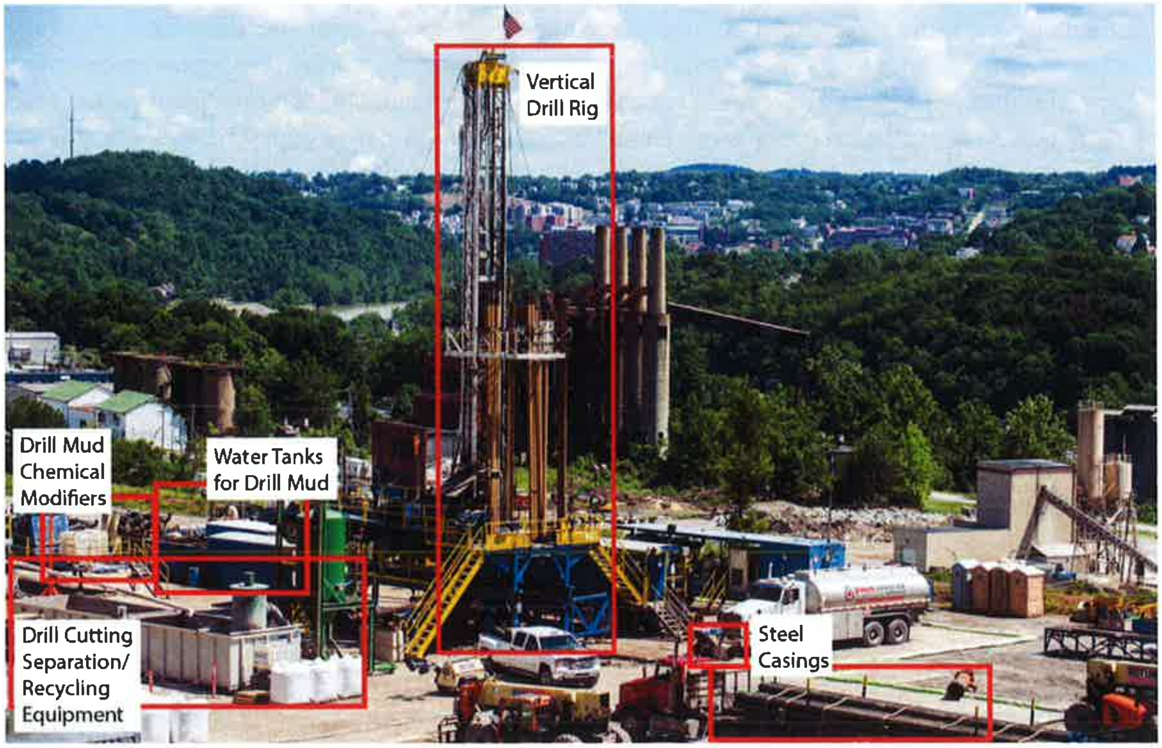

Figure 3. A typical site layout during spud hole (vertical) drilling at a HF site. Marcellus Shale Energy and Environmental Laboratory (MSEEL) photo.

As with vertical drilling, mud rotary drilling is also used during the directional drilling process to circulate cuttings from the drill bit, and involves a water-based fluid containing chemical modifiers. Water used for drilling typically constitutes 3.2×10^5 L (approx. 80,000 gallons) for every well on the site, with volume dependent on the top hole depth and length of the lateral[18]. Lenape Resources, Inc. intends to retain a subcontractor to develop a drilling plan for the WLMG site but has not done so to date. Nevertheless, Lenape expects to use approximately 50,000 gallons during the drilling phase at the proposed WLMG site[29].[ix] Water for drilling is typically stored on site using multiple steel-walled modular tanks that hold approximately 21,000 gallons.[x] Freshwater and recycled drilling wastewater are commonly used as fluid sources for drilling muds.

[ix] Holko Dep. 84:10-25.

[x] Letter from John C. Holko, President, Lenape Resources, Inc., to A.J. Sandone, CEO, Wayne Land & Mineral Group, LLC (June 18, 2019) (WLMG2230-2231) ("All fluids will be stored on site in a combination of vertical 210-barrel tanks and portable 500-barrel tanks. The pad site design will include at least 3 but as many as 5 tanks used during drilling operations and additional tanks during the hydraulic fracturing operation. In addition to the tank storage, portable tanks and hauling will be utilized to supply the larger volumes during hydraulic fracturing."); Letter from Christopher R. Nestor, Overstreet & Nestor, LLC to Mark L. Greenfogel, Warren Environmental Counsel LLC at 1-2 (July 12, 2019) ("WLMG expects to use no more than 100 temporary and portable 500 bbl storage tanks (21,000 gallons each) with a total capacity of 2.1 million gallons to temporarily store water used for fracturing and then use up to 20 temporary 500 bbl storage tanks (21,000 gallons each) with a total capacity of 420,000 gallons to temporarily store flowback and produced water. At the conclusion of the construction phase, and for remaining productive life of the well which is estimated to be 20-50 years, WLMG will temporarily store the small amount of produced water collected pending treatment by properly licensed treatment or disposal facilities in a 300 bbl storage tank (1 tank per producing well) that will hold 12,600 gallons or less.").

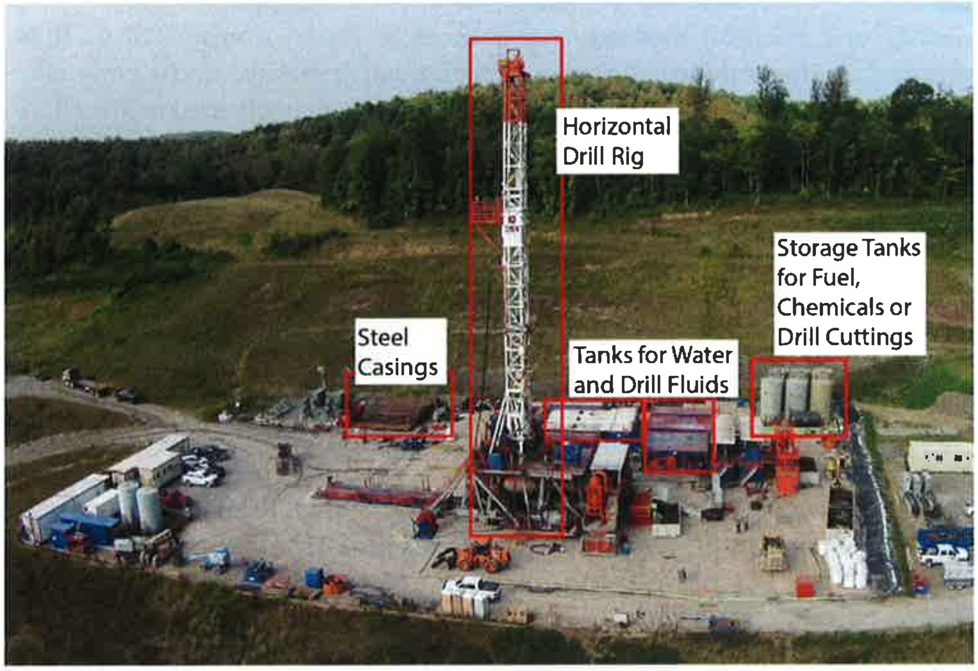

Figure 4. A typical site layout during horizontal drilling at a HF site. Marcellus Shale Energy and Environmental Laboratory (MSEEL) photo.

Hydraulic Fracturing. The third and by far the largest water use activity in HF projects (approximately 98%) is associated with fracture stimulation[18]. Historically an average $15x10^6$ L (4 x 10^6 gallons) of source water has been used to hydraulically fracture one well[13, 17, 18, 30, 32]. However, in 2018 the PADEP reported that unconventional shale gas wells in Pennsylvania used on average up to five times this volume, or $20x10^6$ gallons[33], likely due to increasing depth and/or lateral lengths. Over a 30-year lifetime considering well maintenance and possible repeat stimulations total water use volume is expected to approach $100x10^6$ L ($27x10^6$ gallons) per well[12]. WLMG expects to use up to 5 x 10^6 gallons of water stimulation volume for each well fractured at its proposed site[31, 34] and is contemplating installing six wells at its proposed site, resulting in six times the amount of water used in stimulating a single well.[xi] WLMG left open the possibility that each well may be fractured numerous times during its lifetime.[xii]

In Pennsylvania, O&G operators working in unconventional formations (e.g., Marcellus Shale) are restricted from withdrawing or using water from within the Commonwealth until a Water Management Plan has been submitted and approved by the PADEP[35].[xiii] The WMP must define the HF project's water sources and withdrawal volume, and show that these withdrawals will not affect water quantity and quality of the water source to support existing water uses (considering low flows, withdrawals, and diversions). The WMP also needs to describe the HF project's plan for water reuse.[xiv] WLMG intends to hire a consultant to develop a WMP for the proposed site[31].[xv]

[xi] Coccodrilli Dep. 79:14-20, Aug. 27, 2019.
[xii] Sandone Dep. 159:10-24., Sept. 3, 2019.
[xiii] 25 Pa. Code § 78a.69(a)(1).
[xiv] 25 Pa. Code § 78a.69(b); 25 Pa. Code § 78a.69(d).
[xv] Letter from John C. Holko, President, Lenape Resources, Inc., to A.J. Sandone, CEO, Wayne Land & Mineral Group, LLC (June 18, 2019) (WLMG2230).

The fracture stimulation fluid contains source water (approximately 90% by volume), sand or resin proppant (approximately 9% by volume), and chemical modifiers (approximately 1% by volume)[5, 36, 37]. It is important to note that the chemical modifiers are specific to the formation and the desired fracture network; water-based (slickwater) fracturing results in a high density of microfractures (commonly used in Marcellus shale), while gel-based fracturing uses a higher-viscosity fluid to generate a lower density of larger fractures[3, 4, 38]. Hydraulic fracturing can also be achieved through the use of gases and/or foams; however, the application of these media is currently less economical and/or less efficient then water-based stimulation fluids. As a result, the industry currently prefers to use water-based fracturing fluid[3]. Extensive reviews of the different purposes, structures, and physicochemical properties of fracture fluid chemical modifiers have been conducted[2, 37, 39, 40] and combined with voluntary information provided by the O&G industry on the Frac Focus Chemical Disclosure Register[41] indicate that more than 1,000 chemical substances have been used in HF projects. Many of these compounds lack published information on their biodegradability and toxicity[40, 42]. However, in most cases, the chemical modifiers fall into a dozen classes, including: acids, biocides, breakers, clay stabilizers, corrosion inhibitors, friction reducers, gels, iron control agents, oxygen scavengers, scale inhibitors, solvents, and surfactants[5, 36, 37], many of which pose a risk to drinking water and aquatic life if released to the environment[2, 40, 43]. WLMG has not yet selected the chemicals it will add to water to form its fracturing fluid.[xvi]

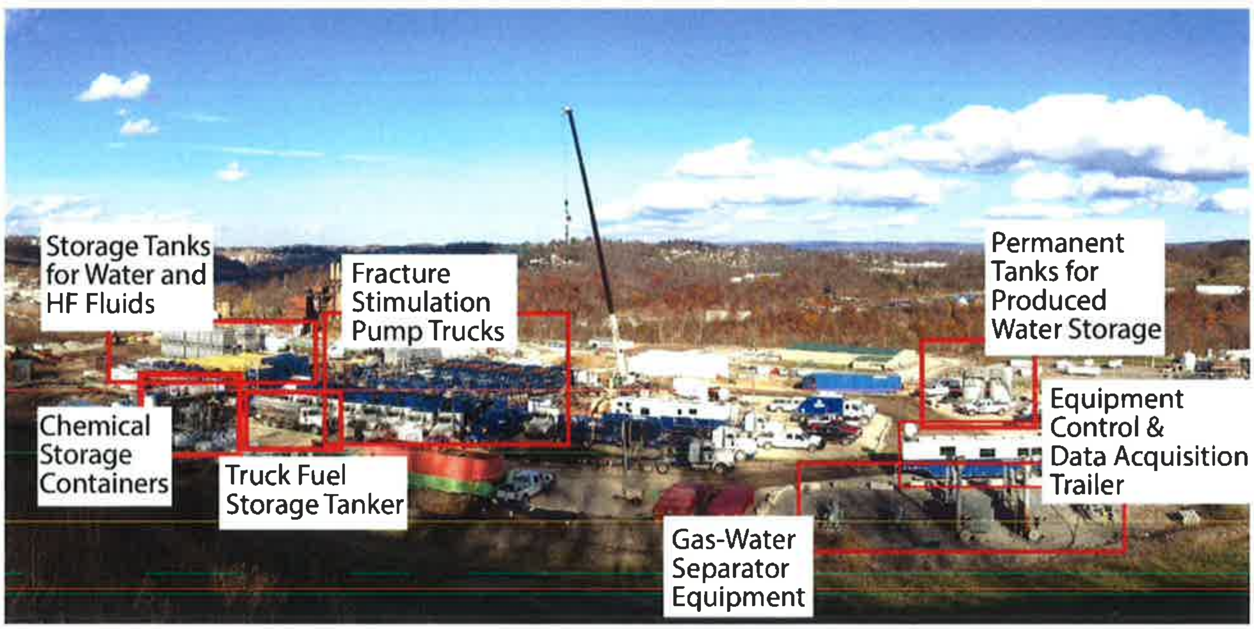

Figure 5. A typical site and equipment layout during hydraulic fracturing activities. Mouser photo.

During the well completion phase, a large fleet of equipment consisting of fracture pumpers, chemical additive units, storage tanks, blenders, and data trucks assemble on the site to manage the water and fracturing fluids and carry out the activities (Figure 5). Fracture fluid composition is stage-specific within each isolated packer section of a well, and the entire sequence is choreographed through complete control of water chemistry, composition, viscosity, volume, pressure, and speed through a massive array of equipment (Figure 5). The fracture stimulation process begins with an acid treatment to remove drilling muds from the wellbore and initiate the fracture process. In the next step, stimulation fluids containing

[xvi] Holko Dep. 102:8-103:10, Aug. 28, 2019.

friction reducers are injected to slick the shale[38]. Following borehole slicking, fracture fluids with chemical modifiers and proppants are sequentially added such that proppant size increases from a fine grain to a large grain size[38]. After 15-20 proppant addition cycles, the section is flushed with water, completing the fracture process for one isolated packer region. Once the sequence has been completed in the first isolated packer region known as the well "toe", the same process is repeated in each packer region as the horizontal well moves toward the well "heel" near the vertical portion of the well. The purpose of the sequence is to clean, open, extend, and prop an extended network of fractures as far as possible into the shale for natural gas production in controlled stages. The number of fracture completion stages is directly related to the length of the lateral. Assuming a total lateral length of 6,000 feet and applying a 300-foot stage length, this constitutes 20 fracture stages. Approximately 17 to 20 stages are expected by Lenape Resources, Inc. in each HF well at the proposed WLMG site[29].

Management of Flowback and Produced Water After fracture stimulation, water returns back to the surface as "flowback", a mixture of fracture stimulation fluids and dilute formation brine[44]. In the Marcellus Shale, about 10-20% of fracture stimulation fluids return to the surface, the rest remaining permanently in the formation[2, 11, 18, 32]. This percentage of return water is consistent with what is expected at the proposed WLMG site[29].[xvii] The flowback is collected into temporary storage containers and managed using one of three approaches: it is recycled in other HF wells, treated on site or transported to a centralized wastewater treatment facility ("CWT") for treatment[7], or permanently disposed in underground injection wells[11]. In Pennsylvania, 90% of produced fluids are recycled, 7% are disposed through deep well injection, while 3% are managed using other methods[33]. As the well is switched over to production, the natural gas, condensates, residual stimulation fluids, and formation brine return to the surface as "produced water", and are separated based on their density and volatility in gas-liquid separator systems (Figure 5). As the well matures, produced water becomes increasingly saline until stimulation fluids are removed and its chemistry is in equilibrium with the formation brine[8, 44, 45]. Separated natural gas is permanently routed to transmission pipelines while condensates and produced water are piped underground to permanent on-site storage containers until they are further managed (Figure 5). Although a specific plan for managing wastewater or solid waste is not required by the PADEP, current regulations define the type of containment that may be used to collect, store, and process drill cuttings, stimulation fluids, flowback, and produced waters generated at unconventional HF sites[35].[xviii] WLMG intends to develop or retain a subcontractor to develop a wastewater management plan for their proposed site but has not done so to date[29, 31].[xix]

Regardless of the water source and wastewater/solid waste management approach at a specific site, HF activities constitute a consumptive use of water resources, through either (i) loss of water-based fluids within the formation, or (ii) mixing of water-based fluids with stimulation chemicals or formation brines, resulting in a chemically complex wastewater that cannot safely be returned to streams or groundwater using conventional treatment processes. Flowback and produced fluids can be reused/recycling on the well pad or at neighboring HF sites,[11] and in 2018 this was done for 90% of produced fluids generated in Pennsylvania[33]. However, reuse of produced fluids has limitations: mixing with fracture fluids causes

[xvii] Holko Dep. 108:15-23, Aug. 28, 2019.
[xviii] 25 Pa. Code § 78a.57.
[xix] Letter from John C. Holko, President, Lenape Resources, Inc., to A.J. Sandone, CEO, Wayne Land & Mineral Group, LLC (June 18, 2019) (WLMG2229-2230, 2232); Holko Dep. 65:17-66:6, 83:19-84:9, 103:15-17 169:20-171:2, Aug. 28, 2019.

mineral precipitation, decreasing effective fracture volume[46]. Continued fluid recycling exacerbates scaling problems and makes it difficult to achieve fracture stimulation chemistries. For residual flowback and produced water, terminal management options include costly treatment or deep-well disposal[7, 11]. Disposal of residual fluids in deep injection wells is common in some Marcellus shale regions (e.g., Pennsylvania and Ohio) but effectively removes the wastewater from the hydrologic cycle[11]. Treatment in CWTs allows treated effluent to be discharged to surface water bodies[7] under National Pollutant Discharge Elimination System (NPDES) permits issued pursuant to the federal Clean Water Act and state laws. However, the discharge of treated residual fluids from HF activities has generated numerous environmental problems, including: incomplete removal of chemical modifiers (e.g., surfactants, weatherizers) in effluents discharged to surface water bodies[47]; accumulation of incompletely removed chemical modifiers and geogenic constituents in the sediments of receiving water bodies[48]; and increased prevalence of brominated compounds formed as disinfection byproducts during drinking water treatment of surface water bodies in Pennsylvania that receive effluent discharges[49, 50]. In other words, all water used for HF activities is either effectively removed from the hydrologic cycle or, if treated and discharged, has not consistently been treated to a level safe for habitat or, after conventional treatment, human re-use.

Equipment Used for Water and Wastewater Management During HVHF Activities

Trucks are the predominant method for moving water to and from HF projects, although in regions of dense drilling activity, pipelines may be constructed or retrofitted to move water from nearby ponds or impoundments to the site. Assuming between $20x10^6$ and $27x\ 10^6$ gallons of water is used for each HF well, and a water tanker size of 8,000 gallons can be used for transport, this constitutes water hauling activity on the order of between 2,500 and 3,375 tanker loads to the site in order to fracture one well several times. In Pennsylvania, hauling typically occurs on newly-constructed access roads that are generally unimproved (i.e, roads contain gravel surfaces rather than asphalt) in order to reach HF projects in rural areas or locations with large topographic change. If site-derived flowback or produced water is stored and conserved to fracture additional wells on the site, supplemental fluids (*e.g.* freshwater) are still required because only a portion (10 to 20% in the Marcellus shale) of injected HF fluid is returned to the surface[18]. Freshwater intended for drilling or HF may be stored off-site in natural or constructed ponds (Figures 6, 7), whereby it is pumped to the pad site during drilling and HF staging activities (Figures 7, 8). Water may also be stored on-site in above-ground portable impoundments or storage containers. It is important to note that the ponds and pump facility shown in Figures 6-8 are located off the well pad, yet like the well pad represent land use associated with the HF activities directly related to water resources.

Figure 6. Unlined water storage pond, located off-site of the well pad are shown behind temporary water storage containers on site. Mouser photo.

Figure 8. Water from the storage pond above is drawn using a gasoline-powered pump to storage containers on site. Mouser photo.

Figure 7. Water from a lined storage pond located off of the well pad is pumped through temporary piping for on-site drilling and HF activities. Mouser photo.

To minimize mixing between freshwater, produced fluids, and chemicals, color-coding or labelling is often used to designate tank purpose, with tanks reserved for a specific type of fluid (Figures 5, 9, 10). Additionally, tanks used for HF fluid preparation often have colors specific to the modifier (*e.g.,* acid addition yellow, other additives orange) since chemical additives are added in purposeful sequences (Figures 9)[38]. Although regulatory agencies have historically allowed produced waters to be stored in open ponds or lined pits[51], accidental leaks to surface water and groundwater combined with improvements in best management practices have pushed the O&G industry toward surface storage containers at HF shale well pads. As of October 2016, the PADEP prohibits the unconventional O&G industry from using pits for the storage of either drill cuttings derived from below the surface casing seat[xx] or waste fluids[35].[xxi] Currently, flowback and produced fluids are typically stored above ground in temporary polypropylene or steel-walled storage containers until minimally treated for re-use in additional HF wells at the site, transported to a nearby HF site, or hauled to a centralized treatment facility or brine disposal well (Figure 10). WLMG expects to use up to 100 temporary and portable 500 barrel tanks (2.1×10^6 gallons) to store water and HF fluids on site during the well completion phase[52].[xxii] Drilling additives and HF chemical modifiers are commonly stored in polypropylene tanks on the well pad near fluid mixing staging areas (Figure 5, 11).

[xx] 25 Pa. Code § 78a.61(c)

[xxi] 25 Pa. Code § 78a.57(b).

[xxii] Letter from Christopher R. Nestor, Overstreet & Nestor, LLC to Mark L. Greenfogel, Warren Environmental Counsel LLC at 1 (July 12, 2019).

Figure 9. Color coded fluid storage containers on a well pad set up in a series for chemical additive treatments prior to HF. Mouser photo.

Figure 10. Produced water storage containers on a well pad. Mouser photo.

Figure 11. Chemical unloading and storage at a HF project. Mouser photo.

During HF, an extensive network of steel piping conveys fracture stimulation fluids from the chemical additive units, tanks, and blender to the wellhead via fracture stimulation pump trucks (Figures 12, 13). In part, to protect water resources and the environment from leaks, the system is ordinarily pressure checked and tested before each HF[27].[xxiii] However, leaks and valve malfunctions are commonplace given the number of piping units and connections in the system[53]. In many cases, fluids are separated to 16 or more fracture stimulation pump trucks in order to reach the appropriate pressures for fracture stimulation (Figure 5).

Figure 12. A HF well (blue, center) connected to piping containing fracture stimulation fluid pressurized from pump trucks. Mouser photo.

Figure 13. A close-up of fracture stimulation fluid piping connected between blender, pump trucks, and the wellhead. Mouser photo.

[xxiii] 25 Pa. Code § 78a.88(a); 25 Pa. Code § 78a.88(b)(1); 25 Pa. Code § 78a.68a(g).

Once hydraulic stimulation is complete, flowback returns to the surface in large volumes at high flow rates[6], requiring extensive management. Flowback fluids are depressurized and conveyed through surface piping to temporary steel storage containers (Figures 14, 15) installed and operated for the sole purpose of flowback and produced water storage. WLMG expects to temporarily store residual fluids in up to twenty 21,000 gallon tanks[52].[xxiv] In Pennsylvania, secondary containment is required for tanks storing produced fluids or brine[27], as shown in Figure 15.[xxv] This secondary containment is a facility designed to manage wastewater by capturing spills and leaks to protect and conserve water resources and the environment. Assuming 20% of the injected volume returns to the surface as flowback/produced water ($4x10^6$ gallons), an estimated 500 tanker truck loads of wastewater (8,000 gallons each) will be hauled off-site for treatment or disposal. These produced volume estimates are larger than those provided by WLMG for its site[31].[xxvi] However, considerable variability and uncertainty exists regarding produced fluid volume until site-specific data is available.

Figure 14. Surface piping moves flowback and produced fluids from the wellhead through gas-water separators to produced fluid tanks. Mouser photo.

Figure 15. Temporary tanks storing flowback and/or produced fluids that are connected to site pipes. Mouser photo.

When flowback diminishes and production activity begins, natural gas and wastewater are separated, first into temporary storage containers (Figures 14, 15) and later into permanent above ground storage containers (Figures 16, 17, left). The number of temporary and permanent storage tanks is dependent on what comes out of the well after stimulation and during production, respectively, and is modified as necessary on a site-specific basis. At least one permanent storage tank would be necessary; tanks can range from 12,600 to 42,000 gallons. WLMG expects to construct one 12,600 gallon storage tank on site for every HF well drilled on the pad to collect produced water for the remaining productive life of the well (20-50 years)[52].[xxvii]

[xxiv] Letter from Christopher R. Nestor, Overstreet & Nestor, LLC to Mark L. Greenfogel, Warren Environmental Counsel LLC at 1 (July 12, 2019).
[xxv] 25 Pa. Code § 78a.57(c).
[xxvi] Letter from John C. Holko, President, Lenape Resources, Inc., to A.J. Sandone, CEO, Wayne Land & Mineral Group, LLC (June 18, 2019) (WLMG2233) ("Drilling wastes may amount to multiple truckloads of solid and liquid wastes with liquid wastes resulting from the hydraulic fracturing treatment amounting to approximately 700,000 to 1,000,000 gallons to be hauled for disposal or treatment by truck.").
[xxvii] Letter from Christopher R. Nestor, Overstreet & Nestor, LLC to Mark L. Greenfogel, Warren Environmental Counsel LLC at 1-2 (July 12, 2019). ("At the conclusion of the construction phase, and for remaining productive life of the well which is estimated to be 20-50 years, WLMG will temporarily store the small amount of produced water

Sometimes, condensate and/or oil are co-produced with natural gas. In these instances, similar permanent storage tanks are installed to hold liquid hydrocarbons until off-site transport (Figure 17, right). Secondary containment is required in Pennsylvania for permanent tanks storing produced fluids, condensate, or oils[27].[xxviii] Permanent storage tanks can be equipped with level indicators so that operators can monitor fluid storage facilities from an off-site location in order to plan for further management (e.g., transport off site) .

Figure 16. Gas-water separators at a HF well pad. Mouser photo.

Figure 17. Permanent tanks storing produced fluids (left) or oil (right) during natural gas production. Mouser photo.

The size of the well pad is directly related to the type, scale, and orientation of the (i) drilling rig and fracture fleet, and the (ii) water/wastewater management equipment needed during drilling, HF, and well transition into production. Additionally, the number of wells to be hydraulically fractured at the site can influence well pad size. A well pad size on the order of 3 to 7 acres is typical; the preliminary site plan created by Tioga Environmental Consulting, LLC for WLMG shows a proposed well pad site approximately 5.8 acres in size[29, 31, 52].[xxix] As shown in Figure 18, about half the well pad is needed to stage temporary or permanent equipment used for water management during the well completion stage, including: temporary storage tanks containing freshwater, recycled fluids, HF fluids, and produced fluids; HF chemical additives, sand proppants, and HF fluid blenders; fracture stimulation pump trucks; and permanent tanks for storing produced water or liquid hydrocarbons. The remaining space is necessary to provide appropriate safety setbacks from equipment, allow space for equipment movement (e.g., tractor trailer turning radius) and deliveries of supplies, and housing equipment control and data acquisition systems. At the end of drilling and hydraulic stimulation, water is used for cleaning/decontamination equipment and rigs before they are moved to the next site.

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collected pending treatment by properly licensed treatment or disposal facilities in a 300 bbl storage tank (1 tank per producing well) that will hold 12,600 gallons or less.").

[xxviii] 25 Pa. Code § 78a.57(c).

[xxix] Coccodrilli Dep. Ex. 10 (Lenape Pad Site Plan attached to E-mail from Anthony Sandone to AJ Sandone (Oct. 9, 2017, 14:21 EDT)).

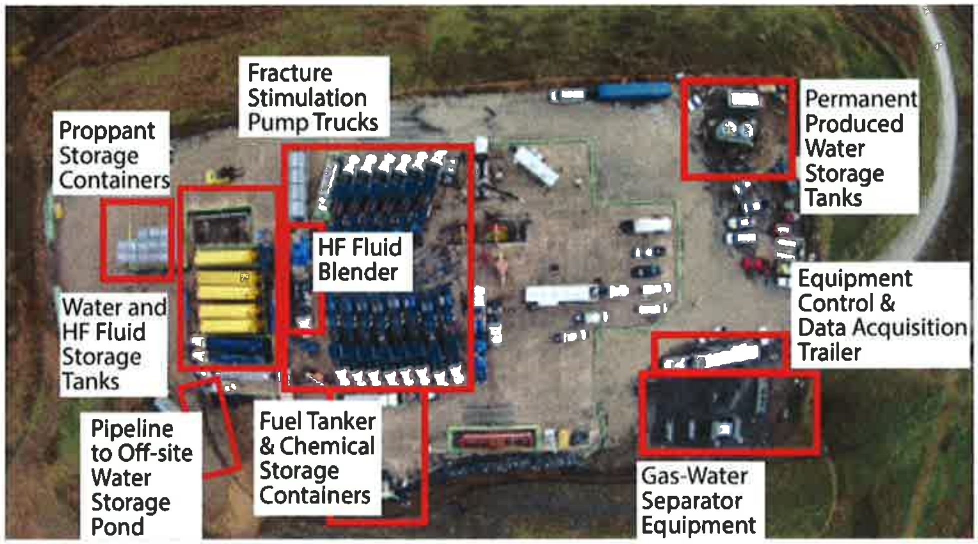

Figure 18. Aerial photo of site shown in Figure 5 highlighting area used for water and wastewater management during HF activities and over the life of the well. Marcellus Shale Energy and Environmental Laboratory (MSEEL) photo.

Engineered Solutions for Water and Wastewater Management and Water Resource Conservation During HVHF Activities

Well pads are generally constructed on several feet of crushed gravel or subbase fill (Figures 19, 20), with material depth and composition design based on the expected equipment and supply load on the well pad. The work surface of the entire well pad may contain a temporary geosynthetic material bermed at the edge (Figure 19). Alternatively, a geosynthetic liner held in place by cement/metal plates may be temporarily constructed under a section of the pad (Figures 20, 21).

Best management practices for HF projects involve managing wastewater and conserving water resources in ground and surface waters through the construction and use of temporary lined berms and/or secondary containment of drill muds, fracture stimulation fluids, and produced water (Figures 5, 15, 17). Beginning in October 2016, the use of secondary containment structures for the protection of ground and surface waters from residual fluids (drilling fluids, HF fluids, produced fluids) became PADEP requirements for the unconventional industry[35].[xxx] Secondary containment is also constructed and used to contain possible releases of stored fuels (e.g., gasoline) and liquid hydrocarbons, as shown in Figures 5 and 18. Piping networks and pumps manage and conserve water resources by containing backflow preventers to reduce flow back to storage tanks. In addition, the wellhead contains multiple emergency shutoff devices to contain fluids and gases within the borehole in the event that HF stimulation or production fluids take a different route from the intended design of the well (Figure 12, 14) or if the formation is overpressurized relative to expected geologic conditions[27]. Under these unanticipated conditions, large fluid volumes and/or natural gas may be forced out of the borehole through malfunctioning valves, pipes, ruptured casings, or failed cement, resulting in the pollution of air, surface and ground water, and/or soils[2].

[xxx] 25 Pa. Code § 78a.57; 25 Pa. Code § 78a.64a.

Figure 19. The edge of a well pad showing the pad height, edge slope, edge berm, and geosynthetic material. Mouser photo.

Figure 20. Equipment staged on a berm with a geosynthetic liner held in place with sand bags. Mouser photo.

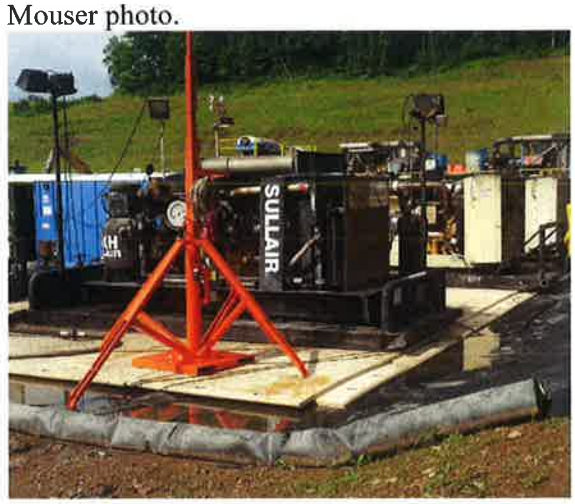

Figure 21. Equipment staged on a geosynthetic liner bermed at the downhill edges and covered by steel plates. Mouser photo.

In 2016, the U.S. EPA released a comprehensive report on the *Impacts from the Hydraulic Fracturing Water Cycle on Drinking Water Resources in the United States*, finding six activities more likely than others to result in impacts to drinking water resources: (1) water withdrawals for HF under conditions of low water availability, (2) injection of HF fluids into improperly cased wells, (3) spills during the management of HF fluids, chemicals, or produced water, (4) injection of HF fluids into groundwater resources, (5) discharge of inadequately treated HF wastewaters to surface water resources, and (6) disposal or storage of HF wastewater in unlined pits[2]. Among these activities, (2) through (5) represent situations that might currently occur through poor engineering, unintended equipment malfunctions, and/or transportation accidents, and are the focus here. Although pits are not currently allowed for the disposal or storage of HF residual fluids in Pennsylvania (*see* footnotes xx and xxi above)[27], pollution of water resources has been documented as a direct result of storage pit overtopping, leakage, or liner rupture[2, 54, 55], highlighting the importance of protecting water resources through the HF project's approach to wastewater storage and management.

<u>Surface Leaks and Blowouts.</u> Given the number and scale of activities at HVHF sites involving the use and management of water resources, unintended water loss and/or accidental release of HF residual fluids containing pollutants resulting from equipment failure, human error, or natural events (e.g., intense storm events) are inevitable[2, 53]. The types of pollutants associated with HF residual fluids include high acidity;

oxygen demanding substances such as high total dissolved carbon (including volatile, semi-volatile, and non-volatile organic compounds); high total dissolved solids such as salinity; elevated alkaline earth metals such as barium or strontium; or naturally occurring radioactive materials (NORM) such as radium[2, 7, 37, 43, 44, 47, 48, 56]. Spills, leaks, and/or blowouts of drilling fluid, HF stimulation fluids, flowback fluids, or produced fluids all have resulted in contamination of water resources [2].

The piping network shown in Figure 13 contains hundreds of connections between tanks and the wellhead that collectively contribute to the high-pressure fracture stimulation process. Although piping structures/valves are tested before stimulation[27], any could malfunction for a variety of reasons (overuse, manufacturing defect, weakness, improper installation, etc.). Similarly, water storage containers, especially those connected to flowlines as shown in Figures 14 and 15, represent common locations for equipment failure. Among the unconventional wells drilled between 2005 and 2014 in four states (including Pennsylvania), 2 to 16% of sites reported spills each year, and 50% of those releases were attributed to flowlines or fluid storage in tanks or pits[53]. The USEPA reported a similar spill rate (1 to 10%) that encompassed both the fracture stimulation phase (chemical mixing, hydraulic fracturing fluids) and actively producing wells (produced water storage and handling)[2]. A more recent evaluation of reported data in Texas and Colorado estimated one spill for every 16 well pads developed[21].

In order for surface spills to pollute water resources, there needs to be sufficient volume spilled, and one or more pathways for the fluids/chemicals to reach water resources. Typical volumes of the four most frequently spilled materials at HF sites (wastewater, crude oil, drilling waste, and HF fluid) range from 100 to 10,000 L[57]. Spill volumes as high as 9×10^5L of fracture fluid have been reported in Pennsylvania, while larger spill volumes have been documented in other states (North Dakota, 2.7×10^6L wastewater and 3.7×10^6L of freshwater)[50, 57]. In addition to releases from piping, equipment, tanks and containers, releases of fluids from the well pad can occur if fluids overtop berms, breach secondary containment facilities, break through geosynthetic/subbase materials, or spray through the air. Such releases may result in contamination of streams or groundwater aquifers via overland flow or soil infiltration. Reported spills on well pads in four states were on average 580 m from a stream; however, distances between sites and streams were considerably shorter in Pennsylvania (268 m) and 5.3% of Pennsylvania spills were within required stream setbacks (30.5 m)[57]. Moreover, 85% of spills in Pennsylvania occurred in watersheds which investigators classified as higher value, suggesting Pennsylvania is at higher risk for contamination of drinking water resources as a result of HF-related spills, given the location of HF sites relative to freshwater resources[57]. In addition to migration to streams and in instances when pollutants do not reach surface streams, surface release at times results in pollution of groundwater resources. At least 300 instances in which surface releases of HF wastewater have contaminated residential groundwater have been documented in the Marcellus shale in PA[58, 59]. Another case of residential groundwater contamination in the Marcellus shale, PA was attributed to release of drilling and/or HF fluids through the shallow subsurface from a wellhead or wastewater pit[60].

In addition to leaks and spills described above, there exists the potential for a well "blowout" which constitutes a major failure at the wellhead during hydraulic stimulation, drillout, flowback, or initial production. Between 2005 and 2014 blowouts were reported at a rate of approximately one for every 1000 wells[53, 61]. In Pennsylvania, 9 blowouts were documented by the PADEP between 2011 and 2018.[xxxi] One of these incidents occurred in Bradford County, PA and resulted in the release of an unknown amount of HF fluid and formation brine into nearby fields and a creek, damaging the trout habitat and contaminating water supplies for 16 families[62]. In 2018, a blowout occurred in Powhaten Point, OH where an explosion released natural gas, condensate, produced water, and brine into tributaries of the Ohio River[63]. The situation took 20 days to cap, and resulted in the release of millions of cubic feet of natural gas into the air, subsequent fires, more than 5,000 gallons of produced fluid discharge, and the voluntary evacuation of 94 residences[64]. In addition to major air, water, and soil contamination, blowouts have been associated with well pad fires/explosions, and losses of life[61]. For example, during a 2014 blowout event in Greene County, PA one person lost their life and a second was injured during explosions and fires from two wells at the site.[xxxii] For 5 days until the wells were capped, produced fluids were discharged from the Greene County site. HF operators prepare emergency management plans and sites are typically equipped with kits to deal with minor spills. On-site spills and leaks would generally be mitigated by containing the area, using absorptive media to collect released fluid, and fixing the malfunctioning equipment. However, because blowouts represent situations where fluids and gases are not under control at the wellhead (in terms of pressures or flow rates), emergency responders would typically assist in containing fires and/or discharges in order to minimize environmental and public health impacts. A well operator will use blow out prevention equipment to protect air and water resources.

Improperly Cased Wells. Shale wells create new pathways into the deep subsurface where formations are over pressurized; therefore, HF wells that are not properly sealed within the rock generate new pathways for residual O&G fluids and gases to escape[32]. Because shale wells penetrate fresh groundwater aquifers, it is critical that wells be sealed off from contact with shallow water bearing formations to prevent fracturing fluids, natural gas and production fluids from migrating into aquifers. In Pennsylvania, operators are required to encase and cement wells to allow effective control of the well at all times, including to prevent the migration of gas and other fluids into groundwater[27].[xxxiii] Casings are facilities designed to protect water resources; nevertheless, well leakage can occur through joints or cracks in casings or through cementation materials meant to bind telescoping casings to each other and to the earth[2]. Wells that were properly cased during installation can lose integrity during pressure testing, hydraulic stimulation, or production activities[65]. Geochemical reactions between the rock, cement and steel, or the cement, steel, and produced water can corrode the casing as the well matures[32]. Migration of fugitive or stray gases (e.g., methane, ethanes or other noble gases) from improperly cased wells has been the source of intense debate[26, 50, 66-68]. In the township of Dimock, PA, groundwater wells for 18 residences were contaminated with natural gas that migrated from deeper geologic formations into shallower aquifers from poor cementation around production casings from HF wells.[xxxiv] Another documented case of water resource pollution occurred in Kildeer, ND when production casing ruptured during hydraulic stimulation[2]. Regardless of the source, failures associated with well construction including casings and cementation are estimated to occur at 1-10% of all HF wells[69] and 3.4% in Pennsylvania[5] and are likely to result in water resource pollution from

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[xxxi] PADEP, Data Furnished in Response to DRBC's Request for Information No. 2018-07, Feb. 8, 2019.
[xxxii] *Consent Assessment of Civil Penalty in the matter of: Chevron Appalachia, LLC,* Commonwealth of Pennsylvania Department of Environmental Protection, May 21, 2015
[xxxiii] 25 Pa. Code § 78a.81(a).
[xxxiv] U.S. EPA, 2016. Hydraulic Fracturing for Oil and Gas: Impacts from The Hydraulic Fracturing Water Cycle on Drinking Water Resources in the United States (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-16/236F, p. 6-11 (Text Box 6-2).

the subsurface migration of HF stimulation fluids, formation fluids, and natural gas into fresh groundwater and surface water resources[2].

Wastewater Releases on Access Roads. Well pad access roads represent another risk to water resources through road maintenance activities and fluid/chemical hauling. Unlike well pads, where secondary containment systems are constructed to hold water-based and other fluids in the event of accidental spills, access roads do not protect water resources from spills through liners or berms. Therefore, in the event of a hauling accident involving chemicals, production wastewater or other residual O&G fluids, or condensate/oil, fluid migration into water resources is likely. A recent study based on Texas and Colorado spill data estimated that a spill occurs during transportation for every 19 well pads developed[21]. This is not surprising considering the frequency and volume of fluid hauling required at HF sites from drilling through production activities. Several hundred truck loads of HF residual fluids will likely be removed from the proposed WLMG site over the lifetime of the well.

Heavy truck activity on HF site access roads results in the need for regular maintenance, especially during freeze-thaw cycles. At least a dozen states allow O&G brines to be used for dust control, road stabilization, and/or deicing[22]. Although PA prohibits the spreading of unconventional formation brine on roadways, application of conventional brines is still allowed[35].[xxxv] Spreading of O&G wastewaters on access roads constitutes a discharge of pollutants (e.g., salts, organic constituents, radium) that may leach into nearby waterways. The organic constituents of O&G wastewaters may affect key trophic levels in aquatic ecosystems (e.g., signaling pathways in the water flea *Daphnia magna*)[22].

Summary and Conclusion

In my opinion, the facilities on WLMG's well pad site will be deliberately designed to utilize, manage, and conserve water resources during natural gas development and production process in the following ways:

- Water-based fluids will be used for dust-suppression, de-icing, and/or stabilization of access roads and the well pad. After application, chemical modifiers used in these fluids will move from unimproved road surfaces into surface waters, groundwater and soils, potentially contaminating water resources. Plans must be developed in advance of performing these activities.
- The well pad most likely will be approximately six acres in size, and half this area will be used to store water, wastewater and chemicals. The well pad will be designed to accommodate the scale of activity; a longer lateral will require a larger water volume to be stored and utilized during the drilling and HF process, generate increased flowback and produced fluid volume, and require greater land use acreage for the well pad and associated off-site water storage activities. The well pad will also be designed to protect and conserve water resources through the use of liners, berms and other facilities.

[xxxv] 25 Pa. Code § 78a.70; 25 Pa. Code § 78a.70a; 25 Pa. Code § 78a.53; Pennsylvania Department of Environmental Protection: Approval of Brine Roadspreading Plans (1998), http://www.depgreenport.state.pa.us/elibrary/GetDocument?docId=8085&DocName=APPROVAL%20OF%20BRINE%20ROADSPREADING%20PLANS.PDF%20%20%3Cspan%20style%3D%22color%3Agreen%3B%22%3E%3C%2Fspan%3E%20%3Cspan%20style%3D%22color%3Ablue%3B%22%3E%3C%2Fspan%3E.

- WLMG expects to use up to 100 temporary and portable 500 barrel tanks ($2.1x10^6$ gallons) to store water and HF fluids on site during the well completion phase. WLMG expects to temporarily store residual fluids in up to twenty 21,000 gallon tanks. WLMG expects to construct one 12,600 gallon storage tank on site for every HF well drilled on the pad to collect produced water for the remaining productive life of the well (20-50 years). The purpose of these containers is to manage water, wastewater and other fluids.
- In order to conserve water resources, best management practices for HF projects involve managing wastewaters (drill muds, HF fluids, produced fluids) and stored fuels (condensates, gasoline) through the construction and use of facilities such as temporary lined berms and/or secondary containment facilities. These planned facilities much be designed in advance of the project's construction.
- Chemicals, proppant, and water will be blended and routed through an elaborate array of steel piping into the wellhead at high pressures via fracture stimulation pumps. The fluid-based HF stimulation sequence will be monitored and all equipment controlled by trained staff using a sophisticated data acquisition system housed in an on-site trailer.
- Given the number and scale of activities at each HVHF site utilizing and managing water resources, unintended water loss and/or accidental release of HF residual fluids containing pollutants are inevitable. Surface leaks and spills are commonplace, occurring at 2-16% of all HF sites. Failures of casings and cementation occur at an additional 1-10% of all HF wells. A well operator must plan for such leaks and spills and employ facilities to prevent the release/discharge via the surface and subsurface migration of HF stimulation fluids, formation fluids, and natural gas into fresh groundwater and surface water resources. Nevertheless, experience shows that these adverse impacts to water resources occur.
- In HVHF activities, the well bore penetrates drinking water aquifers. Accordingly, casings are employed to protect and conserve water resources from migration of fluids and gas from the wellbore into the aquifer. Nonetheless, instances of groundwater contamination resulting from casing and cementation failure have occurred.
- More than a thousand water and/or wastewater tanker truckloads will be transported *to the site* for use during HF activities while several hundred wastewater tanker truckloads will be transported *from the site* for reuse, treatment, or disposal over the life of the well. In the event of a hauling accident, residual O&G fluids may be released, and pollute water resources.
- More than 1,000 chemical substances have been used in HF projects. Many of these compounds pose a risk to drinking water and aquatic life if released to the environment.
- Water used for HVHF activities is consumptively used.
- Pennsylvania is at higher risk for contamination of drinking water resources as a result of HF-related spills, given the location of HF sites relative to freshwater resources. In addition, the discharge of treated residual fluids from HF activities in Pennsylvania has generated numerous environmental pollution problems in receiving water bodies and in downstream public drinking water treatment facilities.

All opinions in this report are rendered to a reasonable degree of scientific certainty. The author (PJ Mouser) has not testified as an expert or witness on any other cases in the last 4 years. PJ Mouser received compensation of $16,000 for the study and development of this testimony. Please see attached CV for a list of the PJ Mouser's experience and publications. Materials considered in this report include those noted in the footnotes and the cited references.

References

(1) Arthur, J.; Langhus, B.; Alleman, D. *Modern Shale Gas Development in the United States: A Primer*; US Department of Energy, Office of Fossil Energy: 2009.

(2) USEPA *Hydraulic Fracturing For Oil And Gas: Impacts From The Hydraulic Fracturing Water Cycle On Drinking Water Resources In The United States (Final Report)*; U.S. Environmental Protection Agency: 2016.

(3) King, G. E. In *Thirty Years of Gas Shale Fracturing: What Have We Learned? SPE 133456*, SPE Shale Gas Production Conference, Florence, Italy, September 19-22, 2010; Society of Petroleum Engineers: Florence, Italy, 2010.

(4) Veatch, R.; King, J. D.; Holditch, S. A., *Essentials of Hydraulic Fracturing Vertical and Horizontal Wellbores*. PennWell Corporation: Tulsa, OK, 2017; p 812.

(5) Vidic, R. D.; Brantley, S. L.; Vandenbossche, J. M.; Yoxtheimer, D.; Abad, J. D., Impact of Shale Gas Development on Regional Water Quality. *Science* **2013,** *340*, (6134).

(6) Kondash, A. J.; Albright, E.; Vengosh, A., Quantity of flowback and produced waters from unconventional oil and gas exploration. *Science of The Total Environment* **2017,** *574*, 314-321.

(7) USEPA *Detailed Study of the Centralized Waste Treatment Point Source Category for Facilities Managing Oil and Gas Extraction Wastes*; U.S. Environmental Protection Agency: 2018; p 262.

(8) Chapman, E. C.; Capo, R. C.; Stewart, B. W.; Kirby, C. S.; Hammack, R. W.; Schroeder, K. T.; Edenborn, H. M., Geochemical and Strontium Isotope Characterization of Produced Waters from Marcellus Shale Natural Gas Extraction. *Environ. Sci. Technol.* **2012,** *46*, (6), 3545-3553.

(9) Abualfaraj, N.; Gurian, P. L.; Olson, M. S., Characterization of Marcellus Shale Flowback Water. *Environmental Engineering Science* **2014,** *31*, (9), 514-524.

(10) Orem, W.; Tatu, C.; Varonka, M.; Lerch, H.; Bates, A.; Engle, M.; Crosby, L.; McIntosh, J., Organic substances in produced and formation water from unconventional natural gas extraction in coal and shale. *International Journal of Coal Geology* **2014,** *126*, (0), 20-31.

(11) Lutz, B. D.; Lewis, A. N.; Doyle, M. W., Generation, transport, and disposal of wastewater associated with Marcellus Shale gas development. *Water Resour. Res.* **2013,** *49*, (2), 647-656.

(12) Clark, C. E.; Horner, R. M.; Harto, C. B., Life Cycle Water Consumption for Shale Gas and Conventional Natural Gas. *Environ. Sci. Technol.* **2013,** *47*, (20), 11829-11836.

(13) Gallegos, T. J.; Varela, B. A.; Haines, S. S.; Engle, M. A., Hydraulic fracturing water use variability in the United States and potential environmental implications. *Water Resour. Res.* **2015,** *51*, (7), 5839-5845.

(14) NYSDEC *Final Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program*; New York Department of Environmental Conservation: Albany, NY, 2015.

(15) DRBC, Proposed New 18 CFR Part 440 -Hydraulic Fracturing in Shale and Other Formations. In Commission, D. R. B., Ed. Delaware River Basin Commission: November 30, 2017, 2017; Vol. 18 CFR Part 440, p 8.

(16) Nicot, J. P.; Scanlon, B. R.; Reedy, R. C.; Costley, R. A., Source and Fate of Hydraulic Fracturing Water in the Barnett Shale: A Historical Perspective. *Environ. Sci. Technol.* **2014,** *48*, (4), 2464-2471.

(17) Kondash, A.; Vengosh, A., Water Footprint of Hydraulic Fracturing. *Environmental Science & Technology Letters* **2015,** *2*, (10), 276-280.

(18) Jiang, M.; Hendrickson, C. T.; VanBriesen, J. M., Life Cycle Water Consumption and Wastewater Generation Impacts of a Marcellus Shale Gas Well. *Environ. Sci. Technol.* **2014,** *48*, (3), 1911-1920.

(19) Piechota, T.; Van Ea, J.; Bastista, J.; Stave, K.; James, D. *Potential environmental impacts of dust suppressants: avoiding another times beach: an expert panel summary, Las Vegas, NV, May 30-31, 2002*; 600/R-04/031; USEPA: 2004.

(20) PDEP, Roadspreading of Brine for Dust Control and Road Stabilization. In https://spcregion.org/water/pdf/November17Brine/Roadspreading of Brine For Dust Control and Road Stabilization.pdf, Protection, P. D. o. E., Ed. PDEP: 2013; Vol. 8000-FS-DEP1801.

(21) Clancy, S. A.; Worrall, F.; Davies, R. J.; Gluyas, J. G., The potential for spills and leaks of contaminated liquids from shale gas developments. *Science of The Total Environment* **2018,** *626*, 1463-1473.

(22) Tasker, T. L.; Burgos, W. D.; Piotrowski, P.; Castillo-Meza, L.; Blewett, T. A.; Ganow, K. B.; Stallworth, A.; Delompré, P. L. M.; Goss, G. G.; Fowler, L. B.; Vanden Heuvel, J. P.; Dorman, F.; Warner, N. R., Environmental and Human Health Impacts of Spreading Oil and Gas Wastewater on Roads. *Environ. Sci. Technol.* **2018,** *52*, (12), 7081-7091.

(23) EIA *Marcellus Shale Play Geology Review*; U.S. Energy Information Administration: Washington, D.C., 2017.

(24) Hyne, N., *Nontechnical Guide to Petroleum Geology, Exploration, Drilling & Production*. 3rd ed.; PennWell Corporation: Tulsa, OK, 2012; p 724.

(25) Vengosh, A.; Jackson, R. B.; Warner, N.; Darrah, T. H.; Kondash, A., A Critical Review of the Risks to Water Resources from Unconventional Shale Gas Development and Hydraulic Fracturing in the United States. *Environ. Sci. Technol.* **2014,** *48*, (15), 8334-8348.

(26) Darrah, T. H.; Vengosh, A.; Jackson, R. B.; Warner, N. R.; Poreda, R. J., Noble gases identify the mechanisms of fugitive gas contamination in drinking-water wells overlying the Marcellus and Barnett Shales. *Proceedings of the National Academy of Sciences* **2014,** *111*, (39), 14076.

(27) 25 Pa. Code Chapters 78 and 78a.

(28) Knox, D.; Jiang, P. In *Drilling Further with Water-Based Fluids - Selecting the Right Lubricant* SPE International Symposium on Oilfield Chemistry,, The Woodlands, TX, 2-4 February, 2005, 2005; Society of Petroleum Engineers: The Woodlands, TX, 2005.

(29) John C. Holko Dep., Aug. 28, 2019.

(30) Kondash, A. J.; Lauer, N. E.; Vengosh, A., The intensification of the water footprint of hydraulic fracturing. *Science Advances* **2018,** *4*, (8), eaar5982.

(31) Letter from John C. Holko, President, Lenape Resources, Inc., to A.J. Sandone, CEO, Wayne Land & Mineral Group, LLC (June 18, 2019) (WLMG 2229-2233).

(32) Jackson, R. B.; Vengosh, A.; Carey, J. W.; Davies, R. J.; Darrah, T. H.; O'Sullivan, F.; Pétron, G., The Environmental Costs and Benefits of Fracking. *Annual Review of Environment and Resources* **2014,** *39*, (1), 327-362.

(33) PADEP *Oil and Gas Annual Report*; Pennsylvania Department of Environmental Protection: 2018.

(34) A.J. Sandone III Dep., Sept. 3, 2019.

(35) PDEP, Environmental Protection Performance Standards at Oil an Gas Well Sites. In *25 PA Code Chs. 78 and 78a*, Pennsylvania Department of Environmental Protection: 2016.

(36) Gregory, K. B.; Vidic, R. D.; Dzombak, D. A., Water Management Challenges Associated with the production of Shale Gas by Hydraulic Fracturing. *Elements* **2011,** *7*, (3), 181-186.

(37) Elsner, M.; Hoelzer, K., Quantitative Survey and Structural Classification of Hydraulic Fracturing Chemicals Reported in Unconventional Gas Production. *Environ. Sci. Technol.* **2016,** *50*, (7), 3290-3314.

(38) Arthur, J.; Bohm, B.; Layne, M., Hydraulic Fracturing Considerations for Natural Gas Wells of the Marcellus Shale. In *The Ground Water Protection Council Annual Forum*, Cincinatti, OH, 2008.

(39) Waxman, H.; Markey, E.; DeGette, D., Chemicals used in hydraulic fracturing. In U. S. House of Representatives, Committee on Energy and Commerce: 2011.

(40) Stringfellow, W. T.; Domen, J. K.; Camarillo, M. K.; Sandelin, W. L.; Borglin, S., Physical, chemical, and biological characteristics of compounds used in hydraulic fracturing. *Journal of Hazardous Materials* **2014,** *275*, (0), 37-54.

(41) FracFocus Chemical Disclosure Registry. Access at http://www.fracfocusdata.org/DisclosureSearch/ (Oct 8, 2019).

(42) Elliott, E. G.; Ettinger, A. S.; Leaderer, B. P.; Bracken, M. B.; Deziel, N. C., A systematic evaluation of chemicals in hydraulic-fracturing fluids and wastewater for reproductive and developmental toxicity. *Journal Of Exposure Science And Environmental Epidemiology* **2016,** *27*, 90.

(43) Cozzarelli, I. M.; Skalak, K. J.; Kent, D. B.; Engle, M. A.; Benthem, A.; Mumford, A. C.; Haase, K.; Farag, A.; Harper, D.; Nagel, S. C.; Iwanowicz, L. R.; Orem, W. H.; Akob, D. M.; Jaeschke, J. B.; Galloway, J.; Kohler, M.; Stoliker, D. L.; Jolly, G. D., Environmental signatures and effects of an oil and gas wastewater spill in the Williston Basin, North Dakota. *Science of The Total Environment* **2017,** *579*, 1781-1793.

(44) Cluff, M. A.; Hartsock, A.; MacRae, J.; Carter, K. E.; Mouser, P. J., Temporal Changes in Microbial Ecology and Geochemistry in Produced Water from Hydraulically Fractured Marcellus Shale Gas Wells. *Environ. Sci. Technol.* **2014,** *48*, (11), 6508–6517.

(45) Barbot, E.; Vidic, N. S.; Gregory, K. B.; Vidic, R. D., Spatial and Temporal Correlation of Water Quality Parameters of Produced Waters from Devonian-Age Shale following Hydraulic Fracturing. *Environ. Sci. Technol.* **2013,** *47*, (6), 2562-2569.

(46) Paukert Vankeuren, A. N.; Hakala, J. A.; Jarvis, K.; Moore, J. E., Mineral Reactions in Shale Gas Reservoirs: Barite Scale Formation from Reusing Produced Water As Hydraulic Fracturing Fluid. *Environ. Sci. Technol.* **2017,** *51*, (16), 9391-9402.

(47) Getzinger, G. J.; O'Connor, M. P.; Hoelzer, K.; Drollette, B. D.; Karatum, O.; Deshusses, M. A.; Ferguson, P. L.; Elsner, M.; Plata, D. L., Natural Gas Residual Fluids: Sources, Endpoints, and Organic Chemical Composition after Centralized Waste Treatment in Pennsylvania. *Environ. Sci. Technol.* **2015,** *49*, (14), 8347-8355.

(48) Burgos, W. D.; Castillo-Meza, L.; Tasker, T. L.; Geeza, T. J.; Drohan, P. J.; Liu, X.; Landis, J. D.; Blotevogel, J.; McLaughlin, M.; Borch, T.; Warner, N. R., Watershed-Scale Impacts from Surface Water Disposal of Oil and Gas Wastewater in Western Pennsylvania. *Environ. Sci. Technol.* **2017,** *51*, (15), 8851-8860.

(49) Wang, Y.; Small Mitchell, J.; VanBriesen Jeanne, M., Assessing the Risk Associated with Increasing Bromide in Drinking Water Sources in the Monongahela River, Pennsylvania. *Journal of Environmental Engineering* **2017,** *143*, (3), 04016089.

(50) Brantley, S. L.; Yoxtheimer, D.; Arjmand, S.; Grieve, P.; Vidic, R.; Pollak, J.; Llewellyn, G. T.; Abad, J.; Simon, C., Water resource impacts during unconventional shale gas development: The Pennsylvania experience. *International Journal of Coal Geology* **2014,** *126*, 140-156.

(51) Mohan, A. M.; Hartsock, A.; Hammack, R.; Vidic, R. D.; Gregory, K. B., Microbial communities in flowback water impoundments from hydraulic fracturing for recovery of shale gas. *FEMS Microbiol. Ecol.* **2013,** *86*, (3), 567-580.

(52) Overstreet, D.; Nestor, C., Supplemental letter from WLMG council to ML Greenfogel dated July 12, 2019. In 2019.

(53) Patterson, L. A.; Konschnik, K. E.; Wiseman, H.; Fargione, J.; Maloney, K. O.; Kiesecker, J.; Nicot, J.-P.; Baruch-Mordo, S.; Entrekin, S.; Trainor, A.; Saiers, J. E., Unconventional Oil and Gas Spills: Risks, Mitigation Priorities, and State Reporting Requirements. *Environ. Sci. Technol.* **2017,** *51*, (5), 2563-2573.

(54) Papoulias, D. M.; Velasco, A. L., Histopathological analysis of fish from Acorn Fork Creek, Kentucky exposed to hydraulic fracturing fluid releases. *Southeastern Naturalist* **2013,** *12*, (sp4), 92-111.

(55) Kuwayama, Y.; Roushot, S.; Krupnick, A.; Richardson, N.; Mares, J. *Pits versus Tanks: Risks and Mitigation Options for On-site Storage of Wastewater from Shale Gas and Tight Oil Development* Resources for the Future: Washington, DC, 2015; p 68.

(56) Oetjen, K.; Giddings, C. G. S.; McLaughlin, M.; Nell, M.; Blotevogel, J.; Helbling, D. E.; Mueller, D.; Higgins, C. P., Emerging analytical methods for the characterization and quantification of organic contaminants in flowback and produced water. *Trends in Environmental Analytical Chemistry* **2017,** *15*, 12-23.

(57) Maloney, K. O.; Baruch-Mordo, S.; Patterson, L. A.; Nicot, J.-P.; Entrekin, S. A.; Fargione, J. E.; Kiesecker, J. M.; Konschnik, K. E.; Ryan, J. N.; Trainor, A. M.; Saiers, J. E.; Wiseman, H. J.,

Unconventional oil and gas spills: Materials, volumes, and risks to surface waters in four states of the U.S. *Science of The Total Environment* **2017,** *581-582*, 369-377.

(58) Drollette, B. D.; Hoelzer, K.; Warner, N. R.; Darrah, T. H.; Karatum, O.; O'Connor, M. P.; Nelson, R. K.; Fernandez, L. A.; Reddy, C. M.; Vengosh, A.; Jackson, R. B.; Elsner, M.; Plata, D. L., Elevated levels of diesel range organic compounds in groundwater near Marcellus gas operations are derived from surface activities. *Proceedings of the National Academy of Sciences* **2015,** *112*, (43), 13184-13189.

(59) PADEP *Water Supply Determination Letters*; Pennsylvania Department of Environmental Protection: http://files.dep.state.pa.us/OilGas/BOGM/BOGMPortalFiles/OilGasReports/Determination_Letters/Regional_Determination_Letters.pdf, 2019.

(60) Llewellyn, G. T.; Dorman, F.; Westland, J. L.; Yoxtheimer, D.; Grieve, P.; Sowers, T.; Humston-Fulmer, E.; Brantley, S. L., Evaluating a groundwater supply contamination incident attributed to Marcellus Shale gas development. *Proceedings of the National Academy of Sciences* **2015,** *112*, (20), 6325-6330.

(61) Considine, T. J.; Watson, R. W.; Considine, N. B.; Martin, J. P., Environmental regulation and compliance of Marcellus Shale gas drillingEnvironmental Regulation and Compliance of Marcellus Shale Gas Drilling. *Environmental Geosciences* **2013,** *20*, (1), 1-16.

(62) AP, Gas Well Spews Polluted Water. *New York Times* April 20, 2011, 2011.

(63) USEPA *Pollution Report No. 2 ("POLREP #2) – XTO Energy Well Blowout – E18512, Powhatan Point, OH*; United State Environmental Protection Agency, Region V: Feb 20, 2018, 2018.

(64) DiSavino, S.; Palmer, K., Exxon's XTO caps leaking Ohio gas well, 20 days after blowout. *Reuters* 2018.

(65) Soeder, D. J., *Unconventional: The Development of Natural Gas from the Marcellus Shale.* Geological Society of America: Boulder, CO., 2017; Vol. Special Paper 527, p 141.

(66) Jackson, R. B.; Vengosh, A.; Darrah, T. H.; Warner, N. R.; Down, A.; Poreda, R. J.; Osborn, S. G.; Zhao, K.; Karr, J. D., Increased stray gas abundance in a subset of drinking water wells near Marcellus shale gas extraction. *Proceedings of the National Academy of Sciences* **2013,** *110*, (28), 11250.

(67) Warner, N. R.; Jackson, R. B.; Darrah, T. H.; Osborn, S. G.; Down, A.; Zhao, K. G.; White, A.; Vengosh, A., Geochemical evidence for possible natural migration of Marcellus Formation brine to shallow aquifers in Pennsylvania. *Proc. Natl. Acad. Sci. USA* **2012,** *109*, (30), 11961-11966.

(68) Osborn, S. G.; Vengosh, A.; Warner, N. R.; Jackson, R. B., Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing. *Proc. Natl. Acad. Sci. USA* **2011**.

(69) King, G. E.; King, D. In *Environmental risk arising from well construction failure: differences between barrier failure and well failure, and estimates of failure frequency across common well types, locations and well age.* , SPE Annual Technical Conference, New Orleans, LA, Sept 30-Oct 2, 2013; Society of Petroleum Engineers: New Orleans, LA, 2013.

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Educational Background

University of Vermont, Burlington, VT	Civil and Environmental Engineering	Ph.D.	2006
University of Vermont, Burlington, VT	Civil and Environmental Engineering	M.S.	2003
Utah State University, Logan, UT	Environmental Engineering	B.S.	1998

Employment History

University of New Hampshire, Durham

Jan 2018 – current Administrator, Environmental Engineering Undergraduate Program
Aug 2017 – current Associate Professor, Dept. of Civil and Environmental Engineering

The Ohio State University, Columbus

2017– 2019 Adjunct Associate Professor, Dept. of Civil, Envr., and Geodetic Engr.
June 2017–Aug 2017 Associate Professor, Dept. of Civil, Environmental, and Geodetic Engr.
2014 – 2017 Graduate Program Faculty Member, Dept. of Microbiology
2012 – 2019 Faculty Member, Environmental Science Graduate Program
2011 – May 2017 Assistant Professor, Dept. of Civil, Environmental, and Geodetic Engr.

University of Maine, Orono

2010 – 2011 Assistant Research Professor, Dept. of Civil and Environmental Engr.

Sanborn, Head & Associates, Portland, ME

2007 – 2010 Project Manager/Senior Project Engineer

University of Massachusetts, Amherst

2006 – 2007 Postdoctoral Research Associate, Dept. of Microbiology
Advisor: Dr. Derek Lovely

University of Vermont, Burlington

2000 – 2006 Graduate Research and Teaching Assistant, School of Engineering
Advisors: Dr. Donna Rizzo (Ph.D.) and Dr. W. Cully Hession (M.S.)

Municipality of Logan, Utah

1998 – 2000 Environmental Engineer, Environmental Health Division
1997 – 1998 Engineering Intern, Permits and Compliance Division

Metropolitan Water District of Salt Lake City, UT

1997 Engineering Intern, Little Cottonwood Water Treatment Facility

Professional Registration

2009-present Professional Engineer (P.E.), State of Maine #12026

SCHOLARLY WORK

ARTICLES IN REFEREED JOURNALS

No.	Journal Details
1.	*Evans MV, Sumner A, Daly RA, *Luek JL, Plata D, Wrighton KC, **Mouser PJ.** Hydraulically fractured natural-gas well microbial communities contain genomic (de)halogenation potential. (2019, in press). *Environmental Science & Technology Letters*. doi/10.1021/acs.estlett.9b0047.
2.	*Evans MV, Getzinger G, *Luek JL, *Hanson AJ, McLaughlin MC, Blotevogel J, Welch SA, Nicora CD, Purvine SO, Xu C, Cole DR, Darrah TH, Hoyt DW, Metz TO, Ferguson PL, Lipton MS, Wilkins MJ, **Mouser PJ**, *In situ* transformation of ethoxylate and glycol surfactants by shale-colonizing microorganisms during hydraulic fracturing, (2019). *International Society of Microbial Ecology Journal (ISME)*, doi: 10.1038/s41396-019-0466-0.
3.	*Hanson AJ, *Luek JL, *Tummings S, McLaughlin M, Blotevogel J, **Mouser PJ**. (2019). High total dissolved solids in shale gas wastewater inhibits biodegradation of alkyl and nonylphenol ethoxylate surfactants. (2019). *Science of the Total Environment*, 668, 1094-1103.
4.	Booker AE, Hoyt DW, Meulia T, Eder E, Nicora CD, Purvine SO, Daly RA, Moore JD, Wunch K, Pfiffner S, Lipton MS, **Mouser PJ**, Wrighton KC, Wilkins MJ. (2019). Deep Subsurface Pressure Stimulates Metabolic Versatility in Shale-Colonizing *Halanaerobium*. *Applied and Environmental Microbiology*.
5.	Plata DL, Jackson RB, Vengosh A, **Mouser PJ.** (2019). More than a decade of hydraulic fracturing and horizontal drilling research. *Environmental Sciences: Processes & Impacts* 21 (2), 193-194.
6.	Akondi R. Sharma S, *Trexler R, **Mouser PJ,** Pfiffner S. (2019). Microbial Lipid Biomarkers Detected in Deep Subsurface Black Shales. *Environmental Sciences: Processes & Impacts*, 21, 291-307.
7.	*Evans MV, *Panescu J, *Hanson AJ, Sheets J, Welch SA, *Nastasi N, Daly RA, Cole DR, Darrah TH Wilkins MJ, Wrighton KC, **Mouser PJ.** (2018), Influence of *Marinobacter* and *Arcobacter* taxa on system biogeochemistry during early production of hydraulically fractured shale gas wells in the Appalachian Basin. *Frontiers of Microbiology*, 9, 2646.
8.	*Luek JL, Hari M, Schmitt-Kopplin P, **Mouser PJ,** Gonsior M. (2019). Organic sulfur fingerprint indicates continued injection fluid signature 10 months after hydraulic fracturing. *Environmental Science: Processes & Impacts*, 21, 206-213. Doi: 10.1039/C8EM00331A
9.	Daly R, Roux S, Borton MA, Morgan DM, Johnston MD, Booker AE, Hoyt DW, Meulia T, Wolfe RA, *Hanson AJ, **Mouser PJ,** Sullivan MB, Wrighton KC, Wilkins MJ, (2018) Viruses control dominant bacteria colonizing the terrestrial deep biosphere after hydraulic fracturing. *Nature Microbiology*, 4, 352-361.

10.	Rogers JD, Ferrer I, Thurman EM, Rosenblum JS, *Evans M, **Mouser PJ**, Ryan JN. (2019). Degradation of polyethylene glycol and polypropylene glycol in microcosms of produced water and surficial aquifer sediment. *Environmental Science: Processes & Impacts*, 21, 256-268. DOI:10.1039/C8EM00291F
11.	*Brooker MR, *Evert MH, Longnecker K, Kujawinski, EB, **Mouser PJ**. (2018). Discrete Organic Phosphorus Signatures are Evident in Pollutant Sources within a Lake Erie Tributary. *Environmental Science & Technology*, 52 (12) 6771-6779. DOI: 10.1021/acs.est.7b05703.
12.	Borton MA, Hoyt DW, Roux S, Daly RA, Welch SA, Nicora CD, Purvine S, Eder EK, *Hanson AJ, Sheets JM, Morgan DM, Sharma S, Carr TR, Cole DR, **Mouser PJ**, Lipton MS, Wilkins MJ, Wrighton KC. (2018). *In vitro* interactions scaled to *in situ* conditions: microorganisms predict field scale biogeochemistry in hydraulically fractured shale. *Proceedings of the National Academy of Science*, doi.org/10.1073/pnas.1800155115.
13.	*Panescu J, Daly R, Wrighton K, Mouser, PJ. (2018). Draft Genome Sequences of Two Chemosynthetic *Arcobacter* Strains Isolated from Hydraulically Fractured Wells in Marcellus and Utica Shales, *Genome Announcements*, 6 (20), e00159-18. doi:10.1128/genomeA.00159-18.
14.	*Tummings S, *Panescu J, Daly R, Wrighton K, Mouser PJ. (2018). Draft Genomes of Marinobacter Strains Recovered from Utica Shale Produced Fluids. *Genome Announcements*, 6 (14) 1-2. doi: 10.1128/genomeA.00155-18.
15.	Luek J, Hari, M, Schmitt-Kopplin P, Mouser PJ, Gonsior M. (2018). Temporal Dynamics of Halogenated Organic Compounds in Marcellus Shale Flowback. *Water Research*, 136, 200-206. doi.org/10.1016/j.watres.2017.07.012.
16.	*Heyob KM, Blotevogel J, Volker M, Brooker M, Lamendella R, Borch T, Lenhart JJ, and **Mouser PJ**. (2017). Biodegradation of Alkyl Ethoxylates and Poly Glycols in Hydraulic Fracturing Fluids: Rates Extents and Microbial Processes. *Environmental Science & Technology*, 51 (23) 13985-13994. 10.1021/acs.est.7b01539.
17.	Akondi R, *Trexler RV, Pfiffner S, **Mouser PJ** and Sharma S. (2017) A Modified Lipid Extraction Method for Deep Subsurface Shales. *Frontiers in Microbiology*. doi: 10.3389/fmicb.2017.01408.
18.	Booker A, Borton MA, Daly R, Welch S, Nicora C, Hoyt D, Wilson T, Purvine S, Wolfe R, Sharma S, **Mouser P,** Cole D, Lipton M, Wrighton K, Wilkins, M. (2017). Sulfide Generation by Dominant *Halanaerobium* Microorganisms in Hydraulically Fractured Shales, *mSphere* of the American Society of Microbiology, 2 (4), e00257-17. doi: 10.1128/mSphereDirect.00257-17.
19.	Luek J, Schmitt-Kopplin P, **Mouser PJ,** Liberatore HK, Richardson SD, Gonsior M. (2017). Halogenated organic compounds identified in hydraulic fracturing wastewaters using ultrahigh resolution mass spectrometry. *Environmental Science & Technology*, 51 (10), 5377-5385. doi: 10.1021/acs.est.6b06213.
20.	**Mouser PJ,** Borton MA, Darrah T, Hartsock A, Wrighton KC. (2016). Fracturing offers View of Microbial Life in the Deep Terrestrial Subsurface. *FEMS Microbiological Ecology,* fiw166. doi: 10.1093/femsec/fiw166.

21.	Daly RA, Borton, MA, Wilkins MJ, Hoyt DW, Kountz DJ, Wolfe RA, Welch, SA, Marcus, DN, *Trexler RV, Kryzcki JA, MacRae JD, Cole, DA, **Mouser PJ**, Wrighton KC, (2016). Microbial metabolisms in a new 2.5 km deep ecosystem created by hydraulic fracturing in shales. *Nature Microbiology*, 1, 16146. doi:10.1038/nmicrobiol.2016.146.
22.	**Mouser PJ,** *Liu S, *Cluff M, *McHugh M, Lenhart JJ, MacRae J, (2016). Redox Conditions Alter Biodegradation Rates and Microbial Community Dynamics of Hydraulic Fracturing Fluid Organic Additives in Soil–Groundwater Microcosms. *Environmental Engineering Science*, 33 (10), 1-12. doi.org/10.1089/ees.2016.0031.
23.	He X, Liu Y-L, *Conklin A, Westrick J, Weavers LK, Dionysiou DD, Lenhart JJ, **Mouser PJ,** Szlag D, and Walker HW, (2016). Toxic cyanobacteria and drinking water supply: Impacts, detection and treatment, *Harmful Algae,* 54, 174-193. Doi: 10.1016/j.hal.2016.01.001.
24.	*Kekacs DJ, Drolette B, *Brooker M, Plata D, and **Mouser PJ,** (2015). Aerobic Biodegradation of Organic Compounds in Hydraulic Fracturing Fluid, *Biodegradation*. 26 (4), 271-287. doi: 10.1007/s10532-015-9733-6.
25.	*Kekacs DJ, *McHugh M, and **Mouser PJ,** (2015). Physical Changes in Produced Fluids from Hydraulic Fractured Wells in the Marcellus Shale. *Journal of Environmental Engineering*, 06015006, doi: 10.1061/(ASCE)EE.1943-7870.0000985.
26.	*Krinks JK, Qiu M, Mergos IA, Weavers LK, **Mouser PJ**, Verweij H, (2015). Piezoceramic membrane with built-in ultrasonic defouling. *Journal of Membrane Science*, 494, 130-135. doi 10.1016/j.memsci.2015.07.058
27.	Wilkins MJ, Daly R, **Mouser PJ,** *Trexler R, Sharma S, Cole DR, Peterson L, Wrighton KC, Biddle JF, Denis E, Fredrickson JK, Kieft TL, Onstott TC, Pfiffner SM, Phelps TJ, Schrenk MO, (2014). Trends and Future Challenges in Sampling the Deep Terrestrial Biosphere. *Frontiers in Microbiology, Systems Microbiology*, doi: 10.3389/fmicb.2014.00481.
28.	**Mouser PJ,** N'Guessan AL, Qafoku N, Sinha M, Peacock A, Williams KH, Figueroa L, and Long PE, (2014). Influence of Carbon and Microbial Community Priming on the Attenuation of Uranium in a Contaminated Floodplain Aquifer. *Groundwater*. doi: 10.1111/gwat.12238.
29.	*Brooker M, Bohrer G, **Mouser PJ,** (2014). Microbial Factors Affecting Methane Emission in Wetland Sediments. *Journal of Ecological Engineering*, 72, 84-94. DOI: 10.1016/j.ecoleng.2014.05.028.
30.	*Cluff M, Hartsock A, MacRae J, Carter K, **Mouser PJ**, (2014), Temporal Changes in Microbial Ecology and Geochemistry in Produced Water from Hydraulically Fractured Marcellus Shale Gas Wells. *Environmental Science & Technology*. 48, 11, 6508–6517, doi:10.1021/es501173p.
31.	Qafoku N, Gartman B, Kukkadapu R, Arey B, **Mouser PJ,** Heald S, Williams KH, Resh C, Yabusaki S, Long PE, (2014). Complex Uranium Interactions in a Multi-Element Contaminated, Subsurface Naturally Reduced Zone. *Applied Geochemistry*, 14, 77-85. doi.org/10.1016/j.apgeochem.2013.12.001.

32.	Bibby KJ, Brantley SL, Reible DD, Linden KG, **Mouser PJ**, Gregory KB, Ellis BR, and Vidic RD, (2013). Suggested Reporting Parameters for Investigations of Wastewater from Unconventional Shale Gas Extraction. *Environmental Science & Technology,* 47, (23), 13220-13221. doi: 10.1021/es404960z.
33.	Pearce A, Rizzo DM, and **Mouser PJ,** (2011). Subsurface Characterization of Groundwater Contamination using Microbial Community Profile Data and a Non-Parametric Decision-Making Process *Water Resources Research*, 47, W06511, doi:10.1029/2010WR009992.
34.	Zhuang K, Izallalen M, **Mouser PJ**, Richter H, Risso C, Mahadevan R, Lovley DR, (2011). Genome-Scale Dynamic Modeling of the Competition Between *Rhodoferax* and *Geobacter* in Anoxic Subsurface Environments. *Intl. Society for Microbial Ecology (ISME) Journal,* 5, 305-316. doi: 10.1038/ismej.2010.117.
35.	**Mouser PJ,** Rizzo DM, Druschel G, Morales SE, Hayden N, O'Grady P, Stevens L, (2010). Microbial Community Profiles Enhance Detection of Groundwater Contamination from a Leaking Waste Disposal Site. *Water Resources Research,* 46, W12506, doi:10.1029/2010WR009459.
36	Elifantz H, N'Guessan AL, **Mouser PJ**, Williams KH, Wilkins M, Ward JE, Long PE, Lovley DR, (2010). Expression of Acetate Permease-like (apl) Genes in Subsurface Communities of *Geobacter* species under Fluctuating Acetate Concentrations. *FEMS Microbiological Ecology,* 73, (3), 441-449. doi: 10.1111/j.1574-6941.2010.00907.x.
37	N'Guessan AL, Elifantz H, Nevin K, **Mouser PJ**, Methe B, Woodward TL, Manley K, Williams KH, Wilkins M, Larsen JT, Long PE, Lovley DR, (2010). Molecular Analysis of Phosphate Limitation in *Geobacteraceae* During Bioremediation of a Uranium-Contaminated Aquifer, *ISME Journal*, 4, 253-266. doi:10.1038/ismej.2009.115.
38.	DiDonato Jr. RJ, Young ND, Butler JE, Chin K, Hixson KK, **Mouser PJ**, Lipton MS, DeBoy R, Methé BA, (2010). Genome Sequence of the Deltaproteobacterial Strain NaphS2 and Analysis of Differential Gene Expression during Anaerobic Growth on Naphthalene. *PLoS ONE* 5(11): e14072. doi:10.1371/journal.pone.0014072.
39.	Callister SJ, Wilkins MJ, Nicora CD, Williams KH, Banfield JF, VerBerkmoes NC, Hettich RL, N'Guessan L, **Mouser PJ**, Elifantz H, Smith RD, Lovley DR, Lipton MS, and Long PE, (2010). Analysis of Biostimulated Microbial Communities from Field Experiments Reveals Temporal and Spatial Differences in Proteome Profiles. *Environmental Science & Technology,* 44:8897-8903. doi: 10.1021/es101029f.
40.	**Mouser PJ**, N'Guessan AL, Elifantz H, Holmes DE, Williams KH, Wilkins M, Long PE, Lovley DR, (2009). Influence of Ammonium on Bacterial Community Structure, Nitrogen Fixation and Ammonium Transporter Genes During *In Situ* Bioremediation of Uranium-Contaminated Groundwater, *Envr. Sci. & Technol.,* 43, (12), 4386-4392. doi: 10.1021/es8031055.
41.	Wilkins MJ, VerBerkmoes N, Williams KH. Callister SJ, **Mouser PJ**, Elifantz H, N'Guessan L, Thomas BC, Lipton MS, Lovley DR, Hettich RL, Long PE, Banfield JF, (2009). Proteogenomic Monitoring of *Geobacter* Physiology During Stimulated U

	Bioremediation, *Applied and Envr. Micro.*, 75, (20), 6591-6599. doi: 10.1128/AEM.01064-09.
42.	**Mouser PJ**, Holmes DE, Adams L, DiDinato R, Postier B, Liu A, Lovley DR, (2009). Quantifying Expression of *Geobacter* species Oxidative Stress Genes in Pure Culture and During Uranium Bioremediation, *ISME Journal*, 3, 454-465. doi: 10.1038/ismej.2008.126.

CONFERENCE PROCEEDINGS

1. Sharma S, Carr TR, Mouser PJ, Wrighton K, Cole D, Wilkins M, Darrah T, Hakala A. (2017). Biogeochemical Characterization of Core, Fluids, and Gas at MSEEL Site. In: Unconventional Resources Technology Conference, Austin, TX, URTeC 2669965.

PROFESSIONAL PRESENTATIONS

i. Invited Seminar Presentations (Given by Mouser)

1. *Tufts University, Dept. of Civil and Environmental Engineering*. Microbial Survival and Sustenance in Fractured Shale 10/2018.
2. *University of New Hampshire, Dept. of Earth Science*. Microbial Survival and Sustenance in Fractured Shale 09/2018.
3. *Gordon Research Conference, Environmental Sciences: Water*. The Outsiders: Microbial Survival and Sustenance in Fractured Shale, 6/2018.
4. *University of Vermont, Department of Civil and Environmental Engineering*. The Role of Microbial Communities in Hydraulically Fractured Shale Wells and Produced Wastewater, 4/2018.
5. *University of Maine, Department of Biology and Ecology*. Biodegradation of Organic Compounds in the Hydraulically Fractured Shale Ecosystem, 2/2018.
6. *Colorado State University, Civil and Environmental Engineering* and *CSU Water Center*, From the Land Down Under: Microbial Community Dynamics and Metabolic processes influencing organic additives in black shales, 11/2017.
7. *Youngstown State University, Lecture Series on Energy and the Environment*, Biodegradation of fracturing fluid additives: key microbial players and metabolisms influencing organic compound fate in shale produced fluids, 9/2017.
8. *University of Maryland, Center for Environmental Science*, Chesapeake Biological Laboratory Distinguished Lecture Series. Biodegradation of Organic Additives in the Hydraulic Fracturing System, 5/2017.
9. *University at Buffalo, SUNY*, Buffalo, NY. From the land down under – Environmental Bioprocesses in the Engineered Shale, 3/2017.

10. *University of New Hampshire*, Durham, NH. From the land down under – Environmental Bioprocesses in the Engineered Shale, 2/2017.
11. *Stone Laboratory Guest Lecture Series*, Put-in-Bay, OH. Microbial Modification of Natural and Anthropogenic Compounds in engineered systems, 6/2016.
12. *Ohio American Chemical Society Silver Circle*, Columbus, OH. Diving into shale – microbial travels and persistence in the hydraulic fractured ecosystem, 5/2016.
13. *Pennsylvania State University*, College Park, PA. Diving into shale – microbial travels and persistence in the hydraulic fractured ecosystem, 4/2016.
14. *Duquesne University*, Pittsburg, PA, Diving into shale – microbial travels and persistence in the hydraulic fractured ecosystem, 4/2016.
15. *Kenyon College*, Gambier, OH, Diving into shale – microbial travels and persistence in the hydraulic fractured ecosystem, 1/2016.
16. *University of Akron, Ohio*. Joint seminar to Geology and Biology Depts. Biodegradability of Organic Additives in Hydraulic Fracturing Fluids across Redox and Salinity Gradient, 9/2014.
17. *Pacific Northwest National Laboratory* (PNNL), Earth Sciences Division, Richmond, WA. A Temporal Microbial Metagenomics Trajectory after Hydraulic Fracturing in Marcellus Shale, 5/2014.
18. *The Ohio State University,* Department of Microbiology, Columbus, OH, The Role of Microorganisms in Shale Energy Development: From the Lab to the Field, 4/2014.
19. *University of Minnesota,* Department of Biochemistry, St. Paul, MN, Biodegradability of Hydraulic Fracturing Fluids by Wastewater Sludge and Sediment Microorganisms, 4/2014.
20. *Duke University,* Civil and Environmental Engineering, Durham, NC, Microorganisms and Shale Energy Development: From Laboratory Experiments to Field–Scale Observations, 3/2014.
21. *University of Pittsburgh*, Civil and Environmental Engineering, Pittsburgh, PA, Microorganisms and Shale Energy Development: From Laboratory Experiments to Field–Scale Observations, 2/2014.
22. *University of California Berkeley*, Energy Bioscience Institute, Berkeley, CA, Microorganisms and Shale Energy Development: From Laboratory Experiments to Field–Scale Observations, 10/2013.
23. *U.S. Geological Survey, Ohio Water Science Center*, Columbus, OH, Biotechnology Tools for Characterizing Subsurface Environments, 12/2012.
24. *Bowling Green State University*, Department of Biological Sciences, Bowling Green, OH, Detecting and Delineating Groundwater Contamination at a Waste Disposal Site using Microbial Community Profiles, 11/2011.
25. *Rensselaer Polytechnic Institute*, Department of Civil and Environmental Engr., Troy, NY, Molecular-scale Characterization of Dissolved Organic Matter from a Uranium Contaminated Aquifer and its Utilization by Native Microbial Communities, 10/2011.

26. *Water Management Association of Ohio and Ohio Water Resources Center* joint quarterly luncheon, Columbus, OH, Biotechnology Tools for Characterizing Microbial Ecology and Metabolic Condition in Freshwater Environments, 10/2011.

27. *Rensselaer Polytechnic Institute*, Department of Civil and Environmental Engineering, Troy, NY, Complex Systems Tools for Describing Spatiotemporal Changes in Microbial Community Dynamics in Subsurface Environments, 3/2011.

28. *The Ohio State University*, School of the Environment and Natural Resources, Columbus, OH, Using Multivariate and Spatial Statistics to Describe Spatiotemporal Changes in Microbial Ecology in Contaminated Environments, 10/2011.

29. *The Ohio State University*, The Environmental Science Graduate Program, Columbus, OH, Influence of Nitrogen on Microbial Ecology and Metabolic Condition of Bacteria During Uranium Bioremediation, 10/2010.

30. *The Ohio State University*, Department of Civil and Environmental Engineering and Geodetic Science, Columbus, OH, Influence of Nitrogen on Microbial Ecology and Metabolic Condition of Bacteria During Uranium Bioremediation, 6/2010.

31. *Clemson University*, Environmental Engineering and Earth Sciences, Clemson, SC, Detecting Contamination and Assessing the Metabolic State of Bacteria in Polluted Environments, 1/2010.

32. *University of Maine*, Department of Civil and Environmental Engineering, Orono, ME, Bacterial Community Structure and Metabolic State During Bioremediation of U-contaminated Groundwater, 10/2009.

33. *University of Vermont*, College of Engineering and Mathematics, Burlington, VT, Impact of Ammonium Microbial Community Structure and Ammonium Transporter Genes During U(VI) Bioremediation, 4/2009.

34. *Utah State University*, Center for Integrated BioSystems, Logan, UT, Impact of Ammonium Microbial Community Structure and Ammonium Transporter Genes During U(VI) Bioremediation, 10/2008.

35. *Utah State University,* Department of Environmental Engineering, Logan, UT, Delineating the Extent of Groundwater Contamination and Examining the Physiological Status of *in situ* Bacteria Involved in Subsurface Bioremediation: Biotechnology Tools for Environmental Engineers, 10/2008.

36. *University of Massachusetts*, Department of Civil and Environmental Engineering, Amherst, MA, Gene Expression Patterns under Conditions of Oxidative Stress in *Geobacter sulfurreducens*, 1/2007.

37. *University of Massachusetts*, Environmental Biotechnology Center, Department of Microbiology, Amherst, MA, Molecular-Based Microbiological Data in Detection and Long-Term Monitoring Strategies, 12/2005.

38. *University of Tennessee*, Center for Environmental Biotechnology, Knoxville, TN, Comparison of Site Characterization Methods using Microbiological Profiles, 11/2004.

ii. Other Presentations (Given by Mouser, a Mouser Research Group Member, or Collaborator)

1. Luek J, Murphy C, Wrighton KC, **Mouser PJ.** (2019). Detection of antibiotic and metal resistance genes in deep shale microbial community members. ACS annual conference, Orlando, FL, Mar 31-Apr 4, 2019.
2. Evans M, Luek J, Daly R, Wrighton KC, **Mouser PJ**. (2019). Microbial (de)halogenation in hydraulically fractured natural-gas wells in the Appalachian Basin. ACS annual conference, Orlando, FL, Mar 31-Apr 4, 2019.
3. **Mouser PJ,** Hanson AJ, Lipp JS, Trexler R, Booker A, Wrighton KC, Wilkins MJ, Pfiffner S, Hinrich K-U (2018). Microbial lipid biomarkers in the hydraulically fractured shale ecosystem: Chemical structures in produced fluid communities and a piezotolerant isolate. Deep Carbon Observatory Deep Life Community (DCL) Meeting, Shanghai, China Oct 31-Nov 1, 2018.
4. **Mouser PJ,** Heyob KM, Blotevogel J, Lenhart JJ, Borch T (2018). Pathways and Mechanisms for Natural Attenuation of Nonionic Surfactants in Hydraulic Fracturing Fluids if Released to Agricultural Soil and Groundwater. ACS annual conference, New Orleans, LA, Mar 19-22, 2018.
5. Hanson AJ*, Lipp JS, Hinrich K-U, **Mouser PJ** (2018). Microbial lipid biomarkers in a Marcellus Shale natural gas well: From remnant molecules to adapted communities. ACS annual conference, New Orleans, LA, Mar 19-22, 2018.
6. *Brooker MR, Longnecker K, Kujawinski E, **Mouser PJ** (2017). Discerning Organic Phosphorus Signatures in Pollutant Sources from Lake Erie Tributaries. International Association of Great Lakes Research Annual Conference. May 14, 2017 Detroit, MI.
7. *Rosi A, Mergos I, Verweij H, **Mouser PJ**, Weavers L (2017). Alteration of membrane-adherent biofilm properties by acoustic cavitation. American Chemical Society (ACS) annual conference, San Francisco, CA April 2-6, 2017.
8. *Hanson AJ, Lipp JS, Hinrich K-U, **Mouser PJ** (2017). High Resolution LC-MS Analysis of Microbial Lipid Biomarkers as Evidence of Deep Shale Microbial Life. ACS annual conference, San Francisco, CA April 2-6, 2017.
9. **Mouser PJ**, (2017). Biodegradation of Organic Additives in the Hydraulic Fracturing System: These Shale Wells Aint Sterile! ACS conference, San Francisco, CA April 2-6, 2017.
10. *Volker M, Getzinger GL, Metz T, Plata DL, Borton M, Wilkins M, Welch S, Cole D, Wrighton KC, and Mouser, PJ (2017). In situ biodegradation of ethoxylated surfactants by halotolerant bacteria in a hydraulically fractured shale well. ACS annual conference, San Francisco, CA April 2-6, 2017.
11. Plata D, Mouser PJ, Elsner M, Drollette B, and Sumner A (2017). Chemical transformations in high volume hydraulic fracturing fluids. ACS annual conference, San Francisco, CA April 2-6, 2017.

12. *Brooker MR, Longnecker K, Kujawinski E, Mouser PJ (2017). Discerning Organic Phosphorus Signatures in Pollutant Sources from Lake Erie Tributaries. Lake Erie Millennium Network 8th Binational Meeting. February 21, 2017, Windsor, ON, Canada

13. Brooker MR, Evert MH, Mouser PJ (2016). Discerning Organic Phosphorus Signatures in Pollutant Sources from Lake Erie Tributaries. Understanding Algal Blooms: State of the Science Conference. Sept 15, 2016, Toledo, OH.

14. *Trexler RV, Akondi R, Pfiffner S, Daly RA, Wilkins MJ, Sharma S, Wrighton KC, and **Mouser, PJ** (2016). Phospholipid Fatty Acid Evidence of Recent Microbial Life in Pristine Marcellus Shale Cores. Eastern Section American Association of Petroleum Geology (AAPG), Lexington, KY, Sept 25-27, 2016.

15. *Evert M, *Panescu J, Daly RA, Welch SA, *Hespen J, Sharma S, Cole D, Darrah TH, Wilkins MJ, Wrighton KC, **Mouser PJ** (2016). Temporal Changes in Fluid Biogeochemistry and Microbial Cell Abundance after Hydraulic Fracturing in Marcellus Shale. Eastern Section American Association of Petroleum Geology (AAPG), Lexington, KY, Sept 25-27, 2016.

16. *Hanson AJ, *Trexler RV, Mouser PJ (2016). Analysis of Microbial Lipid Biomarkers as Evidence of Deep Shale Microbial Life. Eastern Section American Association of Petroleum Geology (AAPG), Lexington, KY, Sept 25-27, 2016.

17. *Pansecu J, *Evert M, *Hespen J, Daly RA, Wrighton KC, **Mouser PJ** (2016). *Arcobacter* isolated from the produced fluids of a Marcellus shale well may play a currently unappreciated role in sulfur cycling. Eastern Section American Association of Petroleum Geology (AAPG), Lexington, KY, Sept 25-27, 2016.

18. Akondi R, *Trexler RV, Pfiffner S, **Mouser PJ** and Sharma S, (2016). Comparing different extraction methods for analyses of ester-linked diglyceride fatty acids in Marcellus Shale. Eastern Section American Association of Petroleum Geology (AAPG), Lexington, KY, Sept 25-27, 2016.

19. Borton MA, Daly RA, Morgan DM, Booker AE, Hoyt DW, **Mouser PJ,** Sharma S, Wilkins MJ, Wrighton KC (2016). *Methanohalophilus* is the dominant source of biogenic methane in hydraulically fractured shales. Eastern Section American Association of Petroleum Geology (AAPG), Lexington, KY, Sept 25-27, 2016.

20. Saup C, Daly RA, **Mouser PJ,** Wrighton KC, Wilkins MJ (2016). Enrichment and characterization of microorganisms persisting in deep shales and their interfaces. S Eastern Section American Association of Petroleum Geology (AAPG), Lexington, KY, Sept 25-27, 2016.

21. *Volker M, Getzinger GL, Hoyt, DW, Plata DL, Wrighton KC, and **Mouser, PJ** (2016). *In situ* biodegradation of alkyl ethoxylates by halotolerant bacteria in a hydraulically fractured shale well. American Chemical Society (ACS) annual conference, Philadelphia, PA August 21-24, 2016.

22. Borton MA, Welch SA, Wilson TA, Booker AE, Daly RA, Sheets JM, Trexler RV, Marcus DN, Wolfe RA, **Mouser PJ,** Wilkins MJ, Sharma S, Cole DR, Wrighton KC (2016). Metagenomics reveals the prevalence for sulfur reduction across hydraulically fractured shales, ISME Conference, Montreal, CA, Aug 21-26, 2016.

23. **Mouser PJ**, (2016). Microbial Degradation of Organic Chemical Additives in the Hydraulic Fracturing System (2016). Gordon Research Conference, Environmental Sciences: Water, Holderness, NH, June 26-30.

24. Wrighton KC, Daly R, Hoyt D, Trexler R, MacRae JD, Wilkins MJ, **Mouser PJ,** (2015). Something new from something old? Fracking stimulated microbial processes. Presentation #B13K-08 at the American Geophysical Union Annual Meeting, San Francisco, CA, Dec 14-18.

25. **Mouser PJ,** Daly RA, Wolfe R, and Wrighton KC, (2015). Microbes living in unconventional shale during energy extraction have diverse hydrocarbon degradation pathways. Oral presentation at 2015 Geological Society of America Annual Meeting. Baltimore, MD, Nov 1-4.

26. *Volker M, *Heyob K, Blotevogel J, Borch T, Plata D, and **Mouser PJ** (2015). Accumulation of smaller ethoxylate chain lengths during anaerobic biodegradation of nonylphenol ethoxylate surfactants used in hydraulic fracturing fluids. Geological Society of America Annual Meeting, Baltimore, MD, Nov 1-4.

27. *Trexler R, Pfiffner S, Akondi R, Sharma S. and **Mouser PJ,** (2015). Optimizing Methods for Extracting Lipids from Organic-Rich Shale to Estimate Microbial Biomass and Diversity. Geological Society of America Annual Meeting, Baltimore, MD, Nov 1-4.

28. Akondi R, Sharma S, Pfiffner S, **Mouser PJ,** *Trexler R, and Warrier A, (2015). Comparison of phospholipid and diglyceride fatty acid biomarker profiles in Marcellus Shale cores of different maturities. Geological Society of America Annual Meeting, Baltimore, MD, Nov 1-4.

29. Mergos IA, *Krinks JK, Qiu MH, Weavers LK, **Mouser PJ,** and Verweij H, (2015). Ultrasonic stimulation of piezoelectric membranes for fouling mitigation", Euromembrane, Aachen, Germany, Sept 6-10.

30. **Mouser PJ,** (2015). The Impact of Fracking on the Microbiology of Deep Shale, American Soc. for Microbiology Annual Conference, New Orleans, LA, May 30-June 2.

31. Marcus DN, Hoyt DW, Daly RA, Wolfe R, Wilkins MJ, **Mouser PJ**, Wrighton KC. (2015). Methylotrophic Methanogenesis in Deep Shales, Something New from Something Old. Multiomics for Microbiomes Conference, Pacific Northwest National Laboratory, Richland, WA, Sept 12-14.

32. Wrighton KC, Hoyt DW, Daly RA, Marcus DN, *Trexler RV, Wolfe R, **Mouser PJ**, Wilkins MJ. (2015). Drivers of microbial methanogenesis in deep shales after hydraulic fracturing. American Society for Microbiology Annual Conference, New Orleans, LA, May 30-June 2.

33. Daly R, **Mouser PJ**, Trexler RV, Wrighton KC (2015). Viral Predation and Host Immunity Structure Microbial Communities in a Terrestrial Deep Subsurface, Hydraulically Fractured Shale System. American Society for Microbiology Annual Conference, New Orleans, LA, May 30-June 2.

34. Heyob K, and **Mouser PJ,** (2015). Biodegradability of Organic Additives in Hydraulic Fracturing Fluids. 2015 Kentucky Oil and Gas Association in Lexington, KY, July 14-16.

35. **Mouser PJ,** (2015), Influence of Salinity, Concentration, and Redox on the Biodegradability of Organic Additives in Hydraulic Fracturing Fluids American Chemical Society Annual Conference, Denver, CO March 22-26.

36. *Heyob K, Blotevogel J, Borch T and **Mouser PJ,** (2015). Anaerobic Biodegradation of Polypropylene Glycols within Hydraulic Fracturing Fluid. American Chemical Society (ACS) annual conference, Denver, CO March 22-26.

37. **Mouser PJ** and *Kekacs D, (2014). Influence of Concentration and Salinity on the Biodegradability of Organic Additives in Hydraulic Fracturing Fluid, H23C-0890, Fall Meeting, American Geophysical Union, San Francisco, CA, Dec 15-19.

38. *Trexler RV, Wrighton KC, Pfiffner S, Wilkins MJ, Daly R, **Mouser PJ,** (2014). Temporal Changes in Microbial Metagenomic Signatures and Lipid Profiles after Hydraulic Fracturing, B11A-0033, Fall Meeting, American Geophysical Union, San Francisco, CA, Dec 15-19.

39. Daly R, **Mouser PJ,** *Trexler R, Wrighton KC, (2014). Viral Predation and Host Immunity Structure Microbial Communities in a Terrestrial Deep Subsurface, Hydraulically Fractured Shale System, B13A-0177, Fall Meeting, American Geophysical Union, San Francisco, CA, Dec 15-19

40. *Brooker M, Witter J, Islam K, **Mouser PJ,** (2014). Physical and Chemical Properties of Bench Sediments in Self-Formed Agricultural Drainage Channels, H23-0973, Fall Meeting, American Geophysical Union, San Francisco, CA, Dec 15-19.

41. *Krinks J, Weavers L, and **Mouser PJ,** (2014). Effectiveness of Ultrasound to Clean Biologically-Fouled Membranes. Water Management Association of Ohio Annual Conference, Nov 18-19.

42. *Heyob K and **Mouser PJ** (2014). The Anaerobic Biodegradation of a Synthetic Hydraulic Fracturing Fluid in Groundwater and Sandstone Microcosm Systems. Water Management Association of Ohio's Annual Conference, Nov 18-19.

43. **Mouser PJ.** (2014). A One-year Microbial Metagenomics Trajectory after Hydraulic Fracturing in Marcellus Shale, International Society Subsurface Microbiology (ISSM) conference, Pacific Grove, CA, Oct 6-10.

44. **Mouser PJ,** *Trexler RV, Wilkins MJ, Hartsock A, MacRae JD, Wrighton KC, (2014). Temporal Changes in Microbial Metagenomic Profiles after Hydraulic Fracturing, Goldschmidt Abstract 1740. Sacramento, CA, June 8-13.

45. *Kekacs D, Drollette B, Plata D, **Mouser PJ** (2014). Inherent Biodegradability of Organic Chemicals used in Hydraulic Fracturing Fluid, Goldschmidt Abstract 1219, Sacramento, CA, June 8-13.

46. *Evert MH, Williams KH, Lenhart JJ, Wilkins MJ, **Mouser PJ,** (2014). NOM Molecular Characterization to Better Understand Uranium Mobility in Aquifer Sediments and Groundwater, Goldschmidt Abstract 649, Sacramento, CA, June 8-13.

47. **Mouser PJ,** *Liu S, *Cluff MA, McRae JD, Lenhart JJ, (2013). Biodegradability of Hydraulic Fracturing Fluids Under Natural Aquifer Conditions, Water Management Association of Ohio (WMAO) Annual Conference, Columbus, OH, Nov 13-14.

48. Stuckman M, Zheng Z, Lenhart JJ, **Mouser PJ,** (2013). Arsenic Release Mechanisms from Ohio Ground Water Aquifers under Methanogenic Conditions, Water Management Association of Ohio's Annual Conference, Columbus, OH, Nov 13-14.

49. *Kekacs DJ and **Mouser PJ,** (2013). Microbial Transformation of Hydraulic Fracturing Fluid Chemical Additives, Midwest Geobiology Symposium, Indianapolis, IN, Sept 28.

50. *Evert MH, Williams KH, Wilkins MJ, Lenhart JJ, **Mouser PJ,** (2013). Natural Organic Matter Characterization to Better Understand Uranium Mobility in Aquifer Systems. Midwest Geobiology Symposium, Indianapolis, IN, Sept 28.

51. **Mouser PJ,** (2013). Molecular Characterization of Freshwater Dissolved Organic Matter and Preferential Utilization by Aquifer Microbial Communities. American Chemical Society (ACS) annual conference, Indianapolis, IN. Sept 9-12.

52. **Mouser PJ**, *Liu S, and Lenhart JJ, (2013). Biodegradation of Hydraulic Fracturing Fluids in Sediment Microcosms. American Chemical Society (ACS) annual conference, Indianapolis, IN, Sept 9-12.

53. **Mouser PJ,** *Ansari M, *Liu S, Hartsock A, MacRae JD, and Lenhart JJ, (2013). What is the Role of Microorganisms in Shale Energy Extraction Fluids? From Laboratory Experiments to Field-Scale Observations. Association of Environmental Engineering and Science Professors (AEESP) annual conference, Golden, CO, July 14-17.

54. **Mouser PJ,** (2013). The Role of Microorganisms in Shale Energy Extraction: From Field-Scale Observations to Laboratory Biodegradation Experiments, American Society of Microbiology annual conference, Denver, CO, May 18-21.

55. **Mouser PJ,** (2013). Microbial Metagenomic Temporal Trajectory after Hydraulic Fracturing , Ohio Chapter of the American Microbiology Society Annual Meeting, Columbus, OH, April 3.

56. Stuckman M, Lenhart JJ, **Mouser PJ,** and Zheng Z, (2013). Biotic and Abiotic Arsenic Release Processes from Ground Water Aquifers under Methanogenic Conditions, 245rd American Chemical Society National Meeting, New Orleans, LA, April 5-8,

57. Stuckman M, Lenhart JJ, **Mouser PJ,** and Zheng Z, (2013). Microbial Arsenic Release from Ohio Ground Water Aquifers under Methanogenic and Transient Redox Conditions, Watershed Workshop by Ohio Water Environment Association, Columbus, OH, April 4.

58. *Brooker M, Bohrer G, **Mouser PJ,** (2012). Factors Influencing Microbial Carbon Emission Potential from Wetland Sediments and its Relation to Surface- and Plot-Scale Measurements, B33C-0536 Fall Meeting, American Geophysical Union, San Francisco, CA, Dec 3-7.

59. Bohrer G, Morin T, Naor-Azrieli L, **Mouser PJ,** Mitsch WJ, Schafer KV, (2012). Determining the meteorological forcing that affect seasonal and diurnal dynamics of respiration and GPP in a constructed urban wetland in Ohio, B11H-07, Fall Meeting, American Geophysical Union, San Francisco, CA, Dec 3-7.

60. **Mouser PJ,** *Brooker M, Bohrer G, (2012). Factors influencing microbial gas production rates in wetland sediments, 4th International Ecosummit, Columbus, OH, Sept 30 - Oct 5.

61. *Brooker M, Bohrer G, **Mouser PJ,** (2012). Quantifying *in situ* rates of methanogenesis and denitrification in wetland sediments, 4th International Ecosummit, Columbus, OH, Sept 30 - Oct 5.

62. *Brooker M, Bohrer G, **Mouser PJ,** (2012). Factors influencing microbial gas production rates in wetland sediments, Ohio River Basin Consortium for Research and Education Annual Symposium in Athens, OH, July 18-20.

63. *Ansari M, Lenhart JJ, **Mouser PJ,** (2012). Development of Synthetic Fracturing Fluid and Multiplex Pyrosequencing to Detect Hydraulic Fracturing Fluid Releases in Aquifer Materials, Ohio River Basin Consortium for Research and Education Annual Symposium in Athens, OH, July 18-20.

64. **Mouser PJ,** Wilkins MJ, Smith DF, Williams KH, Pasa-Tolic L, Long PE, (2012). Characterization of Natural Organic Matter From A Uranium Contaminated Aquifer and its Utilization by Native Microorganisms, Gordon Research Conference, Environmental Sciences: Water, Holderness, NH, June 24-29.

65. **Mouser PJ,** *Brooker M, Mitsch W, Bohrer G, (2012). Factors Influencing Microbial Gas Production Rates in a Constructed Wetland Ecosystem, First Conference on Atmospheric Biogeosciences of the American Meteorological Society, Boston, MA, May 29-June 1.

66. **Mouser PJ,** Wilkins MJ, Smith DF, Williams KH, Pasa-Tolic L, Long PE. (2012). Molecular-Scale Characterization of NOM From A Uranium Contaminated Aquifer, DOE-SBR 7th Annual PI Meeting, Washington, D.C., Apr 30-May 2.

67. *Ansari M and **Mouser PJ,** (2012). Energy Development in Ohio - Historical Perspective and Current Research on Shale Energy Fluid Microbiology and Biogeochemistry. Conference on Public and Land-Grant University Conference on Energy Challenges: The Next 50 Years, Columbus, OH, May 1.

68. *Kekacs D, Plante M, **Mouser PJ**, and MacRae J, (2012). Geochemical Analysis of Groundwater Wells with Elevated Uranium, Maine Water Conf., Augusta, ME, March 14.

69. **Mouser PJ,** *Ansari M, Hartsock A, *Liu S, Lenhart JJ, (2012). Microbial Community Shifts due to Hydrofracking: Observations from Field-Scale Observations and Laboratory-Scale Incubations, H11C-1196, Fall Meeting, American Geophysical Union, San Francisco, CA, Dec 3-7.

70. **Mouser PJ,** Wilkins MJ, Smith DF, Williams KH, Pasa-Tolic L, Long PE, (2011). Molecular-Scale Characterization of Natural Organic Matter From A Uranium Contaminated Aquifer and its Utilization by Native Microbial Communities. Abstract H21A-1062, Fall Meeting, American Geophysical Union, San Francisco, CA, Dec 5-9.

71. Shafer KV, Bohrer G, Naor-Azrieli L, **Mouser PJ,** Mitch WJ, Wu M, (2011). Temporal Dynamics of Methane Fluxes in Temperate Urban Wetlands, Abstract B12C-05 Fall Meeting, AGU, San Francisco, CA, Dec 5-9.

72. **Mouser PJ** (2011). Detecting and Delineating Groundwater Contamination at a Leaking Waste Disposal Site using Microbial Community Profiles. Maine Water Conference, Augusta, ME, March 16.

73. **Mouser PJ,** (2010). Quantifying Temporal Autocorrelations for the Expression of *Geobacter* species mRNA Gene Transcripts at Variable Ammonium Levels during in situ U(VI) Bioremediation, Abstract B51B-0350, Fall Meeting, American Geophysical Union, San Francisco, CA, Dec 13-17.

74. Pearce AR, **Mouser PJ**, Stevens L, Watzin MC, Druschel GK, Hayden NJ, and Rizzo DM, (2010). Using modified self-organized maps to explore hydrochemical and biological datasets, Abstract H11E-0865, Fall Meeting, American Geophysical Union, San Francisco, CA, Dec 13-17.

Honors and Awards

2016	Ohio State University, College of Engineering, Lumley Research Award
2011	University of Maine Dept. of Civil and Envr. Engr. ASCE Instructor of the Year
2006	Vermont EPSCoR Young Researcher Award, Washington, D.C.
2004	Outstanding Graduate Student, Dept. of Civil and Envr. Engr., Univ. of Vermont
2004	Air & Waste Management Assoc. (AWWA) Jacqueline Shields Award
2003, 2004	Lake Champlain Research Consortium Scholarship

Service

A. Professional

i. Committees

Referee, American Association of Petroleum Geology Outstanding Poster Award, Eastern Section Annual Meeting, Lexington, KY 9/2016

Conference Session Co-Convener , "Marcellus Shale Energy and Environmental Laboratory", American Association for Petroleum Geology Annual Meeting, Lexington, KY 9/2016.

Conference Session Co-Convener, "Impacts on Energy Systems on Water Treatment", ACS Annual Meeting, Philadelphia, PA 8/2016.

Dissertation Award Committee Member, Association of Environmental Engineering and Science Professors, 2012-2015.

Conference Session Co-Convener, "Impacts of Natural Gas Extraction and Production", AGU Fall Meeting, San Francisco, CA 12/2014

Referee - Outstanding Student Paper Award, AGU Fall Meeting, San Francisco, CA 12/2014

Referee, Outstanding Student Paper Award, International Society for Subsurface Microbiology Meeting, Pacific Grove, CA 10/2014.

Workshop Session Co-Convener, "Natural Gas Research & Development Workshop" session on Environmental Stewardship, Oak Ridge National Laboratory. 2/2014.

Workshop Co-Convener, "Trends and Challenges in Sampling the Deep Subsurface", Organized 11 invited panelists and 50 participants, Columbus, OH. 2/2014.

ii. Peer Reviewer Activities

Editorial Board Member:

2017 – 2018 ASCE *Journal of Environmental Engineering*, Associate Editor
2016 – 2018 *Applied and Environmental Microbiology,* Editorial Board

Journal Referee:

Environmental Science & Technology
Environmental Science & Technology Letters
Environmental Sciences: Processes & Impacts
Environmental Engineering Science
Applied & Environmental Microbiology
Nature Communication
Environmental Sciences – Water Research & Technology
FEMS Microbial Ecology
Geomicrobiology
PLoS One
Environmental Microbiology
ASCE Journal of Environmental Engineering
Science
Aquatic Sciences
Groundwater Monitoring & Remediation

Grant Panels and Grant Proposal Reviewer:

2019 Michigan Sea Grant

2015-2019 National Science Foundation (NSF) Chemical, Biotechnology and Environmental Technology

2014 Department of Energy (DOE) Environmental Molecular Sciences Laboratory

2012, 2016 DOE Joint Genome Institute

2015, 2016 NSF Division of Environmental Biology

2016 ACS Petroleum Research Fund

2014 Natural Sciences and Engineering Research Council of Canada (NSERC)

2014, 2016 U.S. Geological Survey and National Institutes for Water Resources (NIWR)

2014 U.S. Geological Survey and National Institutes for Water Resources (NIWR), Ohio Water Research Center In-State Competitive Grants Program

2012 NSF Chemical, Biotechnology and Environmental Technology

B. Academic

i. University

2018	Member, Research and Engagement Academy Panel Reviewer
2016-2017	Co-chair, Faculty Advisory Committee, Subsurface Energy Resources Center
2014-2016	Member, Faculty Advisory Committee, Subsurface Energy Resources Center
2014-2017	Advisor, Society of Environmental Engineers
2015	Member, Sustainability Goals Research and Innovation Workgroup
2012-2013	Member, Strategic Planning Committee, Subsurface Energy Resources Center
2012-2015	Member, Environmental Sci. Graduate Program Graduate Studies Committee
2012	Member, Hydrologic Work Group, Subsurface Energy Resources Center

ii. College

2018	Member, CEPS Teaching Award Review Committee, UNH
2018	Member, CEPS Graduate Fellowship Review Committee, UNH
2011	Conference Exhibitor, Representing the OSU College of Engineering at the Society of Women Engineers Annual Conference, Chicago, IL.

iii. Department

2018-current	Environmental Engineering Program Administrator
2018	Flexible Teaching Model, Ad Hoc Committee Member
2017	Co-wrote Environmental Engineering Program Self Study Plan for ABET Accreditation Review (with John Lenhart and Mark McCord)
2017	Member, Workload Committee (ad hoc), 2017
2015-2017	Member, Undergraduate Curriculum Committee
2016-2017	Member, Construction Engineer Faculty Search
2014-2016	Member, Public Health & Dept. of CEGE Faculty Search
2012-2013	Member, Subsurface Energy Faculty Search
2011-2012	Member, Energy-Infrastructure Faculty Search (failed search)

Press Features on Research Findings

Mar 2019	University of New Hampshire Spark, 2019 Research Review
Nov 2018	University of New Hampshire (UNH) Today: "*Into the Microbial Deep*", B. Potier. https://www.unh.edu/unhtoday/2018/11/microbial-deep
Dec 2016	Discover Magazine 100 Top Stories of 2016: Ohio State team and *Nature Microbiology* findings were #90 "*Digging Deep for New Bacteria*", E. Betz.
Dec 2016	Ohio State University College of Engineering Buckeye Engineering, December issue. "*Improving management of harmful algal blooms*". M. Biss.
Nov 2016	Ohio State University College of Engineering. "*Multidisciplinary research aims to improve water quality, prevent future crisis*". M. Biss.

	https://engineering.osu.edu/news/2016/11/multidisciplinary-research-aims-improve-water-quality-prevent-future-crisis
Oct 2016	Ohio Sea Grant Twineline, Fall 2016 Edition Vol 38 (2). "*How'd that get there? Ohio Sea Grant research to gather phosphorus signatures that can help in HABs management*". C. Dierkes. https://ohioseagrant.osu.edu/news/2016/l3hkn/twine-line-fall-2016
Nov 2015	Midwestern Energy News: *"Researchers study microbes living in shale, and how they can impact drilling", K. Kowalski,* http://midwestenergynews.com/2015/11/17/researchers-study-microbes-living-in-shale-and-how-they-can-impact-drilling/
June 2015	Environmental Education Council of Ohio (EEOC) summer newsletter, Focus on Water Quality Research. "*Organic Chemicals used for Hydraulic Fracturing are Degraded by Lake and Soil Microbes*"
July 2015	McClatchyDC News: *"Could deep earth microbes help us frack for oil?"* S. Cockerham http://www.mcclatchydc.com/news/nation-world/national/article29115688.html
Dec 2014	DOE Berkeley Lab Genome-to-Watershed electronic newsletter, Fall 2014. Mouser paper highlighted. https://esd.lbl.gov/cms/FILES/research/projects/sustainable_systems/E-NEWSLETTER_DRAFT_FINAL.pdf
June 2014	Research Highlighted in AAAS *Science* Magazine, Searching for Life in the Deep Shale, Vol 344, (6191), 1470-1471, E. Pennisi.
Nov 2013	*Ohio State, West Virginia Researchers Awarded $2 Million*, OSU Office of Energy and the Environment, http://oee.osu.edu/ohio-state,-west-virginia-researchers-awarded-$2-million.html
Nov 2013	*Ohio State conducting wide range of shale-related research*, OSU College of Engr., https://engineering.osu.edu/news/2013/11/ohio-state-conducting-wide-range-shale-related-research
May 2013	*The microbial ecology of hydraulic fracturing fluids*, May 2013, *Microbe World Interview* at the American Society for Microbiology meeting in Denver, CO, S. Maloy. http://www.microbeworld.org/podcasts/asm-live/asm-live-archives/1570
Jan 2013	*Creatures thrive in 'fracking' wells* - Ohio State team studies microbes to see where they originate, January 26, 2013, *Columbus Dispatch*, S. Hunt.
Dec 2012	*Hydrofracking Brings out the Tough Bugs*, Dec 4 2012, AGU Blogosphere, J. Shugart.
Dec 2012	*DNA Analysis of Microbes in a Fracking Site Yields Surprises*, December 3, 2012, OSU Research News, P.F. Gorder.
June 2011	*Life on the Fringes*, University of Maine Today, Quarterly Magazine.
Jan 2011	*Is that old Dump Leaking? Ask the Bugs*, January 18, 2011, *New York Times*, P. Voosen. HTTP://WWW.NYTIMES.COM/GWIRE/2011/01/18/18GREENWIRE-IS-THAT-OLD-DUMP-LEAKING-ASK-THE-BUGS-16711.HTML.

Other Service and Outreach Activities

Regional Extension:

Invited Speaker, Workshop on Marcellus-Utica Geosciences Technology, American Association for Petroleum Geologists (AAPG), 6/2014

Invited Speaker, Workshop on Environmental Friendly Drilling, OSU Subsurface Energy Resources Center, 2/2013

Invited Speaker, Workshop on Environmental Issues Related to Shale Energy Development, OSU Subsurface Energy Resources Center, 5/2012

K-12:

Judge, Northern New England Junior Science & Humanities Symposia Program, 3/2019

NH Girls in Technology Day, CEPS, 25 High Schoolers, Water Treatment Activity, 3/2019

Water Treatment, WiE Rise (Women in Engineering) Camp, High Schoolers, 7/2015, 7/2016.

Future City Competition, VIP Final Round Judge, Middle Schoolers Winter 1/2015, 1/2016.

EXHIBIT "6"

O&N OVERSTREET & NESTOR, LLC

February 13, 2020

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Christopher R. Nestor
1425 Crooked Hill Road #62066
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717.350.5939
christopher.nestor@palawgroup.com
www.palawgroup.com

Via E-mail Only

Mark Greenfogel
Warren Environmental Counsel LLC
975 Mill Road
Millridge Manor House Suite A
Bryn Mawr, PA 19010

Re: Wayne Land and Mineral Group, LLC v. Delaware River Basin Commission, *et al.*, No. 3:16-cv-00897-RDM

Mr. Greenfogel:

On behalf of Wayne Land and Mineral Group, LLC, please be advised that Daniel Arthur is no longer designated as an expert whose opinions may be presented at trial.

Sincerely,

Christopher R. Nestor

cc: Counsel of record (via e-mail)

EXHIBIT "7"

DELAWARE RIVER BASIN COMPACT

Delaware River Basin Commission

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UNITED STATES OF AMERICA

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1961

(Reprinted 2009)

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DELAWARE RIVER BASIN COMPACT

United States: Public Law 87-328,
Approved September 27, 1961, 75 Statutes at Large 688

Delaware: 53 Delaware Laws, Chapter 71,
Approved May 26, 1961

New Jersey: Laws of 1961, Chapter 13,
Approved May 1, 1961

New York: Laws of 1961, Chapter 148,
Approved March 17, 1961

Pennsylvania: Acts of 1961, Act No. 268,
Approved July 7, 1961

PART 1

COMPACT

Whereas the signatory parties recognize the water and related resources of the Delaware River Basin as regional assets vested with local, State, and National interests, for which they have a joint responsibility; and

Whereas the conservation, utilization, development, management, and control of the water and related resources of the Delaware River Basin under a comprehensive multipurpose plan will bring the greatest benefits and produce the most efficient service in the public welfare; and

Whereas such a comprehensive plan administered by a basin wide agency will provide effective flood damage reduction; conservation and development of ground and surface water supply for municipal, industrial, and agricultural uses; development of recreational facilities in relation to reservoirs, lakes, and streams; propagation of fish and game; promotion of related forestry, soil conservation, and watershed projects; protection and aid to fisheries dependent upon water resources; development of hydroelectric power potentialities; improved navigation; control of the movement of salt water; abatement and control of stream pollution; and regulation of stream flows toward the attainment of these goals; and

Whereas decisions of the United States Supreme Court relating to the waters of the basin have confirmed the interstate regional character of the water resources of the Delaware River Basin, and the United States Corps of Engineers has in a prior report on the Delaware River Basin (House Document 179, Seventy-third Congress, second session) officially recognized the need for an interstate agency and the economies that can result from unified development and control of the water resources of the basin; and

Whereas the water resources of the basin are presently subject to the duplicating, overlapping, and uncoordinated administration of some forty-three State agencies, fourteen interstate agencies, and nineteen Federal agencies which exercise a multiplicity of powers and duties resulting in a splintering of authority and responsibilities; and

Whereas the joint advisory body known as the Interstate Commission on the Delaware River Basin (INCODEL), created by the respective commissions or Committee on Interstate Cooperation of the States of Delaware, New Jersey, New York, and Pennsylvania, has on the basis of its extensive investigations, surveys, and studies concluded that regional development of the Delaware River Basin is feasible, advisable, and urgently needed; and has recommended that an interstate compact with Federal participation be consummated to this end; and

Whereas the Congress of the United States and the executive branch of the Government have recognized the national interest in the Delaware River Basin by authorizing and directing the Corps of Engineers, Department of the Army, to make a comprehensive survey and report on the water and related resources of the Delaware River Basin, enlisting the technical aid and planning participation of many Federal, State, and municipal agencies dealing with the waters of the basin, and in particular the Federal Departments of Agriculture, Commerce, Health, Education, and Welfare, and Interior, and the Federal Power Commission; and

Whereas some twenty-two million people of the United States at present live and work in the region of the Delaware River Basin and its environs, and the government, employment, industry, and economic development of the entire region and the health, safety, and general welfare of its population are and will continue to be vitally affected by the use, conservation, management, and control of the water and related resources of the Delaware River Basin; and

Whereas demands upon the waters and related resources of the basin are expected to mount rapidly because of the anticipated increase in the population of the region projected to reach thirty million by 1980 and forty million by 2010, and because of the anticipated increase in industrial growth projected to double by 1980; and

Whereas water resources planning and development is technical, complex, and expensive, and has often required fifteen to twenty years from the conception to the completion of a large dam and reservoir; and

Whereas the public interest requires that facilities must be ready and operative when needed, to avoid the catastrophe of unexpected floods or prolonged drought, and for other purposes; and

Whereas the Delaware River Basin Advisory Committee, a temporary body constituted by the Governors of the four basin States and the mayors of the cities of New York and Philadelphia, has prepared a draft of an interstate-Federal compact for the creation of a basin agency, and the signatory parties desire to effectuate the purposes thereof: Now therefore

The states of Delaware, New Jersey and New York and the Commonwealth of Pennsylvania, and the United States of America hereby solemnly covenant and agree with each other, upon the enactment of concurrent legislation by the Congress of the United States and by the respective state legislatures, having the same effect as this Part, to the following Compact:

ARTICLE 1

SHORT TITLE, DEFINITIONS, PURPOSE AND LIMITATIONS

Section 1.1 Short title.. This Act shall be known and may be cited as the Delaware River Basin Compact.

1.2 Definitions. For the purposes of this compact, and of any supplemental or concurring legislation enacted pursuant thereto, except as may be otherwise required by the context:

(a) "Basin" shall mean the area of drainage into the Delaware River and its tributaries, including Delaware Bay;

(b) "Commission" shall mean the Delaware River Basin Commission created and constituted by this compact;

(c) "Compact" shall mean Part I of this act;

(d) "Cost" shall mean direct and indirect expenditures, commitment, and net induced adverse effects, whether or not compensated for, used or incurred in connection with the establishment, acquisition, construction, maintenance and operation of a project;

(e) "Facility" shall mean any real or personal property, within or without the basin, and improvements thereof or thereon, and any and all rights of way, water, water rights, plants, structures, machinery and equipment, acquired, constructed, operated or maintained for the beneficial use of water resources or related land uses including, without limiting the generality of the foregoing, any and all things and appurtenances necessary, useful or convenient for the control, collection, storage, withdrawal, diversion, release, treatment, transmission, sale or exchange of water; or for navigation thereon, or the development and use of hydroelectric energy and power, and public recreational facilities; or the propagation of fish and wildlife; or to conserve and protect the water resources of the basin or any existing or future water supply source, or to facilitate any other uses of any of them;

(f) "Federal government" shall mean the government of the United States of America, and any appropriate branch, department, bureau or division thereof, as the case may be;

(g) "Project" shall mean any work, service or activity which is separately planned, financed, or identified by the commission, or any separate facility undertaken or to be undertaken within a specified area, for the conservation, utilization, control, development or management of water resources which can be established and utilized independently or as an addition to an existing facility, and can be considered as a separate entity for purposes of evaluation;

(h) "Signatory party" shall mean a state or commonwealth party to this compact, and the federal government;

(i) "Water resources" shall include water and related natural resources in, on, under, or above the ground, including related uses of land, which are subject to beneficial use, ownership or control.

1.3 Purpose and Findings. The legislative bodies of the respective signatory parties hereby find and declare:

(a) The water resources of the basin are affected with a local, state, regional and national interest and their planning, conservation, utilization, development, management and control, under appropriate arrangements for intergovernmental cooperation, are public purposes of the respective signatory parties.

(b) The water resources of the basin are subject to the sovereign right and responsibility of the signatory parties, and it is the purpose of this compact to provide for a joint exercise of such powers of sovereignty in the common interests of the people of the region.

(c) The water resources of the basin are functionally inter-related, and the uses of these resources are interdependent. A single administrative agency is therefore essential for effective and economical direction, supervision and coordination of efforts and programs of federal, state and local governments and of private enterprise.

(d) The water resources of the Delaware River Basin, if properly planned and utilized, are ample to meet all presently projected demands, including existing and added diversions in future years and ever increasing economies and efficiencies in the use and reuse of water resources can be brought about by comprehensive planning, programming and management.

(e) In general, the purposes of this compact are to promote interstate comity; to remove causes of present and future controversy; to make secure and protect present developments within the states; to encourage and provide for the planning, conservation, utilization, development, management and control of the water resources of the basin; to provide for cooperative planning and action by the signatory parties with respect to such water resources; and to apply the principle of equal and uniform treatment to all water users who are similarly situated and to all users of related facilities, without regard to established political boundaries.

1.4 Powers of Congress; Withdrawal. Nothing in this compact shall be construed to relinquish the functions, powers or duties of the Congress of the United States with respect to the control of any navigable waters within the basin, nor shall any provision hereof be construed in derogation of any of the constitutional powers of the Congress to regulate commerce among the states and with foreign nations. The power and right of the Congress to withdraw the federal government as a party to this compact or to revise or modify the terms, conditions and provisions under which it may remain a party by amendment, repeal or modification of any federal statute applicable thereto is recognized by the signatory parties.

1.5 Existing Agencies; Construction. It is the purpose of the signatory parties to preserve and utilize the functions, powers and duties of existing offices and agencies of government to the extent not inconsistent with the compact, and the commission is authorized and directed to utilize and employ such offices and agencies for the purpose of this compact to the fullest extent it finds feasible and advantageous.

1.6 Duration of Compact.

(a) The duration of this compact shall be for an initial period of 100 years from its effective date, and it shall be continued for additional periods of 100 years if not later than 20 years nor sooner than 25 years prior to the termination of the initial period or any succeeding period none of the signatory states, by authority of an act of its legislature, notifies the commission of intention to terminate the compact at the end of the then current 100 year period.

(b) In the event that this compact should be terminated by operation of paragraph (a) above, the commission shall be dissolved, its assets and liabilities transferred, and its corporate affairs wound up, in such manner as may be provided by act of the Congress.

ARTICLE 2

ORGANIZATION AND AREA

Section 2.1 Commission Created. The Delaware River Basin Commission is hereby created as a body politic and corporate, with succession for the duration of this compact, as an agency and instrumentality of the governments of the respective signatory parties.

2.2 Commission Membership.[1] The commission shall consist of the Governors of the signatory states, ex officio, and one commissioner to be appointed by the President of the United States to serve during the term of office of the President.

2.3 Alternates. Each member of the commission shall appoint an alternate to act in his place and stead, with authority to attend all meetings of the commission, and with power to vote in the absence of the member. Unless otherwise provided by law of the signatory party for which he is appointed, each alternate shall serve during the term of the member appointing him, subject to removal at the pleasure of the member. In the event of a vacancy in the office of alternate, it shall be filled in the same manner as an original appointment for the unexpired term only.

[1] Section 2.2 is as enacted in 1961. See Endnote regarding subsequent changes.

2.4 Compensation. Members of the commission and alternates shall serve without compensation but may be reimbursed for necessary expenses incurred in and incident to the performance of their duties.

2.5 Voting Power. Each member shall be entitled to one vote on all matters which may come before the commission. No action of the commission shall be taken at any meeting unless a majority of the membership shall vote in favor thereof.

2.6 Organization and Procedure. The commission shall provide for its own organization and procedure, and shall adopt rules and regulations governing its meetings and transactions. It shall organize annually by the election of a chairman and vice-chairman from among its members. It shall provide by its rules for the appointment by each member in his discretion of an advisor to serve without compensation, who may attend all meetings of the commission and its committees.

2.7 Jurisdiction of the Commission. The commission shall have, exercise and discharge its functions, powers and duties within the limits of the basin, except that it may in its discretion act outside the basin whenever such action may be necessary or convenient to effectuate its powers or duties within the basin, or to sell or dispose of water, hydroelectric power or other water resources within or without the basin. The commission shall exercise such power outside the basin only upon the consent of the state in which it proposes to act.

ARTICLE 3

POWERS AND DUTIES OF THE COMMISSION

Section 3.1 Purpose and Policy. The commission shall develop and effectuate plans, policies and projects relating to the water resources of the basin. It shall adopt and promote uniform and coordinated policies for water conservation, control, use and management in the basin. It shall encourage the planning, development and financing of water resources projects according to such plans and policies.

3.2 Comprehensive Plan, Program and Budgets. The commission shall, in accordance with Article 13 of this compact, formulate and adopt:

(a) A comprehensive plan, after consultation with water users and interested public bodies, for the immediate and long range development and uses of the water resources of the basin;

(b) A water resources program, based upon the comprehensive plan, which shall include a systematic presentation of the quantity and quality of water resources needs of the area to be served for such reasonably foreseeable period as the commission may determine, balanced by existing and proposed projects required to satisfy such needs, including all public and private projects affecting the basin, together with a separate statement of the projects proposed to be undertaken by the commission during such period; and

(c) An annual current expense budget, and an annual capital budget consistent with the water resources program covering the commission's projects and facilities for the budget period.

3.3 Allocations, Diversions and Releases. The commission shall have the power from time to time as need appears, in accordance with the doctrine of equitable apportionment, to allocate the waters of the basin to and among the states signatory to this compact and to and among their respective political subdivisions, and to impose conditions, obligations and release requirements related thereto, subject to the following limitations:

(a) The commission, without the unanimous consent of the parties to the United States Supreme Court decree in New Jersey v. New York, 347 U. S. 995 (1954), shall not impair, diminish or otherwise adversely affect the diversions, compensating releases, rights, conditions, obligations, and provisions for the administration thereof as provided in said decree; provided, however, that after consultation with the river master under said decree the commission may find and declare a state of emergency resulting from a drought or catastrophe and it may thereupon by unanimous consent of its members authorize and direct an increase or decrease in any allocation or diversion permitted or releases required by the decree, in such manner and for such limited time as may be necessary to meet such an emergency condition.

(b) No allocation of waters hereafter made pursuant to this section shall constitute a prior appropriation of the waters of the basin or confer any superiority of right in respect to the use of those waters, nor shall any such action be deemed to constitute an apportionment of the waters of the basin among the parties hereto: Provided, That this paragraph shall not be deemed to limit or restrict the power of the commission to enter into covenants with respect to water supply, with a duration not exceeding the life of this compact, as it may deem necessary for a benefit or development of the water resources of the basin.

(c) Any proper party deeming itself aggrieved by action of the commission with respect to an out-of-basin diversion or compensating releases in connection therewith, notwithstanding the powers delegated to the commission by this compact may invoke the original jurisdiction of the United States Supreme Court within one year after such action for an adjudication and determination thereof de novo. Any other action of the commission pursuant to this section shall be subject to judicial review in any court of competent jurisdiction.

3.4 Supreme Court Decree; Waivers. Each of the signatory states and their respective political subdivisions, in consideration of like action by the others, and in recognition of reciprocal benefits, hereby waives and relinquishes for the duration of this compact any right, privilege or power it may have to apply for any modification of the terms of the decree of the United States Supreme Court in New Jersey v. New York, 347 U. S., 995 (1954) which would increase or decrease the diversions authorized or increase or decrease the releases required thereunder, except that a proceeding to modify such decree to increase diversions or compensating releases in connection with such increased diversions may be prosecuted by a proper party to effectuate rights, powers, duties and obligations under Section 3.3 of this compact, and except as may be required to effectuate the provisions of paragraphs IIIB3 and VB of said decree.

3.5 Supreme Court Decree; Specific Limitations on Commission. Except as specifically provided in Sections 3.3 and 3.4 of this article, nothing in this compact shall be construed in any way to impair, diminish or otherwise adversely affect the rights, powers, privileges, conditions and obligations contained in the decree of the United States Supreme Court in New Jersey v. New York, 347 U. S. 995 (1954). To this end, and without limitation thereto, the commission shall not:

(a) Acquire, construct or operate any project or facility or make any order or take any action which would impede or interfere with the rights, powers, privileges, conditions or obligations contained in said decree;

(b) Impose or collect any fee, charge or assessment with respect to diversions of waters of the basin permitted by said decree;

(c) Exercise any jurisdiction, except upon consent of all the parties to said decree, over the planning, design, construction, operation or control of any projects, structures or facilities constructed or used in connection with withdrawals, diversions and releases of waters of the basin authorized by said decree or of the withdrawals, diversions or releases to be made thereunder; or

(d) Serve as river master under said decree, except upon consent of all the parties thereto.

3.6 General Powers. The commission may:

(a) Plan, design, acquire, construct, reconstruct, complete, own, improve, extend, develop, operate and maintain any and all projects, facilities, properties, activities and services, determined by the commission to be necessary, convenient or useful for the purposes of this compact;

(b) Establish standards of planning, design and operation of all projects and facilities in the basin which affect its water resources, including without limitation thereto water and waste treatment plants, stream and lake recreational facilities, trunk mains for water distribution, local flood protection works, small watershed management programs, and ground water recharging operations;

(c) Conduct and sponsor research on water resources, their planning, use, conservation, management, development, control and protection, and the capacity, adaptability and best utility of each facility thereof, and collect, compile, correlate, analyze, report and interpret data on water resources and uses in the basin, including without limitation thereto the relation of water to other resources, industrial water technology, ground water movement, relation between water price and water demand, and general hydrological conditions;

(d) Compile and coordinate systematic stream stage and ground water level forecasting data, and publicize such information when and as needed for water uses, flood warning, quality maintenance or other purposes;

(e) Conduct such special ground water investigations, tests, and operations and compile such data relating thereto as may be required to formulate and administer the comprehensive plan;

(f) Prepare, publish and disseminate information and reports with respect to the water problems of the basin and for the presentation of the needs, resources and policies of the basin to executive and legislative branches of the signatory parties;

(g) Negotiate for such loans, grants, services or other aids as may be lawfully available from public or private sources to finance or assist in effectuating any of the purposes of this compact; and to receive and accept such aid upon such terms and conditions, and subject to such provisions for repayment as may be required by federal or state law or as the commission may deem necessary or desirable;

(h) Exercise such other and different powers as may be delegated to it by this compact or otherwise pursuant to law, and have and exercise all powers necessary or convenient to carry out its express powers or which may be reasonably implied therefrom.

3.7 Rates and Charges. The commission may from time to time after public notice and hearing fix, alter and revise rates, rentals, charges and tolls and classifications thereof, for the use of facilities which it may own or operate and for products and services rendered thereby, without regulation or control by any department, office or agency of any signatory party.

3.8 Referral and Review. No project having a substantial effect on the water resources of the basin shall hereafter be undertaken by any person, corporation or governmental authority unless it shall have been first submitted to and approved by the commission, subject to the provisions of Sections 3.3 and 3.5. The commission shall approve a project whenever it finds and determines that such project would not substantially impair or conflict with the comprehensive plan and may modify and approve as modified, or may disapprove any such project whenever it finds and determines that the project would substantially impair or conflict with such plan. The commission shall provide by regulation for the procedure of submission, review and consideration of projects, and for its determinations pursuant to this section. Any determination of the commission hereunder shall be subject to judicial review in any court of competent jurisdiction.

3.9 Coordination and Cooperation. The commission shall promote and aid the coordination of the activities and programs of federal, state, municipal and private agencies concerned with water resources administration in the basin. To this end, but with limitation thereto, the commission may:

(a) Advise, consult, contract, financially assist, or otherwise cooperate with any and all such agencies;

(b) Employ any other agency or instrumentality of any of the signatory parties or of any political subdivision thereof, in the design, construction, operation and maintenance of structures, and the installation and management of river control systems, or for any other purpose;

(c) Develop and adopt plans and specifications for particular water resources projects and facilities which so far as consistent with the comprehensive plan incorporate any separate plans of other public and private organizations operating in the basin, and permit the decentralized administration thereof;

(d) Qualify as a sponsoring agency under any federal legislation heretofore or hereafter enacted to provide financial or other assistance for the planning, conservation, utilization, development, management or control of water resources.

3.10 Advisory Committees. The commission may constitute and empower advisory committees, which may be comprised of representatives of the public and of federal, state, county and municipal governments, water resources agencies, water-using industries, water-interest groups, labor and agriculture.

ARTICLE 4

WATER SUPPLY

Section 4.1 Generally. The commission shall have power to develop, implement and effectuate plans and projects for the use of the water of the basin for domestic, municipal, agricultural and industrial water supply. To this end, without limitation thereto, it may provide for, construct, acquire, operate and maintain dams, reservoirs and other facilities for utilization of surface and ground water resources, and all related structures, appurtenances and equipment on the river and its tributaries and at such off-river sites as it may find appropriate, and may regulate and control the use thereof.

4.2 Storage and Release of Waters.

(a) The commission shall have power to acquire, operate and control projects and facilities for the storage and release of waters, for the regulation of flows and supplies of surface and ground waters of the basin, for the protection of public health, stream quality control, economic development, improvement of fisheries, recreation, dilution and abatement of pollution, the prevention of undue salinity and other purposes.

(b) No signatory party shall permit any augmentation of flow to be diminished by the diversion of any water of the basin during any period in which waters are being released from storage under the direction of the commission for the purpose of augmenting such flow, except in cases where such diversion is duly authorized by this compact, or by the commission pursuant thereto, or by the judgment, order or decree of a court of competent jurisdiction.

4.3 Assessable Improvements. The commission may undertake to provide stream regulation in the main stream or any tributary in the basin and may assess on an annual basis or otherwise the cost thereof upon water users or any classification of them specially benefited thereby to a measurable extent, provided that no such assessment shall exceed the actual benefit to any water user. Any such assessment shall follow the procedure prescribed by law for local improvement assessments and shall be subject to judicial review in any court of competent jurisdiction.

4.4 Coordination. Prior to entering upon the execution of any project authorized by this article, the commission shall review and consider all existing rights, plans and programs of the signatory parties, their political subdivisions, private parties, and water users which are pertinent to such project, and shall hold a public hearing on each proposed project.

4.5 Additional Powers. In connection with any project authorized by this article, the commission shall have power to provide storage, treatment, pumping and transmission facilities, but nothing herein shall be construed to authorize the commission to engage in the business of distributing water.

ARTICLE 5

POLLUTION CONTROL

Section 5.1 General Powers. The commission may undertake investigations and surveys, and acquire, construct, operate and maintain projects and facilities to control potential pollution and abate or dilute existing pollution of the water resources of the basin. It may invoke as complainant the power and jurisdiction of water pollution abatement agencies of the signatory parties.

5.2 Policy and Standards. The commission may assume jurisdiction to control future pollution and abate existing pollution in the waters of the basin, whenever it determines after investigation and public hearing upon due notice that the effectuation of the comprehensive plan so requires. The standard of such control shall be that pollution by sewage or industrial or other waste originating within a signatory state shall not injuriously affect waters of the basin as contemplated by the comprehensive plan. The commission, after such public hearing may classify the waters of the basin and establish standards of treatment of sewage, industrial or other waste, according to such classes including allowance for the variable factors of surface and ground waters, such as size of the stream, flow, movement, location, character, self-purification, and usage of the waters affected. After such investigation, notice and hearing the commission may adopt and from time to time amend and repeal rules, regulations and standards to control such future pollution and abate existing pollution, and to require such treatment of sewage, industrial or other waste within a time reasonable for the construction of the necessary works, as may be required to protect the public health or to preserve the waters of the basin for uses in accordance with the comprehensive plan.

5.3 Cooperative Legislation and Administration. Each of the signatory parties covenants and agrees to prohibit and control pollution of the waters of the basin according to the requirements of this compact and to cooperate faithfully in the control of future pollution in and abatement of existing pollution from the rivers, streams, and waters in the basin which flow through, under, into or border upon any of such signatory states, and in order to effect such object, agrees to enact any necessary legislation to enable each such party to place and maintain the waters of said basin in a satisfactory condition, available for safe and satisfactory use as public and industrial water supplies after reasonable treatment, suitable for recreational usage, capable of maintaining fish and other aquatic life, free from unsightly or malodorous nuisances due to floating solids or sludge deposits and adaptable to such other uses as may be provided by the comprehensive plan.

5.4 Enforcement. The commission may, after investigation and hearing, issue an order or orders upon any person or public or private corporation, or other entity, to cease the discharge of sewage, industrial or other waste into waters of the basin which it determines to be in violation of such rules and regulations as it shall have adopted for the prevention and abatement of pollution. Any such order or orders may prescribe the date, including a reasonable time for the construction of any necessary works, on or before which such discharge shall be wholly or partially discontinued, modified or treated, or otherwise conformed to the requirements of such rules and regulations. Such order shall be reviewable in any court of competent jurisdiction. The courts of the signatory parties shall have jurisdiction to enforce against any person, public or private corporation, or other entity, any and all provisions of this article or of any such order. The commission may bring an action in its own name in any such court of competent jurisdiction to compel compliance with any provision of this article, or any rule or regulation issued pursuant thereto or of any such order, according to the practice and procedure of the court.

5.5 Further Jurisdiction. Nothing in this compact shall be construed to repeal, modify or qualify the authority of any signatory party to enact any legislation or enforce any additional conditions and restrictions to lessen or prevent the pollution of waters within its jurisdiction.

ARTICLE 6

FLOOD PROTECTION

Section 6.1 General Powers. The commission may plan, design, construct and operate and maintain projects and facilities, as it may deem necessary or desirable for flood damage reduction. It shall have power to operate such facilities and to store and release waters on the Delaware River and its tributaries and elsewhere within the basin, in such manner, at such times, and under such regulations as the commission may deem appropriate to meet flood conditions as they may arise.

6.2 Flood Plain Zoning.

(a) The commission shall have power to adopt, amend and repeal recommended standards, in the manner provided by this section, relating to the nature and extent of the uses of land in areas subject to flooding by waters of the Delaware River and its tributaries. Such standards shall not be deemed to impair or restrict the power of the signatory parties or their political subdivisions to adopt zoning and other land use regulations not inconsistent therewith.

(b) The commission may study and determine the nature and extent of the flood plains of the Delaware River and its tributaries. Upon the basis of such studies, it may establish encroachment lines and delineate the areas subject to flood, including a classification of lands with reference to relative risk of flood and the establishment of standards for flood plain use which will safeguard the public health, safety and property. Prior to the adoption of any standards delineating such area or defining such use, the commission shall hold public hearings, in the manner provided by Article 14, with respect to the substance of such standards. At or before such public hearings the proposed standards shall be available, and all interested persons shall be given an opportunity to be heard thereon at the hearing. Upon the adoption and promulgation of such standards, the commission may enter into agreements to provide technical and financial aid to any municipal corporation for the administration and enforcement of any local land use ordinances or regulations giving effect to such standards.

6.3 Flood Lands Acquisition. The commission shall have power to acquire the fee or any lesser interest in lands and improvements thereon within the area of a flood plain for the purpose of restricting the use of such property so as to minimize the flood hazard, converting property to uses appropriate to flood plain conditions, or preventing unwarranted constrictions that reduce the ability of the river channel to carry flood water. Any such action shall be in accord with the standards adopted and promulgated pursuant to Section 6.2.

6.4 Flood and Stream Stage Warnings and Posting. The commission may cause lands particularly subject to flood to be posted with flood hazard warnings, and may from time to time cause flood advisory notices to be published and circulated as conditions may warrant.

ARTICLE 7

WATERSHED MANAGEMENT

Section 7.1 Watersheds Generally. The commission shall promote sound practices of watershed management in the basin, including projects and facilities to retard runoff and waterflow and prevent soil erosion.

7.2 Soil Conservation and Forestry. The commission may acquire, sponsor or operate facilities and projects to encourage soil conservation, prevent and control erosion, and to promote land reclamation and sound forestry practices.

7.3 Fish and Wildlife. The commission may acquire, sponsor or operate projects and facilities for the maintenance and improvement of fish and wildlife habitats related to the water resources of the basin.

7.4 Cooperative Planning and Operation.

(a) The commission shall cooperate with the appropriate agencies of the signatory parties and with other public and private agencies in the planning and effectuation of a coordinated program of facilities and projects authorized by this article.

(b) The commission shall not operate any such project or facility unless it has first found and determined that no other suitable unit or agency of government is available to operate the same upon reasonable conditions, in accordance with the intent and purpose expressed in Section 1.5 of this compact.

ARTICLE 8

RECREATION

Section 8.1 Development. The commission shall provide for the development of water related public sports and recreational facilities. The commission on its own account or in cooperation with a signatory party, political subdivision or any agency thereof, may provide for the construction, maintenance and administration of such facilities, subject to the provisions of Section 8.2 hereof.

8.2 Cooperative Planning and Operation.

(a) The commission shall cooperate with the appropriate agencies of the signatory parties and with other public and private agencies in the planning and effectuation of a coordinated program of facilities and projects authorized by this article.

(b) The commission shall not operate any such project or facility unless it has first found and determined that no other suitable unit or agency of government is available to operate the same upon reasonable conditions, in accordance with the intent and purpose expressed in Section 1.5 of this compact.

8.3 Operation and Maintenance. The commission, within limits prescribed by this article, shall:

(a) Encourage activities of other public agencies having water related recreational interests and assist in the coordination thereof;

(b) Recommend standards for the development and administration of water related recreational facilities;

(c) Provide for the administration, operation and maintenance of recreational facilities owned or controlled by the commission and for the letting and supervision of private concessions in accordance with this article.

8.4 Concessions. The commission shall after notice and public hearing provide by regulation for the award of contracts for private concessions in connection with recreational facilities, including any renewal or extension thereof, upon sealed competitive bids after public advertisement therefore.

ARTICLE 9

HYDROELECTRIC POWER

Section 9.1 Development. The waters of the Delaware River and its tributaries may be impounded and used by or under authority of the commission for the generation of hydroelectric power and hydroelectric energy, in accordance with the comprehensive plan.

9.2 Power Generation. The commission may develop and operate, or authorize to be developed and operated, dams and related facilities and appurtenances for the purpose of generating hydroelectric power and hydroelectric energy.

9.3 Transmission. The commission may provide facilities for the transmission of hydroelectric power and hydroelectric energy produced by it where such facilities are not otherwise available upon reasonable terms, for the purpose of wholesale marketing of power and nothing herein shall be construed to authorize the commission to engage in the business of direct sale to consumers.

9.4 Development Contracts. The commission may after public notice and hearing enter into contracts on reasonable terms, consideration and duration under which public utilities or public agencies may develop hydroelectric power and hydroelectric energy through the use of dams, related facilities and appurtenances.

9.5 Rates and Charges. Rates and charges fixed by the commission for power which is produced by its facilities shall be reasonable, nondiscriminatory, and just.

ARTICLE 10

REGULATION OF WITHDRAWALS AND DIVERSIONS

Section 10.1 Power of Regulation. The commission may regulate and control withdrawals and diversions from surface waters and ground waters of the basin, as provided by this article. The commission may enter into agreements with the signatory parties relating to the exercise of such power or regulation or control and may delegate to any of them such powers of the commission as it may deem necessary or desirable.

10.2 Determination of Protected Areas. The commission may from time to time after public hearing upon due notice determine and delineate such areas within the basin wherein the demands upon supply made by water users have developed or threaten to develop to such a degree as to create a water shortage or to impair or conflict with the requirements or effectuation of the comprehensive plan, and any such areas may be designated as "protected areas." The commission, whenever it determines that such shortage no longer exists, shall terminate the protected status of such area and shall give public notice of such termination.

10.3 Withdrawal Permits. In any protected areas so determined and delineated, no person, firm, corporation or other entity shall divert or withdraw water for domestic, municipal, agricultural or industrial uses in excess of such quantities as the commission may prescribe by general regulation, except (i) pursuant to a permit granted under this article, or (ii) pursuant to a permit or approval heretofore granted under the laws of any of the signatory states.

10.4 Emergency. In the event of a drought or other condition which may cause an actual and immediate shortage of available water supply within the basin, or within any part thereof, the commission may, after public hearing, determine and delineate the area of such shortage and declare a water supply emergency therein. For the duration of such emergency as determined by the commission no person, firm, corporation or other public or private entity shall divert or withdraw water for any purpose, in excess of such quantities as the commission may prescribe by general regulation or authorize by special permit granted hereunder.

10.5 Standards. Permits shall be granted, modified or denied as the case may be so as to avoid such depletion of the natural stream flows and ground waters in the protected area or in an emergency area as will adversely affect the comprehensive plan or the just and equitable interests and rights of other lawful users of the same source, giving due regard to the need to balance and reconcile alternative and conflicting uses in the event of an actual or threatened shortage of water of the quality required.

10.6 Judicial Review. The determinations and delineations of the commission pursuant to Section 10.2 and the granting, modification or denial of permits pursuant to Section 10.3 through 10.5 shall be subject to judicial review in any court of competent jurisdiction.

10.7 Maintenance of Records. Each state shall provide for the maintenance and preservation of such records of authorized diversions and withdrawals and the annual volume thereof as the commission shall prescribe. Such records and supplementary reports shall be furnished to the commission at its request.

10.8 Existing State Systems. Whenever the commission finds it necessary or desirable to exercise the powers conferred by this article any diversion or withdrawal permits authorized or issued under the laws of any of the signatory states shall be superseded to the extent of any conflict with the control and regulation exercised by the commission.

ARTICLE 11

INTERGOVERNMENTAL RELATIONS

Section 11.1 Federal Agencies and Projects. For the purposes of avoiding conflicts of jurisdiction and of giving full effect to the commission as a regional agency of the signatory parties, the following rules shall govern federal projects affecting the water resources of the basin, subject in each case to the provisions of Section 1.4 of this compact:

(a) The planning of all projects related to powers delegated to the commission by this compact shall be undertaken in consultation with the commission;

(b) No expenditure or commitment shall be made for or on account of the construction, acquisition or operation of any project or facility nor shall it be deemed authorized, unless it shall have first been included by the commission in the comprehensive plan;

(c) Each federal agency otherwise authorized by law to plan, design, construct, operate or maintain any project or facility in or for the basin shall continue to have, exercise and discharge such authority except as specifically provided by this section.

11.2 State and Local Agencies and Projects. For the purposes of avoiding conflicts of jurisdiction and of giving full effect to the commission as a regional agency of the signatory parties, the following rules shall govern projects of the signatory states, their political subdivisions and public corporations affecting water resources of the basin:

(a) The planning of all projects related to powers delegated to the commission by this compact shall be undertaken in consultation with the commission;

(b) No expenditure or commitment shall be made for or on account of the construction, acquisition or operation of any project or facility unless it shall have first been included by the commission in the comprehensive plan;

(c) Each state and local agency otherwise authorized by law to plan, design, construct, operate or maintain any project or facility in or for the basin shall continue to have, exercise and discharge such authority, except as specifically provided by this section.

11.3 Reserved Taxing Powers of States. Each of the signatory parties reserves the right to levy, assess and collect fees, charges and taxes on or measured by the withdrawal or diversion of waters of the basin for use within the jurisdictions of the respective signatory parties.

11.4 Project Costs and Evaluation Standards. The commission shall establish uniform standards and procedures for the evaluation, determination of benefits, and cost allocations of projects affecting the basin, and for the determination of project priorities, pursuant to the requirements of the comprehensive plan and its water resources program. The commission shall develop equitable cost sharing and reimbursement formulas for the signatory parties including:

(a) Uniform and consistent procedures for the allocation of project costs among purposes included in multiple-purpose programs;

(b) Contracts and arrangements for sharing financial responsibility among and with signatory parties, public bodies, groups and private enterprise, and for the supervision of their performance;

(c) Establishment and supervision of a system of accounts for reimbursable purposes and directing the payments and charges to be made from such accounts;

(d) Determining the basis and apportioning amounts (i) of reimbursable revenues to be paid signatory parties or their political subdivisions, and (ii) of payments in lieu of taxes to any of them.

11.5 Cooperative Services. The commission shall furnish technical services, advice and consultation to authorized agencies of the signatory parties with respect to the water resources of the basin, and each of the signatory parties pledges itself to provide technical and administrative services to the commission upon request, within the limits of available appropriations and to cooperate generally with the commission for the purposes of this compact, and the cost of such services may be reimbursable whenever the parties deem appropriate.

ARTICLE 12

CAPITAL FINANCING

Section 12.1 Borrowing Power. The commission may borrow money for any of the purposes of this compact, and may issue its negotiable bonds and other evidences of indebtedness in respect thereto.

All such bonds and evidences of indebtedness shall be payable solely out of the properties and revenues of the commission without recourse to taxation. The bonds and other obligations of the commission, except as may be otherwise provided in the indenture under which they were issued, shall be direct and general obligations of the commission and the full faith and credit of the commission are hereby pledged for the prompt payment of the debt service thereon and for the fulfillment of all other undertakings of the commission assumed by it to or for the benefit of the holders thereof.

12.2 Funds and Expenses. The purpose of this compact shall include without limitation thereto all costs of any project or facility or any part thereof, including interest during a period of construction and a reasonable time thereafter and any incidental expenses (legal, engineering, fiscal, financial consultant and other expenses) connected with issuing and disposing of the bonds; all amounts required for the creation of an operating fund, construction fund, reserve fund, sinking fund, or other special fund; all other expenses connected with the planning, design, acquisition, construction, completion, improvement or reconstruction of any facility or any part thereof; and reimbursement of advances by the commission or by others for such purposes and for working capital.

12.3 Credit Excluded; Officers, State and Municipal. The commission shall have no power to pledge the credit of any signatory party, or of any county or municipality, or to impose any obligation for payment of the bonds upon any signatory party or any county or municipality. Neither the commissioners nor any person executing the bonds shall be liable personally on the bonds of the commission or be subject to any personal liability or accountability by reason of the issuance thereof.

12.4 Funding and Refunding. Whenever the commission deems it expedient, it may fund and refund its bonds and other obligations whether or not such bonds and obligations have matured. It may provide for the issuance, sale or exchange of refunding bonds for the purpose of redeeming or retiring any bonds (including the payment of any premium, duplicate interest or cash adjustment required in connection therewith) issued by the commission or issued by any other issuing body, the proceeds of the sale of which have been applied to any facility acquired by the commission or which are payable out of the revenues of any facility acquired by the commission. Bonds may be issued partly to refund bonds and other obligations then outstanding, and partly for any other purpose of the commission. All provisions of this compact applicable to the issuance of bonds are applicable to refunding bonds and to the issuance, sale or exchange thereof.

12.5 Bonds; Authorization Generally. Bonds and other indebtedness of the commission shall be authorized by resolution of the commission. The validity of the authorization and issuance of any bonds by the commission shall not be dependent upon nor affected in any way by: (i) the disposition of bond proceeds by the commission or by contract, commitment or action taken with respect to such proceeds; or (ii) the failure to complete any part of the project for which bonds are authorized to be issued. The commission may issue bonds in one or more series and may provide for one or more consolidated bond issues, in such principal amounts and with such terms and provisions as the commission may deem necessary. The bonds may be secured by a pledge of all or any part of the property, revenues and franchises under its control. Bonds may be issued by the commission in such amount, with such maturities and in such denominations and form or forms, whether coupon or registered, as to both principal and interest, as may be determined by the commission. The commission may provide for redemption of bonds prior to maturity on such notice and at such time or times and with such redemption provisions, including premiums, as the commission may determine.

12.6 Bonds; Resolutions and Indentures Generally. The commission may determine and enter into indentures providing for the principal amount, date or dates, maturities, interest rate, denominations, form, registration, transfer, interchange and other provisions of the bonds and coupons and the terms and conditions upon which the same shall be executed, issued, secured, sold, paid, redeemed, funded and refunded. The resolution of the commission authorizing any bond or any indenture so authorized under which the bonds are issued may include all such covenants and other provisions other than any restriction on the regulatory powers vested in the commission by this compact as the commission may deem necessary or desirable for the issue, payment, security, protection or marketing of the bonds, including without limitation covenants and other provisions as to the rates or amounts of fees, rents and other charges to be charged or made for use of the facilities; the use, pledge, custody, securing, application and disposition of such revenues, of the proceeds of the bonds, and of any other moneys of the commission; the operation, maintenance, repair and reconstruction of the facilities and the amounts which may be expended therefor; the sale, lease or other disposition of the facilities; the insuring of the facilities and of the revenues derived therefrom; the construction or other acquisition of other facilities; the issuance of additional bonds or other indebtedness; the rights of the bondholders and of any trustee for the bondholders upon default by the commission or otherwise; and the modification of the provisions of the indenture and of the bonds. Reference on the face of the bonds to such resolution or indenture by its date of adoption or the apparent date on the face thereof is sufficient to incorporate all of the provisions thereof and of this compact into the body of the bonds and their appurtenant coupons. Each taker and subsequent holder of the bonds or coupons, whether the coupons are attached to or detached from the bonds, has recourse to all of the provisions of the indenture and of this compact and is bound thereby.

12.7 Maximum Maturity. No bond or its terms shall mature in more than fifty years from its own date and in the event any authorized issue is divided into two or more series or divisions, the maximum maturity date herein authorized shall be calculated from the date on the face of each bond separately, irrespective of the fact that different dates may be prescribed for the bonds of each separate series or division of any authorized issue.

12.8 Tax Exemption. All bonds issued by the commission under the provisions of this compact and the interest thereof shall at all times be free and exempt from all taxation by or under authority of any of the signatory parties, except for transfer, inheritance and estate taxes.

12.9 Interest.[2] Bonds shall bear interest at a rate determined by the commission, payable annually or semi-annually.

12.10 Place of Payment. The commission may provide for the payment of the principal and interest of bonds at any place or places within or without the signatory states, and in any specified lawful coin or currency of the United States of America.

12.11 Execution. The commission may provide for the execution and authentication of bonds by the manual, lithographed or printed facsimile signature of officers of the commission, and by additional authentication by a trustee or fiscal agent appointed by the commission. If any of the officers whose signatures or counter signatures appear upon the bonds or coupons cease to be officers before the delivery of the bonds or coupons, their signatures or counter signatures are nevertheless valid and of the same force and effect as if the officers had remained in office until the delivery of the bonds and coupons.

12.12 Holding Own Bonds. The commission shall have power out of any funds available therefor to purchase its bonds and may hold, cancel or resell such bonds.

12.13 Sale. The commission may fix terms and conditions for the sale or other disposition of any authorized issue of bonds. The commission may sell bonds at less than their par or face value but no issue of bonds may be sold at an aggregate price below the par or face value thereof if such sale would result in a net interest cost to the commission

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[2] Section 12.9 appears as amended on October 17, 1984.

calculated upon the entire issue so sold of more than six percent per annum payable semi-annually, according to standard tables of bond values. All bonds issued and sold for cash pursuant to this act shall be sold on sealed proposals to the highest bidder. Prior to such sale, the commission shall advertise for bids by publication of a notice of sale not less than ten days prior to the date of sale, at least once in a newspaper of general circulation printed and published in New York City carrying municipal bond notices and devoted primarily to financial news. The commission may reject any and all bids submitted and may thereafter sell the bonds so advertised for sale at private sale to any financially responsible bidder under such terms and conditions as it deems most advantageous to the public interest, but the bonds shall not be sold at a net interest cost calculated upon the entire issue so advertised, greater than the lowest bid which was rejected. In the event the commission desires to issue its bonds in exchange for an existing facility or portion thereof, or in exchange for bonds secured by the revenues of an existing facility, it may exchange such bonds for the existing facility or portion thereof or for the bonds so secured, plus an additional amount of cash, without advertising such bonds for sale.

12.14 Negotiability. All bonds issued under the provisions of this compact are negotiable instruments, except when registered in the name of a registered owner.

12.15 Legal Investments. Bonds of the commission shall be legal investments for savings banks, fiduciaries and public funds in each of the signatory states.

12.16 Validation Proceedings. Prior to the issuance of any bonds, the commission may institute a special proceeding to determine the legality of proceedings to issue the bonds and their validity under the laws of any of the signatory parties. Such proceeding shall be instituted and prosecuted *in rem* and the judgment rendered therein shall be conclusive against all persons whomsoever and against each of the signatory parties.

12.17 Recording. No indenture need be recorded or filed in any public office, other than the office of the commission. The pledge of revenues provided in any indenture shall take effect forthwith as provided therein and irrespective of the date of receipts of such revenues by the commission or the indenture trustee. Such pledge shall be effective as provided in the indenture without physical delivery of the revenues to the commission or to the indenture trustee.

12.18 Pledged Revenues. Bond redemption and interest payments shall, to the extent provided in the resolution or indenture, constitute a first, direct and exclusive charge and lien on all such rates, rents, tolls, fees and charges and other revenues and interest thereon received from the use and operation of the facility, and on any sinking or other funds created therefrom. All such rates, rents, tolls, fees, charges and other revenues, together with interest thereon, shall constitute a trust fund for the security and payment of such bonds and except as and to the extent provided in the indenture with respect to the payment therefrom of expenses for other purposes including administration, operation, maintenance, improvements or extensions of the facilities or other purposes shall not be used or pledged for any other purpose so long as such bonds, or any of them, are outstanding and unpaid.

12.19 Remedies. The holder of any bond may for the equal benefit and protection of all holders of bonds similarly situated:

(a) by mandamus or other appropriate proceedings require and compel the performance of any of the duties imposed upon the commission or assumed by it, its officers, agents or employees under the provisions of any indenture, in connection with the acquisition, construction, operation, maintenance, repair, reconstruction or insurance of the facilities, or in connection with the collection, deposit, investment, application and disbursement of the rates, rents, tolls, fees, charges and other revenues derived from the operation and use of the facilities, or in connection with the deposit, investment and disbursement of the proceeds received from the sale of bonds; or (b) by action or suit in a court of competent jurisdiction of any signatory party require the commission to account as if it were the trustee of an express trust, or enjoin any acts or things which may be unlawful or in violation of the rights of the holders of the bonds. The enumeration of such rights and remedies does not, however, exclude the exercise or prosecution of any other rights or remedies available to the holders of bonds.

12.20 Capital Financing by Signatory Parties; Guarantees.

(a) The signatory parties will provide such capital funds required for projects of the commission as may be authorized by their respective statutes in accordance with a cost sharing plan prepared pursuant to Article 11 of this compact; but nothing in this section shall be deemed to impose any mandatory obligation on any of the signatory parties other than such obligations as may be assumed by a signatory party in connection with a specific project or facility.

(b) Bonds of the commission, notwithstanding any other provision of this compact, may be executed and delivered to any duly authorized agency of any of the signatory parties without public offering and may be sold and resold with or without the guaranty of such signatory party, subject to and in accordance with the constitutions of the respective signatory parties.

(c) The commission may receive and accept, and the signatory parties may make, loans, grants, appropriations, advances and payments of reimbursable or non-reimbursable funds or property in any form for the capital or operating purposes of the commission.

ARTICLE 13

PLAN, PROGRAM AND BUDGETS

Section 13.1 Comprehensive Plan. The commission shall develop and adopt, and may from time to time review and revise, a comprehensive plan for the immediate and long range development and use of the water resources of the basin. The plan shall include all public and private projects and facilities which are required, in the judgment of the commission, for the optimum planning, development, conservation, utilization, management and control of the water resources of the basin to meet present and future needs; provided that the plan shall include any projects required to conform with any present or future decree or judgment of any court of competent jurisdiction. The commission may adopt a comprehensive plan or any revision thereof in such part or parts as it may deem appropriate, provided that before the adoption of the plan or any part or revision thereof the commission shall consult with water users and interested public bodies and public utilities and shall consider and give due regard to the findings and recommendations of the various agencies of the signatory parties and their political subdivisions. The commission shall conduct public hearings with respect to the comprehensive plan prior to the adoption of the plan or any part of the revision thereof.

13.2 Water Resources Program. The commission shall annually adopt a water resources program, based upon the comprehensive plan, consisting of the projects and facilities which the commission proposes to be undertaken by the commission and by other authorized governmental and private agencies, organizations and persons during the ensuing six years or such other reasonably foreseeable period as the commission may determine. The water resources program shall include a systematic presentation of:

1) the quantity and quality of water resources needs for such period;

2) the existing and proposed projects and facilities required to satisfy such needs, including all public and private projects to be anticipated;

3) a separate statement of the projects proposed to be undertaken by the commission during such period.

13.3 Annual Current Expense and Capital Budgets.

(a) The commission shall annually adopt a capital budget including all capital projects it proposes to undertake or continue during the budget period containing a statement of the estimated cost of each project and the method of financing thereof.

(b) The commission shall annually adopt a current expense budget for each fiscal year. Such budget shall include the commission's estimated expenses for administration, operation, maintenance and repairs, including a separate statement thereof for each project, together with its cost allocation. The total of such expenses shall be balanced by the commission's estimated revenues from all sources, including the cost allocations undertaken by any of the signatory parties in connection with any project. Following the adoption of the annual current expense budget by the commission, the executive director of the commission shall:

1) certify to the respective signatory parties the amounts due in accordance with existing cost sharing established for each project; and

2) transmit certified copies of such budget to the principal budget officer of the respective signatory parties at such time and in such manner as may be required under their respective budgetary procedures. The amount required to balance the current expense budget in addition to the aggregate amount of item (1) above and all other revenues available to the commission shall be apportioned equitably among the signatory parties by unanimous vote of the commission, and the amount of such apportionment to each signatory party shall be certified together with the budget.

(c) The respective signatory parties covenant and agree to include the amounts so apportioned for the support of the current expense budget in their respective budgets next to be adopted, subject to such review and approval as may be required by their respective budgetary processes.[3] Such amounts shall be due and payable to the commission in quarterly installments during its fiscal year, provided that the commission may draw upon its working capital to finance its current expense budget pending remittances by the signatory parties.

[3] See Endnote regarding subsequent statutory directives.

ARTICLE 14

GENERAL PROVISIONS

Section 14.1 Auxiliary Powers of Commission; Functions of Commissioners.

(a) The commission, for the purposes of this compact, may:

1) Adopt and use a corporate seal, enter intro contracts, sue and be sued in all courts of competent jurisdiction;

2) Receive and accept such payments, appropriations, grants, gifts, loans, advances and other funds, properties and services as may be transferred or made available to it by any signatory party or by any other public or private corporation or individual, and enter into agreements to make reimbursement for all or part thereof;

3) Provide for, acquire and adopt detailed engineering, administrative, financial and operating plans and specifications to effectuate, maintain or develop any facility or project;

4) Control and regulate the use of facilities owned or operated by the commission;

5) Acquire, own, operate, maintain, control, sell and convey real and personal property and any interest therein by contract, purchase, lease, license, mortgage or otherwise as it may deem necessary for any project or facility, including any and all appurtenances thereto necessary, useful or convenient for such ownership, operation, control, maintenance or conveyance;

6) Have and exercise all corporate powers essential to the declared objects and purposes of the commission.

(b) The commissioners, subject to the provisions of this compact, shall:

1) Serve as the governing body of the commission, and exercise and discharge its powers and duties except as otherwise provided by or pursuant to this compact;

2) Determine the character of and the necessity for its obligations and expenditures and the manner in which they shall be incurred, allowed, and paid subject to any

provisions of law specifically applicable to agencies or instrumentalities created by compact;

3) Provide for the internal organization and administration of the commission;

4) Appoint the principal officers of the commission and delegate to and allocate among them administrative functions, powers and duties;

5) Create and abolish offices, employments and positions as it deems necessary for the purposes of the commission, and subject to the provisions of this article, fix and provide for the qualification, appointment, removal, term, tenure, compensation, pension and retirement rights of its officers and employees;

6) Let and execute contracts to carry out the powers of the commission.

14.2 Regulations; Enforcement. The commission may:

(a) Make and enforce reasonable rules and regulations for the effectuation, application and enforcement of this compact; and it may adopt and enforce practices and schedules for or in connection with the use, maintenance and administration of projects and facilities it may own or operate and any product or service rendered thereby; provided that any rule or regulation, other than one which deals solely with the internal management of the commission, shall be adopted only after public hearing and shall not be effective unless and until filed in accordance with the law of the respective signatory parties applicable to administrative rules and regulations generally; and

(b) Designate any officer, agent or employee of the commission to be an investigator or watchman and such person shall be vested with the powers of a peace officer of the state in which he is duly assigned to perform his duties.

14.3 Tax Exemption. The commission, its property, functions, and activities shall be exempt from taxation by or under the authority of any of the signatory parties or any political subdivision thereof; provided that in lieu of property taxes the commission shall, as to specific projects, make payments to local taxing districts in annual amounts which shall equal the taxes lawfully assessed upon property for the tax year next prior to its acquisition by the commission for a period of ten years. The nature and amount of such payments shall be reviewed by the commission at the end of ten years, and from time to time thereafter, upon reasonable notice and opportunity to be heard to the affected taxing district, and the payments may be thereupon terminated or continued in such reasonable amount as may be necessary or desirable to take into account hardships incurred and benefits received by the taxing jurisdiction which are attributable to the project.

14.4 Meetings; Public Hearing; Records, Minutes.

(a) All meetings of the commission shall be open to the public.

(b) The commission shall conduct at least one public hearing prior to the adoption of the comprehensive plan, water resources program, annual capital and current expense budgets, the letting of any contract for the sale or other disposition by the commission of hydroelectric energy or water resources to any person, corporation or entity, and in all other cases wherein this compact requires a public hearing. Such hearing shall be held upon at least ten days public notice given by posting at the offices of the commission. The commission shall also provide forthwith for distribution of such notice to the press and by the mailing of a copy thereof to any person who shall request such notices.

(c) The minutes of the commission shall be a public record open to inspection at its offices during regular business hours.

14.5 Officers Generally.

(a) The officers of the commission shall consist of an executive director and such additional officers, deputies and assistants as the commission may determine. The executive director shall be appointed and may be removed by the affirmative vote of a majority of the full membership of the commission. All other officers and employees shall be appointed by the executive director under such rules of procedure as the commission may determine.

(b) In the appointment and promotion of officers and employees for the commission, no political, racial, religious or residence test or qualification shall be permitted or given consideration, but all such appointments and promotions shall be solely on the basis of merit and fitness. Any officer or employee of the commission who is found by the commission to be guilty of a violation of this section shall be removed from office by the commission.

14.6 Oath of Office. An oath of office in such form as the commission shall prescribe shall be taken, subscribed and filed with the commission by the executive director and by each officer appointed by him not later than fifteen days after the appointment.

14.7 Bond. Each officer shall give such bond and in such form and amount as the commission may require for which the commission may pay the premium.

14.8 Prohibited Activities.

(a) No commissioner, officer or employee shall:

1) be financially interested, either directly or indirectly, in any contract, sale, purchase, lease or transfer of real or personal property to which the commission is a party;

2) solicit or accept money or any other thing of value in addition to the compensation or expenses paid him by the commission for services performed within the scope of his official duties;

3) offer money or any thing of value for or in consideration of obtaining an appointment, promotion or privilege in his employment with the commission.

(b) Any officer or employee who shall willfully violate any of the provisions of this section shall forfeit his office or employment.

(c) Any contract or agreement knowingly made in contravention of this section is void.

(d) Officers and employees of the commission shall be subject in addition to the provisions of this section to such criminal and civil sanctions for misconduct in office as may be imposed by federal law and the law of the signatory state in which such misconduct occurs.

14.9 Purchasing. Contract for the construction, reconstruction or improvement of any facility when the expenditure required exceeds ten thousand dollars and contracts for the purchase of services, supplies, equipment and materials when the expenditure required exceeds two thousand five hundred dollars shall be advertised and let upon sealed bids to the lowest responsible bidder. Notice requesting such bids shall be published in a manner reasonably likely to attract prospective bidders, which publication shall be made at least ten days before bids are received and in at least two newspapers of general circulation in the basin. The commission may reject any and all bids and readvertise in its discretion. If after rejecting bids the commission determines and resolves that in its opinion the supplies, equipment and materials may be purchased at a lower price in the open market, the commission may give each responsible bidder an opportunity to negotiate a price and may proceed to purchase the supplies, equipment and materials in the open market at a negotiated price which is lower than the lowest rejected bid of a responsible bidder, without further observance of the provisions requiring bids or notice. The commission shall adopt rules and regulations to provide for purchasing from the lowest responsible bidder when sealed bids, notice and publication are not required by this section. The commission may suspend and waive the provisions of this section requiring competitive bids whenever:

1) the purchase is to be made from or the contract to be made with the federal or any state government or any agency or political subdivision thereof or pursuant to any open end bulk purchase contract of any of them;

2) the public exigency requires the immediate delivery of the articles or performance of the service;

3) only one source of supply is available;

4) the equipment to be purchased is of a technical nature and the procurement thereof without advertising is necessary in order to assure standardization of equipment and interchangeability of parts in the public interest; or

5) services are to be provided of a specialized or professional nature.

14.10 Insurance. The commission may self-insure or purchase insurance and pay the premiums therefore against loss or damage to any of its properties; against liability for injury to persons or property; and against loss of revenue from any cause whatsoever. Such insurance coverage shall be in such form and amount as the commission may determine, subject to the requirements of any agreement arising out of the issuance of bonds by the commission.

14.11 Annual Independent Audit.

(a) As soon as practical after the closing of the fiscal year, an audit shall be made of the financial accounts of the commission. The audit shall be made by qualified certified public accountants selected by the commission, who have no personal interest direct or indirect in the financial affairs of the commission or any of its officers or employees. The report of audit shall be prepared in accordance with accepted accounting practices and shall be filed with the chairman and such other officers as the commission shall direct. Copies of the report shall be distributed to each commissioner and shall be made available for public distribution.

(b) Each signatory party by its duly authorized officers shall be entitled to examine and audit at any time all of the books, documents, records, files and accounts and all other papers, things or property of the commission. The representatives of the signatory parties shall have access to all books, documents, records, accounts, reports, files and all other papers, things or property belonging to or in use by the commission and necessary to facilitate the audit and they shall be afforded full facilities for verifying transactions with the balances or securities held by depositaries, fiscal agents and custodians.

(c) The financial transactions of the commission shall be subject to audit by the general accounting office in accordance with the principles and procedures applicable to commercial corporate transactions and under such rules and regulations as may be prescribed by the comptroller general of the United States. The audit shall be conducted at the place or places where the accounts of the commission are kept.

(d) Any officer or employee who shall refuse to give all require assistance and information to the accountants selected by the commission or to the authorized officers of any signatory party or who shall refuse to submit to them for examination such books, documents, records, files, accounts, papers, things or property as may be requested shall forfeit his office.

14.12 Reports. The commission shall make and publish an annual report to the legislative bodies of the signatory parties and to the public reporting on its programs, operations and finances. It may also prepare, publish and distribute such other public reports and informational materials as it may deem necessary or desirable.

14.13 Grants, Loans or Payments by States or Political Subdivisions.

(a) Any or all of the signatory parties or any political subdivision thereof may:

1) Appropriate to the commission such funds as may be necessary to pay preliminary expenses such as the expenses incurred in the making of borings, and other studies of subsurface conditions, in the preparation of contracts for the sale of water and in the preparation of detailed plans and estimates required for the financing of a project;

2) Advance to the commission, either as grants or loans, such funds as may be necessary or convenient to finance the operation and management of or construction by the commission of any facility or project;

3) Make payments to the commission for benefits received or to be received from the operation of any of the projects or facilities of the commission.

(b) Any funds which may be loaned to the commission either by a signatory party or a political subdivision thereof shall be repaid by the commission through the issuance of bonds or out of other income of the commission, such repayment to be made within such period and upon such terms as may be agreed upon between the commission and the signatory party or political subdivision making the loan.

14.14 Condemnation Proceedings.

(a) The commission shall have the power to acquire by condemnation the fee or any lesser interest in lands, lands lying under water, development rights in land, riparian rights, water rights, waters and other real or personal property within the basin for any project or facility authorized pursuant to this compact. This grant of power of eminent domain includes but is not limited to the power to condemn for the purposes of this compact any property already devoted to a public use, by whomsoever owned or held, other than property of a signatory party and any property held, constructed, operated or maintained in connection with a diversion authorized by a United States Supreme Court decree. Any condemnation of any property or franchises owned or used by a municipal or privately owned public utility, unless the affected public utility facility is to be relocated or replaced, shall be subject to the authority of such state board, commission or other body as may have regulatory jurisdiction over such public utility.

(b) Such power of condemnation shall be exercised in accordance with the provisions of any federal law applicable to the commission; provided that if there is no such applicable federal law, condemnation
proceedings shall be in accordance with the provisions of such general state condemnation law as may be in force in the signatory state in which the property is located.

(c) Any award or compensation for the taking of property pursuant to this article shall be paid by the commission, and none of the signatory parties nor any other agency, instrumentality or political subdivision thereof shall be liable for such award or compensation.

14.15 Conveyance of Lands and Relocation of Public Facilities.

(a) The respective officers, agencies, departments, commissions or bodies having jurisdiction and control over real and personal property owned by the signatory parties are authorized and empowered to transfer and convey in accordance with the laws of the respective parties to the commission any such property as may be necessary or convenient to the effectuation of the authorized purposes of the commission.

(b) Each political subdivision of each of the signatory parties is authorized and empowered, notwithstanding any contrary provision of law, to grant and convey to the commission, upon the commission's request, any real property or any interest therein owned by such political subdivisions including lands lying under water and lands already devoted to public use which may be necessary or convenient to the effectuation of the authorized purposes of the commission.

(c) Any highway, public utility or other public facility which will be dislocated by reason of a project deemed necessary by the commission to effectuate the authorized purposes of this compact shall be relocated and the cost thereof shall be paid in accordance with the law of the state in which the facility is located; provided that the cost of such relocation payable by the commission shall not in any event exceed the expenditure required to serve the public convenience and necessity.

14.16 Rights of Way. Permission is hereby granted to the commission to locate, construct and maintain any aqueducts, lines, pipes, conduits and auxiliary facilities authorized to be acquired, constructed, owned, operated or maintained by the commission in, over, under or across any streets and highways now or hereafter owned, opened or dedicated to or for public use, subject to such reasonable conditions as the highway department of the signatory party may require.

14.17 Penal Sanction. Any person, association or corporation who violates or attempts or conspires to violate any provision of this compact or any rule, regulation or order of the commission duly made, promulgated or issued pursuant to the compact in addition to any other remedy, penalty or consequence provided by law shall be punishable as may be provided by statute of any of the signatory parties within which the offense is committed; provided that in the absence of such provision any such person, association or corporation shall be liable to a penalty of not less than $50 nor more than $1,000 for each such offense to be fixed by the court which the commission may recover in its own name in any court of competent jurisdiction, and in a summary proceeding where available under the practice and procedure of such court. For the purposes of this section in the event of a continuing offense each day of such violation, attempt or conspiracy shall constitute a separate offense.

14.18 Tort Liability. The commission shall be responsible for claims arising out of the negligent acts or omissions of its officers, agents and employees only to the extent and subject to the procedures prescribed by law generally with respect to officers, agents and employees of the government of the United States.

14.19 Effect on Riparian Rights. Nothing contained in this compact shall be construed as affecting or intending to affect or in any way to interfere with the law of the respective signatory parties relating to riparian rights.

14.20 Amendments and Supplements. Amendments and supplements to this compact to implement the purposes thereof may be adopted by legislative action of any of the signatory parties concurred in by all of the others.

14.21 Construction and Severability. The provisions of this Act and of agreements thereunder shall be severable and if any phrase, clause, sentence or provision of the Delaware River Basin Compact or such agreement is declared to be unconstitutional or the applicability thereof to any signatory party, agency or person is held invalid, the constitutionality of the remainder of such compact or such agreement and the applicability thereof to any other signatory party, agency, person or circumstance shall not be affected thereby. It is the legislative intent that the provisions of such compact be reasonably and liberally construed.

14.22 Effective Date; Execution. This compact shall become binding and effective thirty days after the enactment of concurring legislation by the federal government, the states of Delaware, New Jersey and New York, and the Commonwealth of Pennsylvania. The compact shall be signed and sealed in six duplicate original copies by the respective chief executives of the signatory parties. One such copy shall be filed with the Secretary of State of each of the signatory parties or in accordance with the laws of the state in which the filing is made, and one copy shall be filed and retained in the archives of the commission upon its organization.

IN WITNESS WHEREOF, and in evidence of the adoption and enactment into law of this compact by the Congress and legislatures, respectively, of the signatory parties, the President of the United States and the respective Governors do hereby, in accordance with authority conferred by law, sign this compact in six duplicate original copies, as attested by the respective secretaries of state, and have caused the seals of the United States and of the respective states to be hereunto affixed this 2nd day of November, 1961.

s/ JOHN F. KENNEDY
PRESIDENT OF THE UNITED STATES

Attest
s/ DEAN RUSK
SECRETARY OF STATE

s/ ELBERT N. CARVEL
GOVERNOR OF
THE STATE OF DELAWARE

Attest
s/ ELISHA C. DUKES
SECRETARY OF STATE

s/ ROBERT B. MEYNER
GOVERNOR OF
THE STATE OF NEW JERSEY

Attest
s/ EDWARD J. PATTEN
SECRETARY OF STATE

s/ NELSON A. ROCKEFELLER
GOVERNOR OF
THE STATE OF NEW YORK

Attest
s/ CAROLINE K. SIMON
SECRETARY OF STATE

s/ DAVID L. LAWRENCE
GOVERNOR OF
THE COMMONWEALTH OF PENNSYLVANIA

Attest
s/ E. JAMES TRIMARCHI, JR.
SECRETARY OFTHE COMMONWEALTH

PART II

EFFECTUATION

UNITED STATES: *(from Public Law 87-328, 75 Stat. 688)*

15.1 Reservations. In the exercise of the powers reserved to the Congress, pursuant to Section 1.4 of the Compact, the consent to and participation in the Compact by the United States is subject to the following conditions and reservations:

(a) Notwithstanding any provision of the Delaware River Basin Compact the Delaware River Basin Commission shall not undertake any project (as defined in such compact), other than a project for which State supplied funds only will be used, beyond the planning stage untilC

(1) such commission has submitted to the Congress such complete plans and estimates for such project as may be necessary to make an engineering evaluation of such project, includingC

(A) where the project will serve more than one purpose, an allocation of costs among the purposes served and an estimate of the ratio of benefits to costs for each such purpose.

(B) an apportionment of costs among the beneficiaries of the project, including the portion of the costs to be borne by the Federal Government and by State and local governments, and

(C) a proposal for financing the project, including the terms of any proposed bonds or other evidences of indebtedness to be used for such purposes; and

(2) such project has been authorized by Act of Congress.

(b) No provision of Section 3.7 of the Compact shall be deemed to authorize the commission to impose any change for water withdrawals or diversions from the Basin if such withdrawals or diversions could lawfully have been made without charge on the effective date of the Compact; or to impose any charges with respect to commercial navigation within the Basin, jurisdiction over which is reserved to the Federal Government:

Provided, That this paragraph shall be applicable to the extent not inconsistent with Section 1.4 of this Compact.

(c) Nothing contained in the Compact shall be deemed to restrict the executive powers of the President in the event of a national emergency.

(d) Notwithstanding the provisions of Article 2, Section 2.2 of the Compact, the member of the commission appointed by the President of the United States and his alternate shall serve at the pleasure of the President.[4]

(e) Nothing contained in the Compact shall be construed as impairing or in any manner affecting the applicability to all Federal funds budgeted and appropriated for use by the commission, or such authority over budgetary and appropriation matters as the President and Congress may have with respect to agencies in the Executive Branch of the Federal Government.

(f) Except to the same extent that state bonds are or may continued to be free or exempt from Federal taxation under the internal revenue laws of the United States, nothing contained in the Compact shall be construed as freeing or exempting from internal revenue taxation in any manner whatsoever any bonds issued by the commission, their transfer, or the income therefrom (including any profits made on the sale thereon).

(g) Nothing contained in the Compact shall be construed to obligate the United States legally or morally to pay the principal or interest on any bonds issued by the Delaware River Basin Commission.

(h) Notwithstanding the provisions of Section 11.5 or any other provision of the Compact, the furnishing of technical services to the commission by agencies of the Executive Branch of the Government of the United States is pledged only to the extent that the respective agencies shall from time to time agree thereto or to the extent that the President may from time to time direct such agencies to perform such services for the commission. Nothing in the Compact shall be deemed to require the United States to furnish administrative services or facilities for carrying out functions of the commission except to the extent that the President may direct.

[4] Section 15.1(d) is as enacted in 1961. This section was subsequently repealed by Public Law 105-18 in June of 1997. Also see Endnote on this subject.

(i) All laborers and mechanics employed by contractors or subcontractors in the construction, alteration or repair, including painting and decorating, of projects, buildings and works which are undertaken by the commission or are financially assisted by it, shall be paid wages at rates not less than those prevailing on similar construction in the locality so determined by the Secretary of Labor in accordance with the Davis-Bacon Act, as amended (40 U. S. C. 276a-276a-5), and every such employee shall receive compensation at a rate not less than one and one-half times his basic rate of pay for all hours worked in any workweek in excess of eight hours in any workday or forty hours in any workweek, as the case may be. A provision stating the minimum wages thus determined and the requirement that overtime be paid as above provided shall be set out in each project advertisement for bids and in each bid proposal form and shall be made a part of the contract covering the project. The Secretary of Labor shall have, with respect to the administration and enforcement of labor standards specified in this provision, the supervisory, investigatory and other authority and functions set forth in Reorganization Plan Numbered 14 of 1950 (15 F. R. 3176, 64 Stat. 1267, 5 U. S. C. 133z-15, and Section 2 of the Act of June 13, 1934, as amended (48 Stat. 948, as amended; 40 U. S. C. 276(c)).

(j) Contracts for the manufacture or furnishing of materials, supplies, articles and equipment with the commission which are in excess of $10,000 shall be subject to the provisions of the Walsh-Healey Public Contracts Act (41 U. S. C. 35 et seq.).

(k) Notwithstanding any other provision of this Act, nothing contained in this Act or in the Compact shall be construed as superseding or limiting the functions, under any other law, of the Secretary of Health, Education, and Welfare or of any other officer or agency of the United States, relating to water pollution: *Provided,* That the exercise of such functions shall not limit the authority of the commission to control, prevent, or abate water pollution.

(l) The provisions of Section 8.4 of Article 8 of the Compact shall not be construed to apply to facilities operated pursuant to any other Federal law.

(m) For purposes of the Act of June 25, 1948, 62 Stat. 982, as amended (Title 28, U. S. Code, chapter 171, and Sections 1346(b) and 240 (b)) and the Act of March 3, 1887, 24 Stat. 505, as amended (Title 28, U. S. Code, Section 1402, 1491, 1496, 1501, 1503, 2071, 2072, 2411, 2412, 2501), and the Act of June 11, 1946, 60 Stat. 237, as amended (Title 5, U. S. Code, Sections 1001 and 1011, Title 50 App. U.S. Code, Section 1900), the commission shall not be considered a Federal agency.

(n) The officers and employees of the commission (other than the United States member, alternate United States member, and advisors, and personnel employed by the United States member under direct Federal appropriation) shall not be deemed to be, for any purpose, officers or employees of the United States or to become entitled at any time by reason of employment by the commission to any compensation or benefit payable or made available by the United States solely and directly to its officers or employees.

(o) Neither the Compact nor this Act shall be deemed to enlarge the authority of any Federal agency other than the commission to participate in or to provide funds for projects or activities in the Delaware River Basin.

(p) The United States district courts shall have original jurisdiction of all cases or controversies arising under the Compact, and this Act and any case or controversy so arising initiated in a State Court shall be removable to the appropriate United States district court in the manner provided by ' 1446, Title 28 U. S. C. Nothing contained in the Compact or elsewhere in this Act shall be construed as a waiver by the United States of its immunity from suit.

(q) The right to alter, amend, or repeal this Act is hereby expressly reserved. The right is hereby reserved to the Congress or any of its standing committees to require the disclosure and furnishing of such information and data by the Delaware River Basin Compact Commission as is deemed appropriate by the Congress or any such committee.

(r) The provisions of Sections 2.4 and 2.6 of Article 2 of the Compact notwithstanding, the member and alternate member appointed by the President and advisor there referred to may be paid compensation by the United States, such compensation to be fixed by the President at the rates which he shall deem to prevail in respect to comparable officers in the executive branch.

(s) 1. Nothing contained in this Act or in the Compact shall impair or affect the constitutional authority of the United Sates or any of its powers, rights, functions, or jurisdiction under other existing or future legislation in and over the area or waters which are the subject of the Compact including projects of the commission: *Provided,* That whenever a comprehensive plan, or any part or revision thereof, has been adopted with the concurrence of the member appointed by the President, the exercise of any powers conferred by law on any officer, agency or instrumentality of the United States with regard to water and related land resources in the Delaware River Basin shall not substantially conflict with any such portion of such comprehensive plan and the provisions of Section 3.8 and Article 11 of the Compact shall be applicable to the extent necessary to avoid such substantial conflict: *Provided further,* That whenever the President shall find and determine that the national interest so requires, he may suspend, modify or delete any provision of the comprehensive plan to the extent that it affects the exercise of any powers, rights, functions, or jurisdiction conferred by law on any officer, agency or instrumentality of the United States other than the commission. Such action shall be taken by executive order in which such finding and determination shall be set forth.

2. For the purposes of paragraph 1 hereof, concurrence by the member appointed by the President shall be presumed unless within 60 days after notice to him of adoption of the comprehensive plan, or any part or revision thereof, he shall file with the commission notice of his nonconcurrence. Each concurrence of the member appointed by the President in the adoption of the comprehensive plan or any part or revision thereof may be withdrawn by notice filed with the commission at any time between the first and sixtieth day of the sixth year after the initial adoption of the comprehensive plan and of every sixth year thereafter.

(t) In the event that any phrase, clause, sentence or provision of Section 1.4 of Article 1 of the Compact, is declared to be unconstitutional under the constitution of any of the signatory parties, or the applicability thereof to any signatory party, agency or person is held invalid by a court of last resort of competent jurisdiction, the United States shall cease to be a party to the Compact, except to the extent that the President deems remaining a party necessary and proper to protect the national interest, and shall cease to be bound by the terms thereof.

(u) All Acts or parts of Acts inconsistent with the provisions of this Act are hereby amended for the purpose of this Act to the extent necessary to carry out the provisions of this Act: *Provided, however,* That no act of the commission shall have the effect of repealing, modifying or amending any Federal law.

15.2 Effectuation. (a) The President is authorized to take such action as may be necessary and proper, in his discretion, to effectuate the Compact and the initial organization and operation of the Commission thereunder.

(b) Executive departments and other agencies of the executive branch of the Federal Government shall cooperate with and furnish appropriate assistance to the United States member. Such assistance shall include the furnishing of services and facilities and may include the detailing of personnel to the United States member. Appropriations are hereby authorized as necessary for the carrying out of the functions of the United States member, including appropriations for the employment of personnel by the United States member.

15.3 Effect Date. This Act shall take effect immediately.

DELAWARE: *(from 53 Delaware Laws, Chapter 71)*

' **1011. Repealer.** All acts and parts of acts inconsistent with any provision of this act are to the extent of such inconsistency hereby repealed.

' **1012. Effectuation by Chief Executive.** The chief executive is authorized to take such action as may be necessary and proper, in his discretion, to effectuate the compact and the initial organization and operation of the commission thereunder.

' **1013. Effective Date.** This act shall take effect immediately.

NEW JERSEY: *(from New Jersey Laws of 1961, Chapter 13)*

15.1 Repealer. All acts and parts of acts inconsistent with any provision of this act are to the extent of such inconsistency hereby repealed.

15.2 Effectuation by Chief Executive. The chief executive is authorized to take such action as may be necessary and proper, in his discretion, to effectuate the compact and the initial organization and operation of the commission thereunder.

15.3 Effective Date. This act shall take effect immediately.

NEW YORK:[5] *(from New York Laws of 1961, Chapter 148);* with Sections of the Conservation Law as renumbered by Laws of 1962, Chapter 73.

' **631. Commissioner and Alternate.** 1. As provided in the second subdivision of section two of article two of the compact, the governor shall be this state's member on the commission established thereby. The governor shall appoint a member of the water resources commission as his alternate pursuant to the third subdivision of said section two of article two of the compact. In the absence of the governor and such member of the water resources commission, the powers, duties and functions of this state's member of the Delaware River Basin Commission shall be performed by the alternate of said department head on the water resources commission.

[5] The Sections have been renumbered by Laws of 1962, Chapter 73 and now constitute Sections 802-812 of the Conservation Law.

2. Any person serving on the Delaware River Basin Commission pursuant to this section shall be reimbursed for all necessary expenses incurred as an incident of such service, and such reimbursement shall be from the funds of said person's department or office.

' **632. Advisors.** 1. The member of the Delaware River Basin Commission from this state shall have an advisor as contemplated by subdivision six of section two of article two of the compact. Such advisor shall be the mayor of the city of New York or his designee, but no designee of the mayor shall be recognized as an advisor or accorded any privileges as such unless the mayor shall have notified the commission member from this state and the Delaware River Basin Commission in writing of the selection of such designee and of his identity.

2. The members of the water resources commission and the state commissioner of commerce shall constitute an advisory committee with whom the member of the Delaware River Basin Commission from this state shall consult with respect to the conduct of New York participation in the compact. Such member of the commission also shall consult from time to time with other officers of the state government or any subdivision thereof, as may be appropriate.

' **633. Consent to Alteration of Diversions.** 1. Consent of this state to the impairment, diminution or other adverse effect on diversions, compensating releases, rights, conditions, obligations, and provisions for the administration thereof as contemplated by subdivision three of section three of article three of the compact shall not be given, except with the prior approval of the water resources commission.

2. Except with respect to diversions governed by subdivision one of this section and the provision of the compact referred to therein, the provisions of section four hundred fifty-two of the conservation law shall not apply to any diversion or furnishing of water authorized by or made pursuant to the compact.

' **634. Jurisdiction of Courts.** Except as otherwise specifically provided herein, the phrase "court of competent jurisdiction" as used in the compact shall, with reference to this state, mean the supreme court, and said court is hereby given all necessary and appropriate jurisdiction to hear and determine any action or proceeding brought before it pursuant to appropriate provisions of the compact. As used in subdivision six of section ten of article ten of the compact, the phrase "court of competent jurisdiction" shall mean a court in which an appropriate proceeding under article seventy-eight of the civil practice act may be brought. As used in item one of paragraph (a) of subdivision one of section fourteen of article fourteen of the compact, the phrase "court of competent jurisdiction" shall mean any court of this state in which an action or proceeding of the class brought by the Delaware River Basin Commission may be heard and determined.

' **635. Prior to Project Approval.** No project requiring a license, permit or other approval by any agency or officer of this state, or any subdivision thereof, shall be given any such license, permit, or approval, if such project requires approval of the Delaware River Basin Commission pursuant to the compact and such has not been given.

' **636. Agreements with Municipalities.** Any city, county, town or village within the "basin", as that term is defined in the compact, shall have power to make agreements to provide technical and financial aid as contemplated by paragraph (b) of subdivision two of section six of article six of the compact. Nothing herein contained shall be construed to relieve any such city, county, town or village from compliance with any general or special laws relating to the receipt of grants or other assistance from other governmental units and contracts in connection therewith.

' **637. Delegations of Power.** No agency or officer of this state or any subdivision thereof shall accept or exercise any delegation of power pursuant to subdivision one of section ten of article ten of the compact unless, in the absence of the compact, it would have the constitutional or statutory power to exercise such power on its own account.

' **638. Cooperative Services.** Departments, agencies and officers shall provide technical and administrative services to the Delaware River Basin Commission upon request, within the limits of available appropriations and shall cooperate generally with said commission for the purposes of the compact.

' **639. Budget.** The Delaware River Basin Commission shall submit annually to the director of the budget, in accordance with the rules and practice of the state, for study and consideration by such director, an estimate of moneys required to administer, manage and support the commission during the ensuring fiscal year. Such estimate shall include any request for appropriation of funds by New York and shall be accompanied by a tabulation of similar requests which the commission expects to make to each other member state and the formula or factors upon which such respective requests are based. The provisions of subdivision three of section thirteen of article thirteen of the compact shall apply to the budgetary and other fiscal matters related to the participation of this state in the compact.

' **640. Audit.** Pursuant to paragraph (b) of subdivision eleven of section fourteen of article fourteen of the compact, the state comptroller is hereby authorized and empowered from time to time to examine the accounts and books of the commission, including its receipts, disbursements and such other items referring to its financial standing as such comptroller may deem proper and to report the results of such examination to the governor.

' **641. Inconsistent Laws.** No provision of the conservation law or of any other law, which is inconsistent with the provisions of the compact shall be applicable to the Delaware River Basin Commission or to any matter governed by the compact.

' **2. Effectuation.** The compact set forth in the conservation law as amended by section one of this act shall become binding and effective in accordance with the provisions of subdivision twenty-one of section fourteen of article fourteen thereof. The governor is hereby authorized and directed to sign and seal the compact as provided in said subdivision twenty-one and to cause copies thereof to be filed in accordance therewith.

' **3. Effective Date.** This act shall take effect immediately.

PENNSYLVANIA: *(from Pennsylvania Acts of 1961, Act No. 268)*

Section 2. Repealer. All acts and parts of acts inconsistent with any provision of this act are to the extent of such inconsistency hereby repealed.

Section 3. Effectuation by Chief Executive. The chief executive is authorized to take such action as may be necessary and proper in his discretion to effectuate the compact and the initial organization and operation of the commission thereunder.

Section 4. Effective Date. This act shall take effect immediately.

ENDNOTES

[1,4] In June of 1997, Congress enacted and President Clinton signed the 1997 Emergency Appropriations Act ("the Act"), which specified that beginning in fiscal year 1997 and thereafter, the United States members and alternate members appointed under the Delaware River Basin Compact "shall be officers of the U.S. Army Corps of Engineers, who hold Presidential appointments as Regular Army officers with Senate confirmation . . . ." P.L. 105-18, Sec. 3001(a). The Act further provided that Section 15.1(d) of the Compact was repealed, and Section 2.2 was amended by striking the words "during the term of office of the President" and inserting the words "at the pleasure of the President". Previously, Sections 2.2 and 15.1(d) were inconsistent as to the term of the federal representative's appointment.

The Water Resources Development Act of 2007 ("WRDA") modified the 1997 act as follows:

> **(a) Ex-Officio Member.** Notwithstanding Section 3001(a) of the 1997 Emergency Supplemental Appropriations Act ... (Public Law 105-18; 111 Stat. 176) ... and Section 2.2 of the Delaware River Basin Compact to which consent was given by Public Law 87-328 (75 Stat. 691), beginning in fiscal year 2002, and each fiscal year thereafter, the Division Engineer, North Atlantic Division, Corps of Engineers:
>
> (1) shall be:
>
> (A) the ex-officio United States member of the Susquehanna River Basin Compact and the Delaware River Basin Compact; and
>
> * * * *
>
> (2) shall serve without additional compensation; and
>
> (3) may designate an alternate member in accordance with the terms of those compacts.

WRDA (Public Law 110-114), sec. 5019.

[3] The 2007 WRDA directed as follows:

> **(b) Authorization to Allocate.** The Secretary [of the Army] shall allocate funds to the Susquehanna River Basin Commission, Delaware River Basin Commission, and the Interstate Commission on the Potomac River Basin to fulfill the equitable funding requirements of the respective interstate compacts.

Water Resources Development Act of 2007 (Public Law 110-114), sec. 5019.

The Water Resources Reform and Development Act of 2014 (Public Law 113-121) amended subsection (b) of the 2007 WRDA by striking subsection (b) and inserting the following:

(b) AUTHORIZATION TO ALLOCATE

(1) IN GENERAL.— The Secretary shall allocate funds to the Susquehanna River Basin Commission, the Delaware River Basin Commission, and the Interstate Commission on the Potomac River Basin to fulfill the equitable funding requirements of the respective interstate compacts.

(2) AMOUNTS.— For each fiscal year, the Secretary shall allocate to each Commission described in paragraph (1) an amount equal to the amount determined by the Commission in accordance with the respective interstate compact approved by Congress.

(3) NOTIFICATION.— If the Secretary does not allocate funds for a given fiscal year in accordance with paragraph (2), the Secretary, in conjunction with the subsequent submission by the President of the budget to Congress under section 1105(a) of title 31, United States Code, shall submit to the Committee on Environment and Public Works of the Senate and the Committee on Transportation and Infrastructure of the House of Representatives a notice that describes—

(A) the reasons why the Secretary did not allocate funds in accordance with paragraph (2) for that fiscal year; and

(B) the impact of that decision not to allocate funds on each area of jurisdiction of each Commission described in paragraph (1), including with respect to—

(i) water supply allocation;
(ii) water quality protection;
(iii) regulatory review and permitting;
(iv) water conservation;
(v) watershed planning;
(vi) drought management;
(vii) flood loss reduction;
(viii) recreation; and
(ix) energy development.

Water Resources Reform and Development Act of 2014 (Public Law 113-121), sec. 4001.

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Executive Director

Robert Tudor
Deputy Executive Director

DETERMINATION OF THE EXECUTIVE DIRECTOR CONCERNING NATURAL GAS EXTRACTION ACTIVITIES IN SHALE FORMATIONS WITHIN THE DRAINAGE AREA OF SPECIAL PROTECTION WATERS

Technological advances in horizontal drilling and hydraulic fracturing have led to an increase in the number of active and planned natural gas extraction projects in shale formations within the Delaware River Basin. Each of these projects typically involves the construction of a well pad and associated roadways at or about surface elevations, the drilling of a well bore to depths of as much as 6000 feet or more, the withdrawal and transport of surface or ground water, the injection of the water and chemical fracturing mixtures into the wells to release the trapped gas, the recovery and storage of recovered fracturing fluid, water and associated leached constituents extracted with the gas, the storage and potentially the reuse of the recovered wastewater and chemicals and the eventual disposal of the water and chemicals. Each of these activities if not properly performed may cause adverse environmental effects, including effects on water resources.

Section 3.8 of the Delaware River Basin Compact provides in part: "No project having a substantial effect on the water resources of the basin shall hereafter be undertaken by any person, corporation or governmental authority unless it shall have been first submitted to and approved by the Commission…." In section 2.3.5 of the Commission's *Rules of Practice and Procedure* ("RPP"), the Commission has defined those projects that may have a substantial effect on the water resources of the basin in part by establishing thresholds for the daily average gross water withdrawal during any 30 consecutive day period and by the daily average design capacity of domestic sewage treatment facilities. Some natural gas extraction projects may exceed these thresholds and therefore be subject to review pursuant to these provisions, while others may fall below the thresholds and therefore not be subject to review pursuant to these provisions. The RPP further require the sponsor of any project that involves any discharge of pollutants into surface or ground waters of the basin irrespective of quantity to obtain Commission approval. RPP section 2.3.5B.6. See also Commission Water Code section 3.40

In recognition of the importance of protecting high quality waters that are subject to the Commission's antidegradation regulations, the RPP also give the Executive Director the authority in her discretion to require a project sponsor to obtain Commission approval notwithstanding the fact that the thresholds in the RPP have not been exceeded. Section 2.3.5B.18 of the RPP includes as a reviewable project: "Any other project that the Executive Director may specially direct by notice to the project sponsor or land owner as having a potential substantial water quality impact on waters classified as Special Protection Waters." Most of the shale formations that may be subject to the new horizontal drilling and hydraulic fracturing techniques are located within the drainage area to Special Protection Waters. The Executive Director has considered and has now determined that as a result of water withdrawals, wastewater disposal and other activities, natural gas extraction projects in these shale formations may individually or cumulatively affect the water quality of Special Protection Waters by altering their physical, biological, chemical or hydrological characteristics.

The Executive Director therefore specially directs by this notice to natural gas extraction project sponsors that they may not commence any natural gas extraction project located in shale formations within the drainage area of Special Protection Waters without first applying for and obtaining Commission approval. For this purpose a project encompasses the drilling pad upon which a well intended for eventual production is located, all appurtenant facilities and activities related thereto and all locations of water withdrawals used or to be used to supply water to the project. Wells intended solely for exploratory purposes are not covered by this Determination. Commencing a project encompasses performing any of the activities associated with the project, including the activities identified in the first paragraph above. The Commission recognizes that each natural gas extraction project will also be subject to the review of the environmental agency of the state or Commonwealth in which the project is located and in some cases, subject to federal agency review. The Commission intends to coordinate with and where feasible to utilize the review process and approvals of the applicable state or federal agency to minimize duplication of effort and redundant requirements imposed on project sponsors.

A copy of this Declaration will be posted on the Commission's website, and additional copies will be mailed directly to those project sponsors and potential project sponsors that the Commission has identified. The Commission intends to promulgate regulations pertaining to the subject matter of this Declaration after public notice and a full opportunity for public comment.

Any person adversely affected by this Determination may request a hearing by submitting a request in writing to the Commission Secretary within thirty (30) days of the date of this Determination in accordance with the RPP.

Carol R. Collier

Carol R. Collier, Executive Director
Dated: May 19, 2009

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Carol R. Collier
Executive Director

Robert Tudor
Deputy Executive Director

SUPPLEMENTAL DETERMINATION OF THE EXECUTIVE DIRECTOR CONCERNING NATURAL GAS EXTRACTION ACTIVITIES IN SHALE FORMATIONS WITHIN THE DRAINAGE AREA OF SPECIAL PROTECTION WATERS

This determination supplements the Executive Director's Determination of May 19, 2009 ("2009 Determination") concerning natural gas extraction activities in shale formations within the drainage area of Special Protection Waters (SPW) insofar as that determination addressed "wells intended solely for exploratory purposes."

In my Determination of May 2009, I exercised the authority conferred on the Executive Director by section 2.3.5 B.18 of the Commission's *Rules of Practice and Procedure* (RPP) by directing all sponsors of natural gas extraction projects in shale formations within the drainage area of Special Protection Waters to obtain Commission approval before commencing such projects, notwithstanding that the thresholds for review established by the RPP were not exceeded. This action was based on my recognition that as a result of water withdrawals, wastewater disposal and other activities, natural gas extraction projects in shale formations could individually or cumulatively affect the water quality of Special Protection Waters by altering their physical, biological, chemical or hydrological characteristics.

My 2009 Determination that sponsors of natural gas extraction projects in shale formations must obtain Commission approval expressly did not cover "wells intended solely for exploratory purposes." Today, subject to the reservations set forth below, I am withdrawing that exclusion and extending the provisions of my 2009 Determination to include exploratory wells. That is, by this Supplemental Determination, I am specially directing all natural gas well project sponsors, *including the sponsors of natural gas well projects intended solely for exploratory purposes,* that they may not commence any natural gas well project for the production from or exploration of shale formations within the drainage area of Special Protection Waters without first applying for and obtaining Commission approval. For the purpose of this Determination, any natural gas well drilled in or through shale is assumed to be targeting a shale formation and is subject to this Determination, unless the project sponsor proves otherwise. All other aspects of my 2009 Determination remain in effect.

My action today recognizes the risks to water resources, including ground and surface water that the land disturbance and drilling activities inherent in any shale gas well pose. In light of the Commission's May 5, 2010 decision to finalize natural gas regulations before considering project approvals, this Supplemental Determination removes any regulatory incentive for project sponsors to classify their wells as exploratory wells and install them without Commission review before the Commission's natural gas regulations are in place. It thus supports the Commission's goal that exploratory wells do not serve as a source of degradation of the Commission's Special Protection Waters.

Reservation for Existing State-Approved Projects. Where entities have invested in exploratory well projects in reliance on my May 2009 Determination and information from staff, there are countervailing considerations that favor allowing these projects to move ahead. I am informed that since May of 2009 the Pennsylvania Department of Environmental Protection (PADEP) has issued a limited number of natural gas well drilling permits within the Delaware River Basin targeting shale formations, while the New York State Department of Environmental Conservation has not issued any natural gas well permits targeting shales in the Basin since that date. In contrast to the thousands of wells projected to be installed in the Basin over the next several years, the risk to Basin waters posed by only the wells approved by PADEP since May 2009 are comparatively small. Not only are these wells subject to state regulation as to their construction and operation, but they continue to require Commission approval before they can be fractured or otherwise modified for natural gas production. In light of these existing safeguards and the investment-backed expectations of the sponsors of these projects, this Supplemental Determination does not prohibit any exploratory natural gas well project from proceeding if the applicant has obtained a state natural gas well permit for the project on or before the date of issuance set forth below.

A copy of this Supplemental Determination will be posted on the Commission's website, and additional copies will be mailed directly to those project sponsors and potential project sponsors that the Commission has identified.

Any person adversely affected by this action may request a hearing by submitting a request in writing to the Commission Secretary within thirty (30) days of the date set forth below, in accordance with the RPP.

Carol R. Collier

Carol R. Collier, Executive Director
Dated: June 14, 2010

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Robert Tudor
Deputy Executive Director

**AMENDMENT TO
SUPPLEMENTAL DETERMINATION OF THE EXECUTIVE DIRECTOR
CONCERNING NATURAL GAS EXTRACTION ACTIVITIES
IN SHALE FORMATIONS WITHIN THE DRAINAGE AREA OF
SPECIAL PROTECTION WATERS**

On June 14, 2010 I extended to all natural gas exploratory wells, with the exception of those for which the Pennsylvania Department of Environmental Protection (PADEP) had already granted well drilling permits, my determination that the sponsors of natural gas extraction projects in shale formations within the drainage area of Special Protection Waters must obtain the Commission's approval before commencing such projects.

Following this decision, I received a request from the Hess Corporation that it be allowed to proceed with the initial phase of an exploratory drilling program planned for its lease holdings in Wayne County, Pennsylvania. Specifically, Hess requested permission to construct two vertical exploratory wells for which it had obtained Pennsylvania Erosion and Sediment Control General Permits (ESCGP-1's) prior to June 14th and for which as of that date well drilling permit applications had been filed with PADEP and were under active review. A state drilling permit for the Davidson 1V well has since been issued – PADEP Permit No. 127-20020 dated July 13, 2010 – and a PADEP permit for the Hammond 1V well is expected to be approved in July.

Hess cited as a basis for its request that by mid-June the Davidson 1V and Hammond 1V wells were in the final stages of the permitting process and represented a level of investment equivalent to that of the natural gas exploratory wells that were "grandfathered" by my decision of June 14th. Hess also urged that the scientific information to be derived from the two wells was critical to the company and to many hundreds of property owners with whom it has signed leases. Hess and its investment partner Newfield Appalachia LLC ("Newfield") have combined lease holdings of more than 100,000 acres in the Delaware Basin. Although Newfield is proceeding with an exploratory program that includes five wells in east, southeast Wayne County, no other exploratory wells have been approved in the north, northwest portion of the county, where Hess's leases are concentrated. The timing of the exploratory program is important to both entities and their lessors. Hess representatives have advised me that if the company is able to proceed with the Davidson 1V and Hammond 1V wells this summer, the two wells are expected to meet its program needs through the end of the year. Further, Hess has assured me that it supports the Commission's initiative to establish robust and responsible regulations governing natural gas development in the Delaware Basin in that timeframe.

I am convinced that the scientific information that may be derived from the two proposed exploratory wells is important in the near term, while the risk from allowing two additional exploratory wells to proceed is subject to the same balancing that I discussed in my Supplemental Determination of June 14th. Only two exploratory wells are at issue; both are subject to PADEP well drilling permits; and in light of the erosion and sediment control permits issued before June 14th, both are included in Hess's investment-backed expectations. Hess's ESCGP-1 applications, which Hess furnished to the DRBC, provide specific information regarding siting of the two proposed wells and set forth in detail the erosion and sediment control measures to be implemented during and after their construction to protect water resources. These measures go beyond the requirements applicable to the other exploratory well projects "grandfathered" by my June 14th Determination, each of which fell below the five-acre threshold at which the requirement for an ESCGP-1 is triggered. In light of the other factors discussed above, Hess's additional sediment and erosion control demonstrations tip the balance in favor of allowing the two exploratory wells to proceed.

Accordingly, I find that allowing the Davidson 1V and Hammond 1V natural gas exploratory wells to be constructed at this time would serve multiple interests and in particular could help indicate the extent of natural gas development activity that is likely to occur in the Basin. By this Amended Supplemental Determination, I am advising the Hess Corporation that it may proceed with construction of the Davidson 1V and Hammond 1V natural gas exploratory wells. This approval is limited to the two well projects as described in Hess's letter to me of July 13, 2010 and supporting documents, including the ESCGP-1 applications and corresponding permits issued by Pennsylvania in May (collectively "letter of July 13th"). Any proposed deviation from the projects as described in Hess's letter of July 13th will invalidate this Amended Determination unless and until Hess demonstrates to my satisfaction that the proposed change does not increase the risk of harm to the basin's water resources. Any proposal to reconfigure either of the two exploratory wells for production must undergo review and approval by the Commission in accordance with my Determinations of May 19, 2009 and June 14, 2010.

Except as modified herein as to the two Hess exploratory wells, my Supplemental Determination of June 14, 2010 remains in full effect.

Any person adversely affected by this action may request a hearing by submitting a request in writing to the Commission Secretary within thirty (30) days of the date set forth below, in accordance with the Commission's *Rules of Practice and Procedure*.

Carol R. Collier

Carol R. Collier, Executive Director
Dated: July 23, 2010

Series 2010
Number 2

DELAWARE RIVER BASIN COMMISSION

MEETING OF MAY 5, 2010

Minutes

The meeting was held at the office of the Delaware River Basin Commission in West Trenton, New Jersey.

Commissioners present: Katherine E. Bunting-Howarth, Acting Chair, Delaware
Lt. Colonel Thomas J. Tickner, Second Vice Chair, United States
Dana Aunkst, Pennsylvania
Fred Sickels, New Jersey
Peter Freehafer, New York *(Via speaker phone)*

DRBC staff participants: Carol R. Collier, Executive Director
Robert Tudor, Deputy Executive Director
Kenneth J. Warren, DRBC General Counsel, Hangley Aronchick Segal & Pudlin
Pamela M. Bush, Commission Secretary & Assistant General Counsel
Richard C. Gore, Chief Administrative Officer
William J. Muszynski, Water Resources Management Branch Manager
Kenneth F. Najjar, Planning & Information Technology Branch Manager
Chad Pindar, Supervisor, Project Review Section
Amy Shallcross, Supervisor, Operations Section

Acting Chair Dr. Howarth convened the business meeting at 1:30 p.m.

Minutes. Dr. Howarth requested a motion for approval of the Minutes of the Commission's meeting of March 3, 2010. Mr. Sickels so moved, Lt. Col. Tickner seconded his motion, and the Minutes of the Commission's March 3, 2010 meeting were approved by unanimous vote.

Announcements. Ms. Bush announced the following meetings and events:

- *DRBC Regulated Flow Advisory Committee Meeting.* Thursday, May 13, 2010 at 10:00 a.m. in the Goddard Conference Room, DRBC, 25 State Police Drive, West Trenton, NJ. The staff contact is Hernan Quinodoz at (609) 883-9500, extension 225.

- *Delaware River Greenway Partnership (DRGP).* The partnership will sponsor a forum entitled *Health of the Delaware: Facing the Threats* on Tuesday, May 18, 2010 from 8:45 a.m. to 2:30 p.m. at the Prallsville Mills Complex, Route 29, Stockton, NJ. One of the scheduled speakers is DRBC Executive Director Carol Collier. The cost to attend the forum is $25 and includes lunch; please visit the DRGP web site for registration details.

- *DRBC Flood Advisory Committee Meeting.* Wednesday, May 26, 2010 at 10:00 a.m. in the Goddard Conference Room, DRBC, 25 State Police Drive, West Trenton, NJ. The staff contact is Laura Tessieri at (609) 883-9500, extension 304.

- *DRBC Water Quality Advisory Committee Meeting.* Wednesday, June 23, 2010 at 9:30 a.m. in the Goddard Conference Room, DRBC, 25 State Police Drive, West Trenton, NJ. The staff contact is Donna Barnett at (609) 883-9500, extension 308.

- *Water Management Advisory Committee Meeting.* Tuesday, July 27, 2010 at 10:00 a.m. in the Goddard Conference Room, DRBC, 25 State Police Drive, West Trenton, NJ. The staff contact is Donna Barnett at (609) 883-9500, extension 308.

Hydrologic Conditions. Amy Shallcross offered the following report on hydrologic conditions in the Basin:

The observed precipitation for the Delaware River Basin above Montague, New Jersey for the period January 1 through May 3, 2010 was 13.84 inches or 0.67 inches above normal. The observed precipitation for the Basin above Trenton, New Jersey for the same period was 15.74 inches or 1.70 inches above normal and for Wilmington, Delaware, 16.27 inches or 2.27 inches above normal.

The average observed streamflow of the Delaware River at Montague, New Jersey in April 2010 was 9,069 cubic feet per second (cfs) or 80 percent of the long-term average for the month. For the same period, the average observed streamflow of the river at Trenton, New Jersey was 20,540 cfs, or 111 percent of the long-term average for the month.

For the month of May 1-3, 2010, the average observed streamflow at Montague was 4,997 cfs, or 73 percent of the long-term average for the month. The average streamflow at Trenton during the same period was 14,667 cfs, or 108 percent of the long-term average for the month.

In the Lower Basin, as of May 4, 2010, Beltzville Reservoir contained 12.99 billion gallons (bg) usable, or 99.9 percent of usable storage, and Blue Marsh contained 6.92 bg usable, or 106.5 percent of summer pool usable storage. As of May 3, Merrill Creek contained 15.36 bg usable, or 97.9 percent of usable storage.

In the Upper Basin, as of May 4, 2010, Pepacton Reservoir contained 139.013 bg usable, or 99.2 percent of usable storage. Cannonsville contained 96.060 bg usable, or 100.4 percent of usable storage. Neversink contained 33.722 bg usable, or 96.5 percent of usable storage. The total New York City Delaware Basin reservoir storage was 268.795 bg usable, or 99.2 percent of usable storage.

During the month of April 2010, the location of the seven-day average of the 250-parts per million (ppm) isochlor, also known as the "salt line," ranged from River Mile (RM) 54 to RM 67. The normal location of the salt line during April is RM 61, a location which is 17 miles downstream of the Delaware-Pennsylvania state line. As of May 3, the salt line was located at RM 66, which is two miles upstream of the normal location for May.

Executive Director's Report. Ms. Collier's remarks are summarized below.

- *Flow Management Issues.* Ms. Collier reported on several flow management issues:
  - *FFMP Reassessment Analysis.* Ms. Collier said that funding was never found to support a proposed "reassessment" of the Flexible Flow Management Program for the New York City reservoirs. As a result, the Decree Parties delegated to their work group the tasks of considering how to improve the reservoir releases program to better support fisheries ecology, salinity repulsion, water quality and supply reliability, flood and spill mitigation, the Trenton and Montague flow targets, recreational uses of the river and Lower Basin storage. Information on the status of the work group's efforts will be presented at the Regulated Flow Advisory Committee (RFAC) meeting on May 13, 2010.
  - *Flood Analysis Model.* The flood analysis model studied the potential uses of existing reservoirs to control flooding. In developing the model, the USGS, USACE and NWS examined three sub-regions of the basin: upstream of Trenton, and the Schuylkill and Christina river sub-basins, respectively. The model was completed and posted on the Commission's website at the end of 2009. A scope of work has been developed for an independent peer review of the model, and DRBC is working with the USACE on funding and management issues for that review.
  - *New York City Operating Support Tool (OST).* New York City has hired a consultant to help it develop a new tool that will facilitate consideration of multiple factors in designing reservoir releases, including NOAA-NWS 30- and 60-day forecasts. This tool will broaden the options for development of the next Flexible Flow Management Plan (FFMP). The current FFMP expires May 2011.
  - *Ecological Flows.* A joint report by the Pennsylvania Fish & Boat Commission and the fisheries division of the New York State DEC focused on trout habitat is being used to inform the summer releases program for the New York City Delaware Basin reservoirs. A study commissioned several years ago by the U.S. Fish & Wildlife Service to characterize the habitat of the federally endangered dwarf wedgemussel is past due. The dwarf wedgemussel habitat study is needed to support flow management decisions. The U.S. Fish & Wildlife Service is now re-scoping the study design to better address biological and hydrological needs.
- *Water Charges Program.* DRBC is preparing a document to respond to comments received on a proposal to increase the rates charged for surface water withdrawals and consider how the proposal might be modified to address a number of concerns raised by interested parties.
- *DRBC Staff Additions and Changes.* Ms. Collier introduced the new administrative assistant for the Planning and Information Technology Branch, Donna Barnett. Donna took over in the P&IT Branch for Victoria Lawson, who has moved to the Project Review Section. Ms. Collier also introduced John Calkin, who joined the Commission as a seasonal employee. John is an attorney with a background in forestry. He will help Pam Bush and Ken Warren

with regulatory issues. Ms. Collier welcomed both new staffers warmly. She also reported that Ed Santoro had officially retired from the Commission and wished him well.

- *2010 Delaware River Sojourn.* The Delaware River Sojourn will take place during the third week of June. Ms. Collier described this as a great opportunity to experience the river. The sojourn is accompanied by a safety patrol, is characterized by a spirit of camaraderie, and involves learning about river ecology and management issues from the resource itself.

- *Edelman Award.* The Edelman Award competition, now in its 39th year, looks at operational research in the for-profit and not-for-profit sectors and how it helps move projects forward. This year, a nomination for the award was submitted for the work of Peter Kolesar, a professor from Columbia University, with the assistance of the Delaware River Foundation, Trout Unlimited and The Nature Conservancy, to improve the design of releases from the New York City reservoirs to support multiple objectives. The project did not win but was one of six finalists. Bob Tudor represented the Commission at the awards ceremony and described the event as akin to "American Idol." He said the other contenders were international corporations like petroleum refining companies and the overnight package delivery service, DHL. The Central Bank of Mexico, which handles $200 billion in transactions per day, took the prize. The buzz among participants was that Dr. Kolesar's project came in a close second. .

- *DRBC's 50th Anniversary.* October 2011 marks the 50th anniversary of DRBC. Staff will highlight this milestone over the course of the next year, starting in October, by focusing on accomplishments in the basin and where DRBC should be heading in the future.

General Counsel's Report. Mr. Warren reported on a case brought by M&M Stone that is pending against DRBC and others in federal court. The case was dismissed by the Federal District Court for the Eastern District of Pennsylvania, not only as to the DRBC but also as to the Pennsylvania Department of Environmental Protection and other defendants. The plaintiff appealed the district court's decision to the Court of Appeals for the Third Circuit. The issues were briefed, and the parties recently received an order from the Third Circuit stating that the court would decide the case solely on the briefs without oral argument. There is nothing more for the DRBC to do but wait. It is possible that the Third Circuit will render its decision by July. Counsel is optimistic about the outcome.

Rulemakings – Estuary Toxics. Dr. Howarth noted that in December 2009 the Commission had heard from Dr. Christopher Crocket of the Philadelphia Water Department, in his capacity as chair of the Commission's Toxics Advisory Committee, with the recommendations of that body for updating human health and aquatic life criteria for the Delaware River Estuary (Water Quality Zones 2 through 5) and extending the criteria to Delaware Bay (Zone 6). She said that on behalf of the Commission she was directing staff to proceed with public notice of the proposed criteria changes, including establishing a written comment period and a hearing date.

Rulemakings – Natural Gas Development. Dr. Howarth next addressed natural gas drilling and in particular, the draft dockets for a surface water withdrawal and a natural gas well pad for the Stone Energy Corporation, which were the subject of a public hearing on February 24, 2010 and a written comment period that ran from February 8 through April 12, 2010. She related that

DRBC had received some 1,700 comments on the Stone Energy dockets. She announced that although she and her fellow Commissioners believe DRBC has sufficient regulatory authority to move forward on water allocation dockets, before considering approval of any well pad projects they would like staff to complete a rulemaking for this type of activity in the Basin.

Dr. Howarth asked the Commissioners to consider the following Resolution for the Minutes to clarify the Commission's intentions with respect to the development of new regulations and consideration of pending applications for projects associated with natural gas development:

> (1) We direct staff to develop draft regulations on well pads in the shales for notice and comment rulemaking; (2) we will postpone the Commission's consideration of well pad dockets until regulations are adopted; and (3) we will move forward with water withdrawal dockets in due course.

Mr. Freehafer via speaker phone said that New York recognized that the impacts of natural gas development on interstate Special Protection Waters could include effects outside the scope of the individual states' rules. He said New York expects the Commission to consider new regulations to fill such potential gaps.

Dr. Howarth requested a motion to adopt the proposed resolution. Lt. Colonel Tickner so moved and Mr. Sickels offered a second. Dr. Howarth repeated the proposed resolution aloud. The Commissioners offered no additional comments and approved the Resolution for the Minutes by unanimous vote.

Public Hearing: Project Review Applications. Although included in the notice of public hearing for this date, hearings on the following eight projects were postponed to allow additional time for review: hearing item 8 – Lyons Borough Municipal Authority, D-1994-080 CP-2; hearing item 10 – Maidencreek Township Authority, D-2000-028 CP-2; hearing item 11 – East Vincent Municipal Authority, D-2005-007 CP-1; hearing item 14 – Arcelor Mittal Plate, LLC, D-2008-036-1; hearing items 15 and 16 – Naval Surface Warfare Center, Carderock Division, Ship Systems Engineering Station, D-2009-003-1 and D-2009-004-1; hearing item 20 – Deb-El Food Products, D-2009-036-1; and hearing item 21 – Arcelor Mittal Plate, LLC, D-2009-039-1.

Project Review Section Supervisor Chad Pindar presented the remaining 19 projects for the Commission's consideration in three categories: Category A, consisting of docket renewals involving no substantial changes (hearing items 1 and 2); Category B, consisting of renewals involving significant changes, such as an increase or decrease in an authorized withdrawal or discharge (hearing items 3, 4, 5, 6, 7, 9 and 12); and Category C, consisting of projects not previously reviewed by the Commission (items 13, 17, 18, 19, 22, 23, 24, 25, 26 and 27).

A. *Renewals with No Substantive Changes (hearing items 1 and 2).* The Commission received comments on the Cabot Corporation project.

   1. Cabot Corporation, D-1970-072-4. An application for the renewal of an existing 0.222 million gallons per day (mgd) discharge from Outfalls Nos. 001 (process wastewater and

EXHIBIT "8"

O&N OVERSTREET & NESTOR, LLC

February __, 2017

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Via Certified Mail
Return Receipt Requested

Steven J. Tambini, P.E.
Executive Director
Delaware River Basin Commission
25 State Police Drive
P.O. Box 7360
West Trenton, NJ 08628-0360

Re: Request for Jurisdictional Determination

Dear Mr. Tambini:

We represent Wayne Land and Mineral Group ("WLMG").

On January 24, 2017, in a proceeding before the United States District Court for the Middle District of Pennsylvania (No. 3:16-cv-00897-RDM), you disclosed the existence of, and invited WLMG to request, a decision from the Delaware River Basin Commission ("Commission") that you referred to as a "jurisdictional determination." Although not provided for in the Compact or in the Commission's current or former regulations, you testified that a "jurisdictional determination" can be obtained prior to, separate from, and without submitting a request for, project approval. You testified that the Commission would promptly consider and respond to such a request and that the Commission would do so without imposing a fee on WLMG. Judge Mariani later inquired of the parties about their willingness to participate in an expedited process for securing a "jurisdictional determination." Having reflected on Judge Mariani's inquiry, by this letter, while reserving and intending to preserve all of its rights and claims including, but not limited to, those asserted in the proceeding referenced above, WLMG is requesting such a "jurisdictional determination" with respect to the activities described in ¶¶ 12-13 & 21-30 of Attachment A.

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EXHIBIT A

Background

As you are aware, WLMG believes that the Commission, by the Executive Director's May 19, 2009 Determination Concerning Natural Gas Extraction Activities in Shale Formations Within the Drainage Area of Special Protection Waters ("Commission's Determination"), among other official actions, has determined that, pursuant to Section 3.8 of the Compact, it has "project" review jurisdiction over all natural gas extraction related activities associated with wells targeting shale formations and located within the area of Special Protection Waters. The Commission's Determination was rendered pursuant to authority expressly delegated by the Commission to the Executive Director by Rule 2.3.5B.18 of the Commission's Rules of Practice and Procedure and has never been reversed, rescinded or revised by the Commission.

With respect to potential impact on water resources, the Commission's Determination expressly states:

> The Executive Director has considered and has now determined that as a result of water withdrawals, wastewater disposal and other activities, natural gas extraction projects in these shale formations may individually or cumulatively affect the water quality of Special Protection waters by altering their physical, biological, chemical or hydrological characteristics (emphasis added).

Subsequently, in a Supplemental Determination dated June 14, 2010, the Executive Director, again exercising authority expressly delegated to her by the Commission by Rule 2.3.5B.18, extended the foregoing determination of impact on water resources to include exploratory wells. The Executive Director then directed:

> [B]y this Supplemental Determination, I am specially directing all natural gas well project sponsors, including the sponsors of natural gas well projects intended solely for exploratory purposes, that they may not commence any natural gas well project for the production from or exploration of shale formations within the drainage area of Special Protection Waters without first applying for and obtaining Commission approval (emphasis added).

The Commission, by the actions above and others, including the imposition of civil penalties on at least one well pad developer, has asserted categorical jurisdiction over all natural gas extraction activities within the area of Special Protection Wasters.

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This determination and assertion of jurisdiction necessarily includes the activities proposed by WLMG as described in ¶¶ 12-13 & 21-30 of Attachment A.

Request for Jurisdictional Determination

Although it believes that the Commission's assertion of jurisdiction is unequivocal and clear, in light of your recent testimony, WLMG requests that the Commission clarify its position and provide a "jurisdictional determination" with respect to WLMG's proposed activities. Specifically, WLMG seeks a determination from the Commission regarding whether the activities described in ¶¶12-13 & 21-30 of Attachment A are subject to Rule 2.3.4 of the Commission's Rules of Practice and Procedure. This rule, titled Submission of Project Required, in pertinent part, states: "Any project which may have a substantial effect on the water resources of the Basin . . . shall be submitted to the Commission for a determination as to whether the project impairs or conflicts with the Comprehensive Plan . . . ." WLMG requests a jurisdictional determination regarding whether it must comply with Rule 2.3.4 in connection with the activities identified in ¶¶ 12-13 & 21-30 of Attachment A.

In an effort to assist the Commission, and to expedite a decision on WLMG's request, for the purposes of this request, WLMG will not seek a hearing with respect to, or otherwise present evidence with regard to the Commission's determination (referenced above) that natural gas extraction activities, conducted within the area of Special Protection Waters may affect the quality of such waters. That is, WLMG will not seek reconsideration of the prior finding by the Executive Director, acting pursuant to expressly delegated authority from the Commission, that natural gas extraction activities, including the activities that WLMG proposes to engage in, individually or cumulatively, "may have a substantial effect on the water resources of the Basin," within the meaning of Rule 2.3.4.

By the foregoing, WLMG has taken steps to narrow this request in order to reduce the burden on the Commission and its staff. The sole question presented by this request for "jurisdictional determination" is whether the Commission is asserting that the activities described in ¶¶ 12-13 & 21-30 of Attachment A, individually or collectively, constitute a "project" subject to review and approval pursuant to Rule 2.3.4.

As you are aware, the Pennsylvania Department of Environmental Protection, believing that the Commission has asserted categorical jurisdiction over all natural gas extraction related activities, will not issue permits to WLMG until the question of the Commission's jurisdiction is resolved and, if necessary, any Commission approvals are secured. The Commission's assertion of jurisdiction over all well pads and wells (at least as understood by the Department of Environmental Protection) has already resulted in considerable delay. In order to minimize the ongoing delay, WLMG request that the Commission provide the requested "jurisdictional determination" within forty-five (45) days.

Sincerely,

David R. Overstreet

Attachment

cc: Kenneth J. Warren (w/attachment)
Jeffrey Belardi

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EXHIBIT A

ATTACHMENT A

EXHIBIT A

IN THE UNITED STATES COURT
FOR THE MIDDLE DISTRICT OF PENNSYLVANIA

WAYNE LAND AND MINERAL GROUP, LLC,	:	
Plaintiff,	:	
v.	:	Civil Action No.
DELAWARE RIVER BASIN COMMISSION,	:	
Defendant.	:	(Electronically Filed)

COMPLAINT

Wayne Land and Mineral Group, LLC ("WLMG") asks this Court to declare that the Delaware River Basin Commission ("Commission") lacks authority under the Delaware River Basin Compact ("Compact") to review and approve a natural gas well pad, a gas well and related facilities and associated activities on WLMG's property in the Delaware River Basin ("Basin") and, in support, states:

INTRODUCTION

1. The Commission, purporting to interpret and rely on Section 3.8 of the Compact, claims discretionary authority to review, approve, and thereby regulate nearly all forms of human activity in the Basin, including the use of private land for residential, commercial and industrial purposes.

2. The Commission's position, distilled to its essence, is that any activity, development or other human undertaking in the Basin that uses water in some manner is a "project" that the Commission has the prerogative to review and approve if the Commission believes that the undertaking may have a "substantial effect" on the water resources of the Basin.

3. Because it is difficult, if not impossible, to identify an undertaking in the Basin that does not involve water in some manner, the Commission's discretionary "project" review authority purportedly extends to nearly every form of human endeavor in the Basin, subject only to the Commission believing, in a given case, that a proposed "project" may have a "substantial effect" on the water resources of the Basin.

4. The Commission, relying on the enormous power that it contends has been delegated to it by Section 3.8 of the Compact, and seeking to placate those State governments and special interest groups opposed to natural gas development, has declared that all natural gas well pads and related facilities targeting shale formations in the Basin are "projects" that it will review under Section 3.8 of the Compact.

5. In addition to asserting that well pads and related facilities are "projects" that it must approve before they are constructed, the Commission has announced that it will not review applications for well pads and related facilities, and associated activities, until it adopts governing regulations. This moratorium, which amounts to a ban on the lawful use of land that cannot be remedied at the ballot box, has been in effect since 2010.

6. WLMG, by this Complaint, seeks relief from the Commission's *ultra vires* assertion of jurisdiction and related dictate that WLMG is prohibited from constructing a well pad and drilling a natural gas well without Commission approval.

7. WLMG, as partial relief for the trampling of its constitutionally protected rights, and seeking to make otherwise lawful

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use of its property, requests that the Court declare that the Commission does not have authority to require WLMG to apply for and obtain Commission "project" approval for a natural gas well pad and related facilities targeting natural gas in shale formations on WLMG's property.

JURISDICTION AND VENUE

8. This action arises under the Compact. The Commission is asserting jurisdiction, pursuant to Section 3.8 of the Compact, over the construction of a well pad, appurtenant facilities, and unspecified "related" activities, associated with the drilling, completing and operating of a gas well targeting shale formations on private property owned by WLMG.

9. The Commission's assertion of jurisdiction is based on its current interpretation of Section 3.8 of the Compact, which provides for Commission approval of "projects," and its related assertion that natural gas well pads and related infrastructure associated with exploration and production wells targeting shale formations, together with related activities conducted on the well pads, constitute "projects" as that term is defined in the Compact.

10. The Court has subject matter jurisdiction over this action under 28 U.S.C. § 1331 because it raises a federal question, and under the statute effectuating the Compact, Pub. L. 87-328, 75 Stat. 688, § 15.1(p) (1961), because this action arises under the Compact. WLMG seeks declaratory and other appropriate relief under 28 U.S.C. §§ 2201 and 2202.

11. Venue is proper within this district pursuant to 28 U.S.C. § 1391(b).

PARTIES AND THE PROPERTY

12. WLMG resides, and owns approximately 180 acres of land, including the natural gas and minerals present on the land, in Wayne County, Pennsylvania. Approximately 75 acres of the land owned by WLMG is located in the Basin (the "Property").

13. The Property is located in a part of the Basin that overlays natural gas reserves in shale formations.

14. The Commission is an agency created by, and with only such authority as is expressly conferred on it by, the Compact. The Compact is an agreement among the United States, New York, Pennsylvania, New Jersey, and Delaware, as approved by Congress in 1961.

BACKGROUND

A. "Project" Review.

15. Section 3.8 of the Compact states: "No project having a substantial effect on the water resources of the basin shall hereafter be undertaken by any person, corporation or governmental authority unless it shall have been first submitted to and approved by the commission . . . ."

16. For purposes of Section 3.8 of the Compact, a "project" is: "any work, service or activity which is separately planned, financed, or identified by the commission, or any separate facility undertaken or to be undertaken within a specified area, for the conservation, utilization, control, development or management of water resources which can be established and utilized independently or as an addition to an existing facility, and can be considered as a separate entity for purposes of evaluation."

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B. The Commission's Assertion of Jurisdiction Over Natural Gas Well Pads and Related Facilities and Activities.

17. The Commission, purporting to rely on authority to review and approve proposed "projects" pursuant to Section 3.8 of the Compact, has determined, and, by publicly announcing its position, has informed WLMG and other landowners in the Basin, that it has jurisdiction over natural gas well pads, all appurtenant facilities, and related activities carried out in connection with gas wells targeting shale formations in the Basin (collectively "Well Pads").

18. The Commission, as the basis for its assertion of jurisdiction, has determined, and publicly announced, that Well Pads constitute "projects" that cannot be constructed or undertaken in Wayne County, Pennsylvania and other areas of the Basin with first applying for and obtaining Commission approval.

19. The Commission has also announced that it will not consider applications for approvals for Well Pads, which are referred to by the Commission as "well pad dockets," until after it adopts regulations purporting to govern Well Pads.

20. The Commission's *de facto* moratorium on the otherwise lawful use of private property for natural gas development has been in force since 2010 and the Commission has yet to adopt regulations governing Well Pads.

C. WLMG's Planned Development of the Property.

21. WLMG acquired the Property with an intent to explore for, extract and sell the natural gas located in shale formations associated with the Property and other nearby land in order to recoup, and earn a reasonable return on, its investment in the Property.

22. WLMG will proceed in phases, beginning with the construction of an access road and well pad on the Property.

23. WLMG has identified a location for the access road and well pad on the Property, taking into account siting requirements.

24. After the access road and well pad are constructed, WLMG will drill an exploratory well to locate productive zones of natural gas located in shale formations on the Property. The next phase of development will include the drilling of one or more lateral wells followed by hydraulic fracturing and, ultimately, the production of natural gas.

25. Pennsylvania has adopted comprehensive environmental regulations governing all phases of the development of natural gas resources within Pennsylvania. Pursuant thereto, persons and entities seeking to construct well pads and appurtenant facilities, and proposing to carry out related activities such as drilling, fracturing, completing and operating natural gas wells in Pennsylvania, must obtain permits and approvals from the Pennsylvania Department of Environmental Protection ("PaDEP").

26. The well pad and appurtenant facilities to be constructed on the Property, as well as related activities to be carried out on the Property, will be designed, constructed and carried out in accordance with all applicable statutory and regulatory requirements including those implemented by PaDEP.

27. The well pad and the appurtenant facilities to be constructed on the Property, as well as all related activities to be carried out on the Property, will be designed, built, operated and carried out for the exploration, extraction and development of natural gas and not for the conservation, utilization, control, development or management of water resources.

28. WLMG does not propose to develop, construct or operate a water withdrawal, dam, impoundment or reservoir, or to construct or operate a wastewater treatment or discharge facility in connection with the development on the Property.

29. All water used in connection with the planned Well Pad on the Property will be obtained from properly licensed and approved sources owned and operated by persons or entities other than WLMG, will be managed and delivered to the Well Pad in accordance with all applicable laws and regulations and any applicable fees will be paid.

30. All wastewater generated in connection with the Well Pad on the Property will be managed by properly licensed and/or permitted entities other than WLMG in accordance with all applicable laws and regulations.

31. When the obstacle created by the Commission's assertion of project approval jurisdiction is removed, WLMG will make the substantial investment associated with obtaining, and take steps necessary to secure, all required permits and approvals from PaDEP and, upon receipt of same, will carry out its plans for the Property.

32. It would be futile and wasteful for WLMG to apply for permits and approvals from PaDEP before resolving the insurmountable obstacle created by the Commission's assertion of jurisdiction and imposition of a moratorium. Permits and approvals issued by PaDEP are valid for defined and limited periods of time and, moreover, PaDEP will not issue final permits and approvals for a Well Pad over which the Commission has asserted jurisdiction and project review authority until after the Commission reviews and approves the Well Pad.

33. Given the Commission's decision not to consider well pad dockets until some indefinite point in the future, it would be futile for WLMG to apply for Commission approval for the Well Pad to be developed on the Property.

34. WLMG, moreover, should not be required to engage in an expensive, time consuming and ultimately futile exercise of attempting to obtain review and approval by the Commission for its Well Pad where, as set forth above, no such review and approval is required under the Compact.

D. Harm To WLMG.

35. The Commission's final determination that Well Pads constitute "projects" subject to Commission review and approval under Section 3.8 of the Compact has an immediate and practical impact on WLMG. The Commission's unlawful assertion of jurisdiction is an absolute barrier to WLMG's ability to move forward with its plan to develop a Well Pad on the Property.

36. Other than the Commission's unlawful assertion of jurisdiction over a Well Pad on the Property, an injury to WLMG which has been aggravated by imposition of the *de facto* moratorium, there are no known impediments to WLMG securing all permits and approvals necessary for the construction and operation of its Well Pad. Thus, the sole, insurmountable obstacle to the development of the Property as described herein is the Commission's unlawful assertion of jurisdiction.

37. As a result of the Commission's unlawful assertion of jurisdiction, WLMG is unable to develop a Well Pad on the Property and to thereby recoup its upfront costs and earn a reasonable return on its investment. Among other things, WLMG is unable to drill an exploratory well in order to precisely identify productive gas zones on the Property

and, thereby, to immediately increase the value of the Property and WLMG's nearby land.

38. The Commission is authorized to seek civil penalties from a person who undertakes a "project" without Commission approval pursuant to Section 3.8 of the Compact. Specifically, Section 14.17 of the Compact provides that a person, association or corporation who violates or attempts or conspires to violate a provision of the Compact or a rule, regulation or order of the Commission may be liable for a penalty of as much as $1,000 for each offense and $1,000 per day for a continuing violation, attempt or conspiracy to be fixed by a court of competent jurisdiction.

39. The Commission's final determination regarding its jurisdiction and authority under the Compact puts the public on notice that persons that construct well pads and appurtenant facilities, or that engage in related activities, in connection with wells targeting shales located in Wayne County and other areas of the Basin without prior authorization from the Commission that they are at risk of incurring substantial civil penalties and other potential enforcement actions.

40. WLMG must choose between proceeding in the face of incurring substantial civil penalties and other sanctions or waiting for the Commission to lift the moratorium at some indefinite point in the future and then incurring the substantial expense of seeking Commission approval for an undertaking over which the Commission does not have jurisdiction.

41. In light of the fact that the Commission is not considering applications for project approval of Well Pads, WLMG must choose between the substantial risks associated with proceeding without Commission approval or indefinitely deferring otherwise lawful use of the Property.

42. The Commission's assertion of jurisdiction over otherwise lawful use of land in connection with natural gas extraction by WLMG, as well the Commission's assertion of jurisdiction over "related" activities, materially and adversely affects WLMG by interfering with WLMG's right to use the Property in conducting a lawful business activity. The material and adverse effect on WLMG's rights to use the Property and to conduct a lawful business activity is caused by the

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Commission's unlawful assertion of jurisdiction, not simply by the existence of the Compact.

43. A decision in favor of WLMG in this case will remove the sole insurmountable barrier to WLMG's plan to develop the Property in the manner described in this complain and also will result in an increase in the market value of the Property and nearby land owned by WLMG.

44. Absent the relief requested herein, WLMG will be deprived of its constitutionally protected right to use its Property in a lawful and productive manner. In addition, WLMG will incur economic injury in that it will be prevented from confirming the full scope of, and then extracting and selling natural gas associated with, the Property and also from benefiting from an increase in the market value of the Property which will follow the drilling of an exploratory well.

COUNT I – DECLARATORY JUDGMENT

45. WLMG repeats and re-alleges paragraphs 1 through 44 of this complaint as if fully set forth herein.

46. The Commission's "project" approval jurisdiction does not extend to all human undertakings that may have a substantial effect on the water resources of the Basin.

47. The Commission's project approval jurisdiction under Section 3.8 of the Compact is limited to "projects" that have a substantial effect on the water resources of the Basin

48. The Well Pad as proposed by WLMG does not constitute a "project" under Section 3.8 of the Compact.

49. Because WLMG's proposed Well Pad does not constitute a "project," the Commission lacks authority under Section 3.8 of the Compact to require WLMG to obtain Commission approval for the Well Pad.

50. Because WLMG's proposed Well Pad does not constitute a "project," it is irrelevant whether or not the Commission believes that the proposed Well Pad may have a substantial effect on water resources in the Basin.

51. The Commission otherwise lacks authority to require WLMG to submit for its review, and to obtain its prior approval for, the proposed Well Pad.

52. The Commission, in asserting jurisdiction over WLMG's proposed Well Pad, is misconstruing and unlawfully exceeding its authority under the Compact.

53. The Commission, in asserting jurisdiction over, and by precluding the development of WLMG's proposed Well Pad, has and will continue to deprive WLMG of constitutionally protected rights.

WHEREFORE, WLMG requests that the Court:

1. Declare that the Commission does not have jurisdiction over, or the authority to review and approve, or to require WLMG to seek prior approval from the Commission for, or to otherwise preclude the development of, WLMG's proposed well pad, appurtenant facilities or the related activities to be carried out on the Property.

2. Grant such further relief as the Court deems appropriate.

Respectfully submitted,

May 17, 2016

s/David R. Overstreet

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Attorneys for Wayne Land and Mineral Group, LLC

EXHIBIT "9"

Exhibit A

United States Department of the Interior
NATIONAL PARK SERVICE
Upper Delaware Scenic and Recreational River
274 River Road, Beach Lake PA 18405

IN REPLY REFER TO:

N3617 (UPDE-OS)
xN16 (UPDE-OS

May 26, 2010

Ms. Carol Collier, Executive Director
Delaware River Basin Commission
P.O. Box 7360
West Trenton, NJ 08628-0360

Re: Exercise of Project Review Jurisdiction Over All Natural Gas Wells, Including Exploratory Wells, in the Area Draining to Special Protection Waters in the Delaware River Basin

Dear Ms. Collier:

The Delaware River's natural resources are of primary importance to the National Park Service, which manages the Upper Delaware Scenic and Recreational River, the Delaware Water Gap National Recreation Area, and the Middle Delaware National Scenic and Recreational River. The legislation establishing each of these units of the National Park Service cites the need to protect the river's water quality and scientific features, and to fulfill other vital national conservation purposes. Department of the Interior trust species here include the federally endangered dwarf wedgemussel (*Alasmidonta heterodon*), which is found over a 22-mile section of the upper river and in tributaries to the Middle Delaware.

For these reasons, we are writing to refer to you, under Section 3.8 of the Delaware River Basin Compact and Sections 2.3.5.A and C of the Delaware River Basin Commission's (DRBC's) Rules of Practice and Procedure, all projects that involve drilling of natural gas wells that are not already subject to project review under the Commission's regulations and the "*Determination of the Executive Director Concerning Natural Gas Extraction Activities in Shale Formations Within the Drainage Area of Special Protection Waters*" (dated May 19, 2009, and referred to herein as "EDD"). This referral includes both "exploratory" or "test" wells, and wells completed in a geologic strata other than shale, and it extends to all aspects of natural gas development that involves land disturbance or water use from the proposed construction of exploratory wells to gas distribution pipelines.

Because DRBC manages the Basin's water resources without regard for political boundaries, it is the one agency that can evaluate natural gas development holistically and provide a comprehensive assessment of the cumulative impacts of this large scale development on the Special Protection Waters of the Basin, which are subject to anti-degradation regulations.

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Section 3.8 of the Delaware River Basin Compact states in part: "*No project having a substantial effect on the water resources of the basin shall hereafter be undertaken by any person, corporation or governmental authority unless it shall have been first submitted to and approved by the Commission ...*" Under Section 2.3.5.A of the Rules of Practice and Procedure, the Commission has identified types of projects that will be deemed not to have a substantial effect on the water resources of the basin. However, the introductory portion of Section 2.3.5.A. provides two exceptions to this list of projects excluded from Section 3.8 review. Section 2.3.5.A. begins with the following: "***Except as the Executive Director may specifically direct by notice to the project owner or sponsor, or as a state or federal agency may refer under paragraph C. of this section,...***" (emphasis by bold italics added).

The EDD recognizes the potential adverse effects of natural gas development activities on water resources in the following text: "*Each of these projects typically involves the construction of a well pad and associated roadways at or about surface elevations, the drilling of a well bore to depths of as much as 6000 feet or more, the withdrawal and transport of surface or groundwater, the injection of the water and chemical fracturing mixtures into the wells to release the trapped gas, the recovery and storage of recovered fracturing fluid, water and associated leached constituents extracted with the gas, the storage and potentially the reuse of the recovered wastewater and chemicals and the eventual disposal of the water and chemicals.* ***Each of these activities if not performed properly may cause adverse environmental effects, including effects on water resources.***" (emphasis by bold italics added).The DRBC has also recognized that the locations of wells within watersheds can significantly affect the potential environmental impacts of those wells. Regulatory review of the locations of proposed exploratory wells, as well as production wells, is required to protect the high quality Special Protection Waters of the Basin. We are less concerned, for example, with well pads sited in previously disturbed agricultural fields, close to existing roadways, and with adequate erosion and sedimentation controls and riparian buffers, than we are with the construction of well pads and roadways in previously undisturbed, forested areas.

However, the EDD states that "*Wells intended solely for exploratory purposes are not covered by this Determination.*" The decision to exclude exploratory wells may have been based largely on the fact that these "test" wells will, for the most part, not require hydrofracturing, and will each require less than the 100,000 gallon threshold for consumptive use that requires project review under the Compact in accordance with the DRBC Rules of Practice and Procedure. Yet, experience with natural gas development in the region has shown that a very large percentage of "exploratory" wells are eventually converted to production wells. Thus, the DRBC will have little or no influence over the location of these projects if they're proposed at pre-existing "test" well sites. This could result in projects having greater environmental impacts, or in the denial of permits which might otherwise have been approved if the projects had been located in less environmentally sensitive areas.

The high quality water resources, habitats and associated species found in the Upper Delaware are products of an upper Basin watershed that is, in much of its expanse, relatively undisturbed, and is approximately 89% forested. Changes in land cover, urbanization and development, and an increase in impervious surfaces in the watershed have the potential to increase runoff, erosion

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and sedimentation, and the loads of silt and clay to streams and rivers. An influx of sediment and fine particles typically impacts streambeds by filling pore space in the substrate, decreasing interstitial water flow, and degrading the quality of interstitial water out of proportion to our impacts on surface waters. These interstitial habitats are critically important to fish spawning and reproduction, juvenile mussels, and macroinvertebrates; all of which are important components of the river's ecosystem.

It is important to understand all the potential and cumulative impacts of large scale changes in land use associated with natural gas development, from test wells to pipelines, throughout the watershed on the water resources of the Basin. We have advocated for assessing cumulative impacts, incorporating modeling and based on the build-out potential of this activity. This assessment should include the potential effects of land use disturbance and water use in all phases of gas exploration and development, from exploratory wells to distribution pipelines.

Through the DRBC, the people of this region have considerable discretion over where surface activities and development can be located throughout this blanket shale formation. We recognize that state regulations provide a measure of protection for the region's water resources. However, given the national and regional significance of the Wild & Scenic Delaware River, extra protections above and beyond those already afforded by state programs are warranted. We call upon the DRBC to prioritize landscapes for protection based on the ecosystem services they provide, require thoughtful siting of development to minimize disturbance, and mandate the use of Best Management Practices and riparian buffers to help ensure that Special Protection Waters are not degraded and other high quality resources are preserved for current and future generations.

Sincerely,

Sean J. McGuinness
Superintendent

C: Brigadier General Peter DeLuca, Commander, U.S. Army Corps of Engineers, NAD Fort Hamilton Military Command
Dennis Reidenbach, Regional Director, NPS Northeast Region
Rick Harris, Associate Regional Director, Natural Resources and Science
David W. Reynolds, Chief, Natural Resources and Science
John J. Donahue, Superintendent, Delaware Water Gap National Recreation Area
Charles Barscz, Manager, Northeast Region Wild & Scenic Rivers Program
Joe DiBello, Manager, Partnerships Program, NPS NERO
Keith Hastie, Ecological Services, US Fish & Wildlife Service
Holly Salazer, Air Resources Coordinator, NPS NERO
William E. Douglas, Executive Director, Upper Delaware Council

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Exhibit B

United States Department of the Interior

FISH AND WILDLIFE SERVICE
300 Westgate Center Drive
Hadley, MA 01035-9589

In Reply Refer To:
FWS/Region 5/ES

JUN 25 2010

Carol Collier, Executive Director
Delaware River Basin Commission
P.O. Box 7360
West Trenton, New Jersey 08628-0360

Dear Ms. Collier:

The National Park Service (NPS) and the U.S. Fish and Wildlife Service (USFWS) (jointly the Services) strongly support the Delaware River Basin Commission's (Commission) June 14, 2010, Supplemental Determination of the Executive Director expanding the requirement for Commission approval to new natural gas "exploratory" well projects and gas wells drilled through shale formations, in the area draining to the Special Protection Waters (SPW) in the Delaware River Basin. However, the Services believe that those "exploratory" wells already approved by the Pennsylvania Department of Environmental Protection (PADEP) should also be subject to Commission review under the new regulations now being drafted by your staff.

Consideration of all Natural Gas Projects

With the exception of activities related to hydraulic fracturing (for increasing production), the environmental effects of natural gas well construction, either as a "production" well or as an "exploratory" well, or into shale or non-shale formations, is virtually identical. Each drilling project involves construction of a well pad and associated roadways, the drilling of a well bore, the withdrawal and transport of surface or groundwater, and the recovery and handling of flow-back water and drilling fluids. As stated in your May 19, 2009, Executive Director's Determination, "Each of these activities, if not performed properly, may cause adverse environmental effects, including effects on water resources."

Additionally, it appears to be industry standard to convert exploratory or test wells to full production wells if suitable gas deposits are encountered. Based on our discussions with PADEP staff working on Marcellus permitting in southwestern Pennsylvania, we concluded that exploratory wells fall into two general categories. A small number of wells (e.g., one to two per county) are drilled during the initial phase of expansion into a new area and are truly exploratory wells intended to optimize drilling practices for the new area. The second and larger category of "exploratory" wells includes wells drilled during subsequent expansion into an area. Only a very

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small percentage of these wells are abandoned without being converted to a production well. In fact, Pennsylvania regulations do not distinguish between exploratory and production wells for State-issued permits. The high rate of exploratory-to-production well conversion, the environmental effects common to both, and the cumulative effects are of concern to the Services.

Trust Resources

The high quality waters and habitats of the upper Delaware Basin support a variety of natural resources that are managed in trust by the Services for the benefit of the American people. Large-scale changes in land use and increased water withdrawals, like those associated with natural gas development (including the construction of exploratory wells) will likely affect the Services' trust resources and should be reviewed for both individual and cumulative environmental effects.

The natural resources of concern include the NPS Upper Delaware Scenic and Recreational River, the Delaware Water Gap National Recreation Area, the Middle Delaware National Scenic River, and the Lower Delaware Wild & Scenic River. The legislation establishing these units cited the need to protect the "outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values …and to fulfill other vital national conservation purposes."

USFWS trust resources in the Delaware Basin include federally listed species, migratory birds, several inter-jurisdictional fishes, and an approved National Wildlife Refuge. The species are protected under the Endangered Species Act (16 U.S.C. 1531 et. seq.) include the federally listed dwarf wedgemussel (*Alasmidonta heterodon*), Indiana bat (*Myotis sodalis*), bog turtle (*Glyptemys muhlenbergii*), and Northeastern bulrush (*Scirpus ancistrochaetus*).

The USFWS administers migratory birds under the Migratory Bird Treaty Act (16 U.S.C. 703 et seq.) and the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d). Approximately 200 species of migratory birds have been identified within the upper Delaware Basin, including an increasing population of bald eagles (*Haliaeetus leucocephalus*) and the largest congregation of wintering bald eagles in the northeast. Additionally, the Delaware River corridor and the corridor along the Kittatinny Ridge within the watershed are designated as Audubon Important Bird Areas. Many species of migratory birds for which USFWS has responsibility breed in or migrate through the high-quality riparian corridors of the Basin.

Managed fish species inhabiting the Delaware River and its tributaries include, but are not limited to, the federally endangered shortnose sturgeon (*Acipenser brevirostrum*), the American shad (*Alosa sapidissima*), Eastern brook trout (*Salvelinus fontinalis*), and American eel (*Anguilla rostrata*). These and other migratory fish species in the Delaware River and its tributaries are important to the aquatic environment and to the economies of many Pennsylvania, New York, and New Jersey communities.

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The USFWS has also recently approved the creation of the Cherry Valley National Wildlife Refuge in eastern Pennsylvania. Cherry Creek, in the bottom of the valley, ultimately flows into the Delaware River. The established boundary for this new refuge encompasses 20,466 acres in Monroe and Northampton counties, and when completed will protect an area that stretches west from the Delaware Water Gap National Recreation Area and encompasses a stretch of the Appalachian Trail and the slopes of Kittatinny Ridge.

Summary

Natural gas development has the potential to significantly degrade the natural habitats and water quality in the Delaware River Basin, therefore we fully support the Commission's review of all natural gas well projects in the areas draining to SPW. Furthermore, we strongly support the Commission's promulgation of new regulations for assessing the individual and cumulative effects of natural gas development and believe that through thoughtful siting of gas well pads and infrastructure and the use of Best Management Practices, degradation of the high quality natural resources in the Basin can be minimized. We look forward to working with you in the future on this issue. Please contact Paul Phifer, Assistant Regional Director for Ecological Services, at 413-253-8304, if you have any questions.

Sincerely,

Marvin E. Moriarty
Acting Northeast Regional Director, USFWS

Dennis Reidenbach
Northeast Regional Director, NPS

EXHIBIT "10"

VERITEXT
LEGAL SOLUTIONS

Deposition of:

Curt Coccodrilli

August 27, 2019

In the Matter of:

Wayne Land and Mineral Group, LLCv. Delaware River Basin Commission et al

Veritext Legal Solutions

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gallons needed during the drilling operations for the exploration well." Do you see that?
A. Yeah.
Q. Explain to me what is meant by an exploration well?
A. An exploratory well is a vertical well. You sink down to the targeted formation and pull the cores, look at the resistivity logs and other logs, gamma logs, et cetera, and try to define whether it's a viable resource or not.
Q. Okay. So WLMG planned to initially put in an exploration well?
A. Yes.
Q. And Mr. Holko was telling you that 400,000 gallons of water were needed?
A. Yes.
Q. He then goes on to talk about how much water would be needed if completion activity proceeded. Correct?
A. Yes.
Q. Is the same well that is used for exploration also used for completion activity?
A. It could be.
Q. Explain to me how that occurs.
A. You get down to your kickoff point and you go

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lateral, I mean, from, you know, the test well. You could use it for sure.
Q. Okay. So test wells or exploratory wells, those are the same thing?
A. Test well and an exploratory well are the same thing.
Q. Okay. And an exploratory well can be converted into a production well?
A. It can.
Q. Is it less expensive to convert an exploratory well into a production well than it is to drill a new production well?
A. Yes, if you're only drilling one well.
Q. How many wells did WLMG intend to drill?
A. I wanted as many as possible, but to be realistic, you know, six would be a good starting point.
Q. How many wells can fit on the well pad you were contemplating?
A. On that? Six.
Q. Now, Mr. Holko talks about assuming approximately 10 stages?
A. Frack stages.
Q. Explain what a frack stage is.
A. That's the length in a well that you would

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have one stage. So, in other words, if part of your plan was -- with DEP, you have to tell them how many frack stages are in your plan. Okay? So it could be a couple hundred foot per stage.
Q. And how does each stage proceed?
A. How does each stage proceed?
Q. Right.
A. Well, you just keep perforating and throwing sand in there, completing it.
Q. So you go stage by stage?
A. Correct, out to the length of your lateral.
Q. How long did you contemplate your laterals would be?
A. I believe this would have been out -- you know, an average well in PA is about 7,000 foot. I think we had somewhere in 5,000-ish in this particular spot.
Q. Mm-hmm. How did you arrive at 5,000 feet?
A. You talk to your neighbors, see if they're interested.
Q. Is your lateral going to your neighbor's property as well as yours?
A. Yes, sir.
Q. Did you talk to your neighbors?
A. I did.

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Q. Were they interested?
A. Yes.
Q. Which ones?
A. Carnes was interested, Adam Newman was interested, he probably had a couple hundred acres right next to us. They come to mind immediately.
Q. Anyone else?
A. On the other side, yes. The fellow since sold the property, his name was -- jeez, I forget his name, but he was literally right next to us down Beaver Hollow Road. Yes, he was interested as well.
Q. Okay. And you would be able to extend the laterals under your property onto their property? Is that correct?
A. Yes.
Q. You had mentioned that 7,000 feet would be normal in Pennsylvania. Why were you only contemplating 5,000 feet?
A. Because we just -- that's how we talked to the neighbors, and, you know, if they're interested, you can extend that well that far. And, you know, that's -- it's a land development issue at that point. But, yes, there were immediate neighbors that were very interested.
Q. And if there was insufficient interest, you

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A. Probably right -- during the middle of all this here, sometime in May.
Q. Do you have an understanding as to why you did not correspond with him in writing about that?
A. We didn't get that far, so -- to me, he could supply the test well; that's first and foremost. We'll worry about the production later.
Q. What did you understand him to mean by the phrase on the first page of Coccodrilli-6, "Our general price is $8 per a thousand gallons take or pay."
A. What do I understand about it? That that was his price per thousand gallons.
Q. What does take or pay mean?
A. What is take or pay?
Q. Yeah.
A. I believe we're taking the water that he has and paying for it. I don't know what the -- I'm not sure exactly what the or pay means.
Q. Is the price for water as delivered or price that would then require you to truck it to the site?
A. There's an additional trucking fee. That would be his water cost, I believe.
Q. Okay. And then there's an estimated electric pumping charge. What's that about?

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A. I believe that's to take the water out of the withdrawal site. You have to have -- you have to have an electric motor in here pumping it out.
Q. Mm-hmm. So that was the motor that was going to pump the water into the trucks?
A. Yes.
Q. Did you have a relationship with Mr. Nevin before you corresponded with him concerning this water?
A. I did not.
(Coccodrilli Exhibit No. 7 was marked for identification.)
BY MR. WARREN:
Q. Okay. I'm showing you what's been marked Coccodrilli-7. I'll give you a minute to look it over.
Can you identify this document for us?
A. Yeah. It's an e-mail discussion with Mr. Nickens.
Q. All right. Is it an e-mail that you received from Mr. Nickens on or about May 5th, 2016?
A. Yes.
Q. Who is Clearwater Technology?
A. They're the outfit with the withdrawal permit.

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Q. Is Mr. Nickens somehow associated with Don Nevin?
A. I hope so. He's speaking on his behalf.
Q. So Clearwater Technology has a water withdrawal permit with DRBC?
A. Yes.
Q. And it also has excess produced water and rainwater available?
A. That's what it says here, yes, sir.
Q. What operation does Clearwater Technology conduct that results in produced water?
A. I don't know. I'm not a member of their outfit.
Q. Did you make any inquiry when you got this as to what he was talking about when he talked about produced water?
A. Produced water is, you know, basically flowback water.
Q. Where is he getting it from?
A. He might have had some agreement with the drilling outfit.
Q. With what outfit?
A. A drilling outfit, an operator.
Q. What was your reaction to this e-mail?
A. My reaction?

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Q. Mm-hmm.
A. It solves a problem that we had to try and access water. He's a potential MSA.
Q. What do you mean by MSA?
A. Master service agreement.
Q. For water?
A. Yeah.
Q. Did you intend to use produced water at the site?
A. Yes.
Q. How did you intend to use it?
A. To complete the wells.
Q. So were you going to use fresh water and produced water?
A. Yes, sir.
Q. And both were going to come from Clearwater?
A. Yes, sir.
Q. How much produced water did you anticipate using?
A. The mix here is 50-50; that's his mix, so --
Q. Explain how you would go about determining the sources of water and the mix of water to use at the site.
A. That's John's job. I -- he would determine that, and somebody in the engineering side would.

MR. NESTOR: Objection to the form.
Necessary for what, Counsel?
MR. WARREN: Necessary -- fine. Let's take it more slowly.
BY MR. WARREN:
Q. Mr. Coccodrilli, do you see the sentence that I read in document -- on page 1690 on Coccodrilli-9?
A. I do.
Q. What does it mean, if impacts to wetlands and/or streams are necessary?
A. What this means is she's going to charge us more money if we were going to go through a wetland. Period.
Q. Do you have an understanding of why she would do that?
A. Because then she would have to do a more detailed PNDI, I would guess, or whatever they do. I mean, she's the engineer.
Q. Okay.
A. I want to hold -- when you hire somebody of this caliber, I want them to tell me, That's going to add money to your project, that isn't; if you go here, that's less money for you to spend on developing that site.
Q. Okay.

A. That's her job.
Q. All right. You see the road depicted on the map on Coccodrilli-10?
A. I do.
Q. Am I correct that the dark line on this map is the boundary between the Delaware River Basin and the Susquehanna River Basin?
A. I do.
Q. And does the road weave back and forth across the basin boundary?
A. It does.
Q. And is the well pad -- proposed well pad shown by that rectangular figure where the arrow is pointing to, proposed well pad?
A. That's the proposed well pad, yes.
Q. That's where Tioga has suggested siting the well pad?
A. Correct.
Q. Could Tioga have sited the well pad on the other side of the DRB boundary successfully?
MR. NESTOR: Objection. Calls for speculation.
Go ahead and answer.
A. The answer is it would -- no. The slope is too steep.

BY MR. WARREN:
Q. Is that consistent with what you told me before, that the slope throughout the property is about the same?
A. I didn't say that.
Q. Oh.
A. And if I did, I want to stand to be corrected because I said it was very sloped, the entire property is. The only place that wasn't was the pond. That's what I said.
Q. Okay. Where's the pond on this property?
A. It is not on the map.
Q. Where would it be located?
A. Over here, on the left-hand side of the map, looking north to south.
Q. So the pond is on the Susquehanna River Basin portion of the property?
A. Yes.
Q. Would you need -- is it your understanding you would need approval from DRBC to use that water?
A. What water?
MR. NESTOR: Objection. Go -- that was going to be my objection, but, you know, objection to the form.
BY MR. WARREN:

Q. The water in the pond.
A. I prefer not to use the water in the pond because industry standards state that most of the SRBC folk want to use a main river, and they're moving away from any small creek and ponds, ponds especially. I don't know of a single one permitted for water withdrawal anywhere other than one that's man-made from an operator.
Q. Okay. So you don't want to use the pond?
A. If there was a -- you didn't specify what for, what water. Okay? If we could -- if it was drinking water we could feed the men, that would be great, you know, use it on site.
If we want to use water from that pond, I don't see why we couldn't apply for it somewhere, but I don't believe we'd ever get it permitted. Never. And don't you folks have some rules that you --
MR. NESTOR: Don't ask questions.
THE WITNESS: All right.
BY MR. WARREN:
Q. All right. Let's continue on Coccodrilli-9. The predrill survey to identify water supplies within 3,000 feet of the proposed well locations --
A. Yes.

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Q. -- was that done?
A. It was not done.
Q. Is it your intent to do that?
A. Yes.
Q. And tests for wetland delineation, has that been done?
A. The wetland delineation, I believe it was done, and it is referenced here in this map.
Q. Have you seen an aquatic resource delineation report?
A. Aquatic resource delineation report --
Q. That's what's being referenced as being included within Task 4 at the bottom of page 1690.
A. I'm not sure of the exact wording of what -- you know, an existing wetland here on our already-produced map means from a wetland delineation. I don't know if they're one in the same or if it's something different. I don't know. I'm not sure.
Q. Okay.
A. But it's delineated here, and that's really what we really wanted to try and figure out, where the best site was on the property.
Q. Anywhere on the property, or did you have an intent to site this on a particular area of the

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property?
A. This was left to the engineer, where this should go.
Q. And the engineer was told that the engineer could site this anywhere on the property?
A. I believe it was left to her to figure out where exactly the best spot would be for access to pipeline and Rainbow Road, and this was what she came up with. It would add enormous amounts of money to move from this site.
Q. Why?
A. Why? Because every hundred foot or so adds thousands of dollars to any job. And the pipeline is right here.
Q. Okay. Can you --
A. Right -- it parallels, basically -- or it goes to the east off of Rainbow Road. And at that point, right here, we're about 400 foot away from that pipe. Over -- if it was anywhere else, you're thousands of feet away.
Q. Does the pipeline run along Rainbow Road?
A. It ran just -- it looks like, just south of these two ponds here, in the lower right-hand corner.
Q. And is that pipe currently in place?

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A. It is not. I answered that earlier.
Q. Okay. I just want to make sure you're talking about a potential pipe.
A. I am talking about a potential pipe.
Q. Okay. I didn't get a clear answer to this question, so I'm going to ask it one more time.
A. Be my guest.
Q. Have you seen an aquatic resource delineation report?
A. I don't recall seeing an aquatic resource delineation report.
Q. Do you know if one was ever prepared?
A. I don't remember.
Q. Okay. Looking to page 1691, under Design Deliverables, have any of -- have any of those design deliverables been prepared?
A. No, with the -- the only one I'm not sure of is the delineation because my general knowledge of this is this wetland was delineated here; stay away from it.
Q. Okay.
A. I mean, wetland, stay away from, bottom line.
Q. All right. How is the well pad sized?
A. Standard, it might be -- standard sizing is, I think, roughly 300-and-some foot by 700-some. It

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might take up a total of 3 to 7, 8 acres, somewhere in there.
Q. There are dimensions shown on the map in front of you, are there not?
A. Yeah. 765 by 330. I was right in the ballpark.
Q. Mm-hmm. That's approximately 7 acres?
A. I -- I'm not sure exactly. It might be somewhere in that realm. Three to seven.
Q. It's not three, is it?
A. I said it's in that realm. I don't have a scale here. You can answer that.
(Coccodrilli Exhibit No. 11 was marked for identification.)
BY MR. WARREN:
Q. Okay. Let me ask you first, with respect to page 2936 --
A. Yeah, gotcha.
Q. -- on Coccodrilli-11 --
A. Mm-hmm.
Q. -- is that an e-mail that you received?
A. It is.
Q. Can you tell me the context?
A. It was sent to try to make the joint venture agreement with Lenape. It was the beginning of a,

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myself.
Q. And what was its purpose?
A. To figure out what we need to do to get this project off the ground here.
Q. Okay. Were you asking Ms. Peterson to design a combined well pad and tank pad?
A. Yes.
Q. And you provided her with the dimensions?
A. Of the -- the well pad, yeah.
Q. Okay. Is that the dimensions of the combined well pad and tank pad?
A. I don't know if the tank pad is included on that. I'm not sure.
Q. Okay.
A. But the well pad sure is.
Q. Okay. The map that we looked at contained a depiction of a well pad with the dimensions that are specified on C-12. Isn't that correct?
A. That is correct.
Q. And you don't know whether that includes the tank pad?
A. I'm not sure. I'm not sure. I don't believe it does, but that is the well pad dimensions.
Q. Okay. Did you obtain the dimensions from Mr. Holko?

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A. I don't recall exactly where I got them, but, you know, you just Google it, and you find the right well pad dimension and whatever you need to do there. I mean, the proper well pad to fit six wells, that's about the size of it.
(Coccodrilli Exhibit No. 13 was marked for identification.)
BY MR. WARREN:
Q. I'm showing you what's been marked Coccodrilli-13, which appears to be a string of e-mails. Can you identify this for us?
MR. NESTOR: Take your time to read it.
A. Yep. This is the -- some conversations I had with Tioga.
BY MR. WARREN:
Q. And for what purpose?
A. This was to figure out a timeline on what else we needed to get the project off the ground.
Q. Okay. Does this refresh your recollection in any way as to whether a formal wetland delineation was done?
A. It was not done.
Q. Okay.
(Mr. Belardi left the room.)
(Coccodrilli Exhibit No. 14 was marked

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for identification.)
BY MR. WARREN:
Q. Okay. I'm showing you what's been marked Coccodrilli-14. Can you identify it for us?
A. I can. This is the conversation I had with Tioga.
Q. This was in the course of Tioga trying to locate the well pad?
A. Correct.
Q. And what different locations were being considered?
A. It looks like the two well pads that were depicted in the picture --
Q. Mm-hmm.
A. -- and the one specifically 41 52'04.46 by 75 22'56.56.
Q. Which one is that?
A. I believe that was the one to the furthest north -- northeast. The other one, if you look back on the old map, sat squarely over that wetland, and what's the no-no you always tell us? No wetland. So there you go.
MR. YEAGER: I'm sorry. Could we just -- are we up to 14, or are we up to --
THE WITNESS: 14.

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MR. YEAGER: Yeah. Thanks.
BY MR. WARREN:
Q. What was the original location?
A. The original location? I don't -- I believe it was the one that we were looking at, but this could have been a variation of it that would have helped with the design layout based on the footprint of our property alone.
Q. The document on page 2888 says, "The original location is very steep." Do you have an understanding as to what original location was being referenced?
A. I believe it was that one that sits over the wetland.
Q. Okay.
A. This one here, right here.
Q. Okay. Do you want to just mark it on that document and put original location next to it?
A. Yep.
(Witness complied.)
Q. Okay. And then there are two alternate locations also being referenced?
A. I was only aware of one, and that's the one just north -- north of there.
Q. Okay. Do you want to mark that and put

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Q. How about from production waters migrating out?
A. It would, but we're talking about a test well here.
Q. This paragraph only pertains to a test well?
A. Up to the point where you are, yes.
Q. Does casing and cementing protect groundwater when a production well is in place?
A. Yes.
Q. What does it protect the groundwater from in the context of a production well?
A. It protects it from potential gas or produced water migration.
Q. Let me invite your attention to page 4. In the middle, do you see the third full paragraph -- sorry, fourth full paragraph that starts "At some point"?
A. Yes.
Q. "Crews will build oil and gas storage tanks." Why do you intend to build an oil storage tank?
A. I -- whether that was just an error, it's a gas storage tank, I believe, but oil for any type of lubrication process, I would imagine.
Q. Does WLMG intend to extract oil at this site?
A. Our intent at this stage of the game is to

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extract gas.
Q. So you're not going to have storage tanks for oil. Correct?
A. Other than what's necessary to grease or oil equipment, I don't believe we do.
Q. Okay. In the next paragraph, you're going to have water storage tanks with secondary containment. Correct?
A. Here? "Well production starting" -- that one?
Q. Yes, the end of that paragraph.
MR. NESTOR: This is it, right here.
A. Yeah, a reclaimed well pad. Yes.
BY MR. WARREN:
Q. Now, what is the purpose of putting secondary containment around the water storage tanks?
A. In case there was a spill.
Q. And why do you need to contain a spill?
A. So it doesn't leech into the ground or off site.
Q. Are these the -- are these water storage tanks referenced here the tanks that are on backs of trucks, or are they some other kind of water storage tank?
A. Well, initially, they were on a truck, and

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some of them would be on -- stored on site for produced water.
Q. Have you and Mr. Holko discussed the number of tanks required on the site to store produced water?
A. We have.
Q. And what is the result of that discussion?
A. The result is, if we get to that stage of completions and hydraulic fracturing, we would have an adequate number of storage vessels on site.
Q. Okay. And what number did you and Mr. Holko talk about as being an adequate number?
A. For -- remember, are you talking about the hydraulic fracturing side or on the test well side?
Q. The hydraulic fracturing side.
A. Okay. Well, whatever it would take to get those frack stages complete. If we're going to do 10 frack stages, you need enough water on site to complete those frack stages. And it's a timeline, remember.
Q. So you'll store the water on site in tanks?
A. Yes.
Q. And then you'll store the wastewater in tanks when it comes back up the bore hole?
A. Correct.

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Q. The top of page 5 says, "WLMG is uncertain how large these storage tanks will be." Is that still your current understanding?
A. It -- it is. And there's a variety of different types of tanks out there with different sizes.
Q. Will the wastewater storage tanks be secondarily contained?
A. Wastewater storage? I believe they will be secondarily contained.
Q. Why?
A. In case there's a spill or an accident.
Q. Okay. To prevent migration of the wastewater to the ground?
A. Yes.
Q. The last full paragraph on page 5, the last sentence discusses a water management plan required by the Pennsylvania Department of Environmental Protection. Are you familiar with that document?
A. Just ancillary, yes, that it has to be completed and filled out and sent in.
Q. Okay. The last sentence says that the plans must identify the methods and practices that will be utilized to prevent pollutants from directly or indirectly reaching waters of the Commonwealth. Do

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you see that?
A. I do.
Q. What methods and practices does WLMG intend to employ to prevent pollutants from directly or indirectly reaching the waters of the Commonwealth?
MR. NESTOR: Objection to the form.
Answer if you know.
A. The same methods that we have stated earlier to answer your other questions about migration of produced water or spills.
BY MR. WARREN:
Q. Okay. So nothing further that you have in mind that WLMG intends to do with respect to methods and practices to prevent pollutants from --
A. I can assure you that the EHS manager would follow the recommended practices and procedures, yes.
Q. Okay. But I'm asking you to give me as complete a list as you can, a list of all the methods and practices that WLMG intends to utilize.
A. We plan on using the methods that -- I'm not an expert in that field. Okay? Let me just start by saying that. But we know people who are. And that is in the EHS management. So my answer to you is they will be followed accordingly and to the

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letter of the law based on that -- that phrase.
Q. Okay. Can you give me any more specifics?
A. The erosion and sedimentation control, the berms, the permeable layer, the fact that we will have emergency -- all the emergency services notified if there is an accident or spill, and then whatever the remediation method is, based in the plan, will be followed to the letter.
Q. Okay. Anything else?
A. I'm sure there's a few other things I'm missing, but I'm -- I'm not an EHS specialist.
Q. Okay. So you've given me the most complete answer you can?
A. That I can give, yes.
Q. The sentence goes on in speaking about the water management plan and says, quote, "Must identify the permitted processing or disposal facilities where residual wastes will be processed or disposed," closed quote. Which permitted processing or disposal facilities does WLMG intend to use?
A. We intend to use the closest facility that is nearest to this property. And there's stages of this. There's produced water -- you can go and put, I believe, sand and mud and wood shavings in the

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landfill. So there's three landfills within, you know, 50 miles of the -- the property. And then we would get rid of the produced water that we cannot recycle through an injection well process, more than likely trucked out to Ohio.
Q. Have you contacted any landfills to see whether they will accept your waste?
A. We have not.
Q. Have you contacted any disposal facilities in Ohio to see whether they will accept your produced water?
A. I believe John has, and John is an expert in injection wells.
Q. Do you know what site Mr. Holko has contacted?
A. He would know. If he did, I'm sure he has all that information.
Q. What portion of the produced water does WLMG plan to recycle?
A. Whatever the water scientist on site tells us is recyclable, recoverable.
Q. Okay. Do you have any estimate of the volume that will be recyclable?
A. My hunch is somewhere around 15 percent, in there.

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Q. Okay. Where will WLMG recycle its wastewater?
A. We will recycle the wastewater, I believe, on site.
Q. Which facilities do you intend to construct to recycle the wastewater on site?
A. If we have to expand off of that 700 and -- foot thing to put on a tank farm, I believe that will be right off site of the tank farm -- or of the well pad site itself.
Q. And what equipment is necessary in order to recycle?
MR. NESTOR: Objection to the form.
Go ahead and answer.
A. I -- I am not an expert in recycling; however, we do plan on recycling whatever possible to try and save money and only utilize what is appropriate and safe. And whatever equipment is in the recycling process, we will certainly employ the latest equipment that falls in line with DEP's regulations.
BY MR. WARREN:
Q. Has WLMG contacted any consultant who is an expert in recycling wastewater?
A. I believe we have not at this point other

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MR. WARREN: All right. So a conversation about an unprivileged conversation is now privileged? So I've got to depose you?

MR. NESTOR: I'm not suggesting that a conversation took place, Mr. Warren, and we disclosed to you in our discovery any conversations that we had with PA DEP. You asked for them, and we provided that information in response to your document request.

MR. WARREN: Now I'm trying to get into the substance of the conversation, and you won't let the witness testify.

MR. NESTOR: If he knows. I said, if he has independent knowledge of it other than the conversation we had with me or Mr. Overstreet or Mr. Belardi, he can speak to it.

MR. WARREN: Okay. But I'm saying, if you had a conversation with PA DEP that's not privileged, and you won't let the witness testify to it --

MR. NESTOR: That was not what I said.

MR. WARREN: -- who could?

MR. NESTOR: That was not what I said. I said, If you learned about the conversation --

MR. WARREN: Yeah.

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MR. NESTOR: -- from me or counsel, then it's privileged. If he has independent knowledge of it, then he can speak to it.

MR. WARREN: Okay. That's your instruction? He can't answer what you told him about the conversation?

MR. NESTOR: Absolutely. He's not going to answer what I told him about anything. It's a privileged communication between lawyer and client.

MR. WARREN: That's your position.

MR. NESTOR: That is my position. He's not going to talk about it.

MR. WARREN: Okay. I'm just establishing it for the record.

MR. NESTOR: Something that didn't even happen.

MR. WARREN: We know it happened.

MR. NESTOR: Okay. If you say so.

MR. WARREN: Are you --

MR. NESTOR: I'm not testifying here today, Counselor.

MR. WARREN: Okay.

MR. NESTOR: Move on.

MR. WARREN: Just so that the record is clear, documents have been produced that show that

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there were conversations between WLMG's counsel and the department, and that's what I was attempting to ask the witness about.

MR. NESTOR: Why don't you put the document in front of the witness?

MR. WARREN: Why?

MR. NESTOR: You say that it happened, so show the witness. Maybe it will refresh his recollection.

MR. WARREN: You show it to him, then.

MR. NESTOR: Okay. Move on, Counsel. We're wasting time now.

MR. WARREN: Are you denying you produced that document?

MR. NESTOR: I'm not speaking to this any further. You want to take it up, we take it up by motion practice. Move on.

MR. WARREN: It is a waste of time.

BY MR. WARREN:

Q. Am I correct that you have the intent to place tanks at the site to haul wastewater?

A. Yes.

Q. And how do you intend to manage that wastewater?

A. Properly.

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Q. How?

A. Whatever the PA DEP rules and regulations standard operating procedures say, we will abide by.

Q. Okay. I understand that you will abide by their procedures --

A. Mm-hmm.

Q. -- based on your testimony. What are those procedures?

MR. NESTOR: Objection to the form. Answer if you know. If you can recite 25 PA Code to Mr. Warren, please do.

THE WITNESS: I cannot, specifically, no.

BY MR. WARREN:

Q. Yeah, I'm not interested in the code cite; I'm interested in physically what will you be doing to manage wastewater?

A. What will we be doing? We will recycle wastewater, produced water, and then injection well or landfill what we can, you know, as in direct line with Pennsylvania law and regulation.

Q. Okay. You've got to get the wastewater from the wellbore to a tank, don't you?

A. Correct. Remember, it's a test well. We don't -- the well pad itself, in the completions

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the pipeline?
A. They would. In certain cases, they'd have right of way.
Q. That they'd have to negotiate?
A. Sure, with the landowner themselves. It's a separate deal from what the E&P company does.
Q. So why don't you tell me from your experience what happens? So the gas, you extract it, you go through the processes on site, and then it ends up going into a pipe. Right?
A. Sure.
Q. What happens from there?
A. At the end of the wellhead, it gets literally out of the hands of the landowner and gets into a gathering system, which in turn goes into a bigger pipe, which in turn can go into an interstate pipe, and the operator has a marketing department that sells X, Y, or Z at X, Y, or Z price and who's hedging what against whom. So, I mean, there's a lot of different ways to market the gas.
Q. So when we were talking about the number of units that were needed to deal with that midstream company, we're talking about just for that first level gathering line. Correct?
A. Sure, yes.

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Q. And then there's a bigger pipe before you get to the interstate pipes?
A. It depends on how close you are to the pipe, but -- for example, Linden Energy would be -- had plans that would take it across into New York State, so that's an interstate pipe company. We're right next to that potential infrastructure.
Q. Okay.
A. So, to us, there's so much -- you know, there's a lot of cost savings having the wells located right next to the transmission.
Q. And so for that to be built, that mid pipe -- right?
A. Mm-hmm.
Q. -- between the gathering line and the interstate line, how many units are we talking about?
A. Well, again, it depends on where you are.
Q. Okay.
A. And we're -- are you referring specifically to Wayne Land and Mineral now?
Q. I'm talking -- no. From your knowledge --
A. Mm-hmm.
Q. -- of the industry and how these -- all the deals --

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A. Sure.
Q. -- come together.
A. Sure.
Q. You're not just looking at how the deal comes together for your individual site; you also have to think about --
A. The bigger picture.
Q. -- the bigger picture. Right?
A. Yes.
Q. So for that -- so we talked about the gathering line.
A. Sure.
Q. In order for it to be financially feasible for the gathering line to be built, you'd need X number of units.
A. Mm-hmm.
Q. We talked about that.
A. Yes.
Q. What about for that next level, for that bigger pipe to connection from the gathering lines to the interstate?
A. You -- generally, to have it -- a profitable operation would need about 5,000 acres.
Q. Okay.
A. To gather gas from the 5,000 acres and

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what's -- you know, 640 into 5,000 is --
Q. Okay. And how many -- generally, how many well pads do you think that means?
A. You -- if each unit has a few wells on it, it might be -- 15 wells, at the minimum, would be a start.
Q. To get to 5,000 acres?
A. Yeah.
Q. You had talked about in a unit where you were talking about 640 acres. How many wells were you talking about there?
A. Well, in the 640, in -- for example, I'll use Wayne Land and Mineral's proposed pad, we had -- six wells would encompass roughly a unit, which would have been an estimated 640.
Q. So if you got six wells covering 640 acres --
A. Yes, sir.
Q. -- wouldn't you have a lot more than 15 wells to cover 5,000 acres?
A. You could, but again, I'm not John Holko --
Q. Okay.
A. -- and I'm not the one out there trying to market the whole deal. I would be on the land side of this equation. My humble opinion, I've seen well pads with as much as 12 wells on one pad.

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Q. Yeah.
A. I know of well pads that have up to -- planned in the future for less -- for less environmental degradation would be more wells on one pad going out further.
Q. I think I --
A. The footprint.
Q. I think I figured out where we're maybe talking inconsistently. It's in how I asked the question. You're talking about six wells on one pad.
A. Yes.
Q. Okay. And I was asking also about number of pads. So we were alternating between number of wells and number of pads.
A. For clarification --
Q. Okay.
A. -- yeah.
Q. All right. So when you're talking about six wells covering that 640 acres, you're talking about one pad for that area?
A. That's one unit and one pad --
Q. Okay.
A. -- in the 640.
Q. All right. Thank you.

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And then where do the compressor stations come in? You talked about the possibility of one; you haven't gotten to that point yet to know.
A. Sure.
Q. Where would you be putting a compression station if it was determined that you needed one?
MR. NESTOR: Objection to the form.
Answer if you can speculate.
A. That would be in the realm of the midstream company.
BY MR. YEAGER:
Q. Okay.
A. And that's up to them. Every so many miles, you need a compressor --
Q. Right.
A. -- compression station. It's a little bit out of our wheelhouse.
Q. Okay. Do you have a sense on how many -- every so many -- when you say so many, roughly what are you talking about?
A. Just for example, you might need one every three or four miles, here and there. Again, it depends on the size of the pipe --
Q. Right.
A. -- how much gathering is involved in --

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inside of that -- that area to get into the pipe, and there's a lot of other factors that are unknown.
Q. Fair to say that if you were trying to determine the -- the number of compressor stations, where they might need to be located, you would need more information about what was being planned for development?
A. Correct. And what would be going into the pipe, the volume, you know, the rate, and then obviously where it's being marketed.
Q. Okay. And I take it, you don't have any of that information at this stage. Correct?
A. We don't, no. That's -- you know, that's part of the process.
Q. And so if we wanted to determine -- you were asked questions earlier about whether there were any stream crossings --
A. Mm-hmm.
Q. -- that were required. You're not in a position, as you sit here today, to indicate whether there would even be any stream crossings that would be necessary just on the Wayne Land and Mineral Group property because you haven't gotten that far in your planning. Correct?
A. That 's correct.

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Q. And so certainly we wouldn't know off the property what the ripple effects would be and what other stream crossings would be necessary at this stage based on the planning that's been done. Is that correct?
MR. NESTOR: Objection to the form.
Answer it if you can.
A. What I know is there's 400 foot between the edge of our property -- for exam- -- now, mind you, I'm flipping hats here again. On the Wayne Land and Mineral project, there's about 400 foot to get down to the pipeline across from Rainbow Road, and I don't believe there was a stream to get down to that proposed right of way.
BY MR. YEAGER:
Q. Okay.
A. But I'm not a hundred percent sure.
Q. Okay. And then once you get beyond that, you don't know what stream crossings would be necessary?
A. No.
Q. Okay. All right. Mr. Warren spent some time going through the identities of a number of people involved in Wayne Land and Mineral Group. Could you identify each of the people who make up Wayne Land and Mineral Group, which of them were also in

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asks. This asks about the current -- this asks about the current uses of and physical features of the property and other nearby land. I'd like you to answer it with that understanding.

MR. NESTOR: Objection to the form.

Go ahead and answer, if you can.

A. I'm just a little confused by the question, and for one reason. I did mention earlier the quarry. Okay? Is that part of what your question is?

BY MR. YEAGER:

Q. Well, is that a current use of the land, of the property?

A. It is not a current use, no.

Q. Okay. Is it a current use of other nearby land?

A. It is -- there is a quarry next to us.

Q. Okay. That's not a -- okay.

A. Sure. But I understand what you're saying.

Q. Okay.

A. But no. Right now, the quarry's not developed. It's in theory only.

Q. So the physical features of WLMG's property, have you told us everything you know between your testimony today and what we have in the documents

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that you've produced in this case that tells us all the information you have about the physical features of the property and other neighboring land?

MR. NESTOR: Objection to the form.

Go ahead and answer.

A. Yes. You have all of the information that I have relevant to the physical form.

BY MR. YEAGER:

Q. All the information that Wayne Land and Mineral Group has?

A. Yes.

Q. You've also been designated as No. 9 -- in response to Question No. 9 for those specific areas that we've already covered, so I'm not going to go back over that.

When you were asked questions about Exhibit 5 -- and I think it just kind of flowed out of this; I don't know that you actually have to look at No. 5 to answer it -- you were -- there was a discussion about how far out you might go with the laterals --

A. Mm-hmm.

Q. -- and you indicated that a company like EQT can get out farther. Do you recall that testimony?

A. I do.

Q. If you could explain that further for me,

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what -- if you could contrast where you think WLMG, in cooperation with -- with your consultants, can go versus where a company like EQT could go.

A. Sure. The average length of a lateral in PA is around 7,500 foot. I don't want to -- I mean, again, that's a John Holko area of expertise, but I don't see us going out 30,000 feet. But it's definitely a possibility if the technology ever got that far, but there's a lot of expense involved with that -- with getting out that far, and I -- I would say we would develop an average lateral length in that neighborhood, 5 to 7 to 10, somewhere in there.

Q. Why does it cost more to go farther out?

A. Well, it's more time, it's more completions, it's more materials --

Q. Such as?

A. -- overtime, you know, work. There's added cost to complete the well, there's added engineering, there's added permitting. So, I mean, it adds a lot of expense.

Q. When you say materials, what kind of materials?

A. Cement, perforation, sand, you know, frack fluid. I could go on and on and on. Just multiply what a normal well would be times X number of feet

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and, you know, it adds exponentially to the cost of the development of the well pad.

Q. You utilize more water the farther out you go?

A. Yes. That's an added cost that's really critical to that as well.

Q. And at what point would that get determined, how far out you would propose to extend the laterals?

A. That, again, is John's area of expertise. I will defer to him on that. And, you know, again, you can't go any further than the other landowners that you have brought into the -- the deal.

Q. And you're not -- you don't have sufficient information at this point about how far out that would be. Correct?

A. We do not exactly, no. There's been areas of interest and -- but, no, it has not gone further than the development of the test well.

Q. Okay. And if you can look at Exhibit 7, this is the May 5th, 2016, e-mail to you about tank farm setup.

A. Yes.

Q. There's reference there that they could place four large $1.5 -- pardon me, 1.5 million gallon

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A. There will be a place in time when the reservoir is depleted.
BY MR. YEAGER:
Q. Okay.
A. And, you know, what that timeline is in the Marcellus, I'm not sure what that would be.
Q. Okay. So as you sit here today, you can't testify about how many future fracks there might be for any of what's proposed. Correct?
A. I cannot.
Q. And if you're -- in addition to targeting the Marcellus, if you're also targeting the Utica, you'd have rounds of fracks for the Utica as well. Correct?
A. Yes.
Q. Do you still have C-10 in front of you?
A. Yes, sir.
Q. The third sheet of C-10, which has a Bates number WLMG2910 -- you see that?
A. Yes, sir.
Q. -- that's the preliminary site plan. Correct?
A. Yes.
Q. There was another document at C-12 -- it was an e-mail from you to Rebecca Peterson copying John

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Holko dated March 30th, 2016.
A. Let me get there.
Q. Yep. Other than the preliminary site plan that's at WLMG2910 and the latitude, longitude that's referenced in C-12 at WLMG2898, is there any other information that we could look at to identify the location of the well pad or any related facilities that are proposed?
MR. NESTOR: Objection to the form. Answer if you understand the question.
A. I'm not sure I fully understand, but -- are you asking is there another map or something?
BY MR. YEAGER:
Q. Is there any other information that gives us a better understanding or further understanding of what's proposed where?
MR. NESTOR: You mean, other than the proposed well pad?
BY MR. YEAGER:
Q. In addition to the proposed well pad. Any of the facilities that are proposed for the property. We have -- this shows a proposed access road, and it's got a red line of -- with the dimensions of the proposed well pad, and we've got the latitude, longitude.

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A. Yes.
Q. Besides these two documents, is there anything else we can look at to get an understanding of the location of what's being proposed?
MR. NESTOR: Objection to the form. Answer if you understand the question.
A. I understand, but I don't believe we have anything else.
BY MR. YEAGER:
Q. That's fine. I'm just trying to figure out what's out there.
A. Okay.
Q. And the plan, the preliminary site plan that's part of C-10, you'll agree with me that that bears a date of May 16th, 2016?
A. Wait. This is the same --
Q. Yeah, that's it.
A. This? Yes.
MR. NESTOR: The site plan.
THE WITNESS: Wait. The site plan, May -- 5/16/16, yes.
BY MR. YEAGER:
Q. Okay. And that was provided to you by way of an e-mail from Rebecca Peterson of the same date at 11:54 a.m. Correct? It's the preceding page.

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A. Yeah, May -- 1:21 p.m.
Q. Now, if you look at 29 -- WLMG2909, it says -- this is an e-mail with a timestamp of 11:54 --
A. Yeah.
Q. "Hi, Curt. Attached is a preliminary site plan." Right?
A. Yeah.
Q. Okay. So that's when you received it. Correct?
A. Yeah. I'm sorry, yeah.
Q. That's okay.
A. I said --
Q. That was a further communication after that?
A. Yeah. Yep, yep, yep.
Q. So she said it might need to be revised slightly -- and I'm quoting -- "It might need to be revised slightly after the water resources are located." Correct?
A. Yes.
Q. So as of May 16th, 2016, the water resources had not been located. Is that correct?
MR. NESTOR: Objection to the form. Go ahead and answer it, if you can.
A. Had they been delineated or sited? Is that

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A. Not off the top of my head.
Q. Is that name familiar to you at all?
A. The Northeast Marcellus Initiative. I'd have to refresh my memory. I'm not sure.
Q. Okay.
A. Where are we --
MR. NESTOR: I'm not putting a document in front of you. He's asking if you're familiar with it.
MR. YEAGER: I'm just going to ask Mr. Warren a quick question.
(Mr. Yeager and Mr. Warren left the room and then returned.)
BY MR. YEAGER:
Q. Are you familiar with historic drilling that had been done in the region back in the 1950s?
MR. NESTOR: Historic what?
MR. YEAGER: Drilling.
MR. NESTOR: Okay.
A. Yes.
BY MR. YEAGER:
Q. There was drilling in Pike and Monroe Counties?
A. Yes.
Q. And do you recall whether there were any --

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any problems that were encountered as a result of that drilling?
MR. NESTOR: Does he recall?
BY MR. YEAGER:
Q. Are you familiar with?
MR. YEAGER: I wasn't suggesting that he would recall.
A. I was born -- before I was born?
BY MR. YEAGER:
Q. That wasn't what I was suggesting.
A. Any problems that were involved? I'm unaware of any problems that were involved in that process.
Q. Okay. So it was originally contemplated that there would be a delineation of wetlands and water sources. Correct?
A. Yes.
Q. And that there would be a report prepared to reflect what that delineation -- what that investigation revealed. Correct?
A. Yes.
Q. And you've said that that wasn't ultimately prepared. Correct?
A. We did not take that next step, no.
Q. Okay. Why not?
A. The cost involved. And I think if we started

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putting the cart before the horse, then we would just add un- -- undue cost to the project until we had clarity on the jurisdictional question.
Q. And what was the cost savings by not having that report prepared?
A. It's in the -- I think the estimate is in the Tioga report.
Q. All right. We can just rely on that?
A. Sure.
Q. Okay.
A. The prices might have gone up from her. I don't know.
Q. And there's some e-mail about, if we don't do the report now what the -- what the charge would be instead. Correct?
A. Yes.
Q. And you have a 6 percent interest in Wayne Land and Mineral Group?
A. Yes.
Q. It seems like you do an awful lot of the work. Is that accurate?
MR. NESTOR: Objection to the form.
Go ahead and answer.
A. Yes. That's true, yeah.
BY MR. YEAGER:

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Q. More than 6 percent of it?
A. To me, it's a labor of love. It is something I truly enjoy doing.
Q. Are there any -- do you have any role in the Wayne Land and Mineral Group other than being that 6 percent -- holding that 6 percent interest?
A. Well, I believe I answered the question earlier that they rely on me for the -- the land side of the equation, meaning what -- you know, what can we do to help pay down the taxes and insurances and maintenance and --
Q. And do you receive any compensation for that?
A. No.
Q. Do you have any agreements for a compensation beyond a percentage share that's equal to your investment?
A. No, not at this time. Until we work out the detail of the joint venture agreement, that 6 percent can be pretty lucrative.
Q. The joint venture agreement with Lenape.
A. Yes.
Q. There's the letter from June from -- from Mr. Holko --
MR. YEAGER: Ken, do you have it marked? Bear with me. Did you have this one marked?

EXHIBIT "11"

LENAPE RESOURCES, INC.

9489 ALEXANDER ROAD, ALEXANDER, NY 14005 www.lenaperesources.com 585.344.1200 Fax: 585.344.3283

June 18, 2019

Mr. A. J. Sandone
Wayne Land & Mineral Group
2309 Adams Ave.
Scranton, PA 18509

EXHIBIT
PENGAD 800-631-6989
Holko
1
8/28/19 CL

Dear AJ,

In this document, I have collected in one place, and have otherwise reduced to writing, the essential elements of the plan to develop the natural gas resources located on the property owned by Wayne Land & Mineral Group in Wayne County, Pennsylvania.

Final Well Prognosis

WLMG will hire a geologist to provide a final analysis of the reservoir objective including estimated depths of the various zones to be penetrated with the wellbore. This analysis will include the development of a wellbore cross section including estimated depths and formation types. It will be used to develop the casing and wellbore design for initial well drilling plans and permitting guidelines.

Estimated Cost: $15,000 to $30,000

Site Plan

WLMG will hire construction and environmental engineers tasked with the development of the well pad and associated surface facilities to minimize environmental impact and provide a safe operating environment for the well development. This plan will begin with the surveying of the site which is necessary in the development of a plat and drainage evaluation. It will include designing surface collection and protection systems for handling possible spills. It will include design parameters to allow controlled access to the facilities during well development. The pad will be approximately 3 to 5 acres of land graded using heavy equipment and will partially be lined with an impermeable layer to prevent surface contamination during drilling and completion operations. Included will be earthen or manufactured berms isolating the pad site from surrounding lands and preventing negative environmental impacts from fluid flow to adjacent land.

Estimated Cost: $50,000 planning phase
$250,000 construction phase

Water Management Plan

A key component to the drilling and development of shale wells is the proper development of water management. WLMG will hire a consultant familiar with water access within and outside the Delaware River Basin to develop proper controls to minimize water use and promote the re-use and recycling of the necessary water. Key components will be the utilization of both fresh and recycled water contingent on the needs of the process. Water needs during the drilling phase are mostly fresh water and may amount to 50,000 barrels. The necessary volumes and are subject to both the needs associated with water mixtures utilized in the drilling muds as well as the water necessary to mix the cement for casing cement isolation. The completion phase uses more water volume but may consist of a combination of recycled fluid as well as fresh water. This combination is derived by the necessity of the mixing of the chemicals utilized in the hydraulic fracturing operation. Volumes can be as much as 500,000 gallons per treatment stage and are known once the stimulation treatment program is designed. The treatment which includes the chemical additives and the proppant volumes is designed around the length of the lateral along with the treatable stage size designed to best treat the entire producible wellbore including chemicals and total volume of fluid used for proppant transport. Total stimulation volumes can vary from as little as 1,000,000 gallons to volumes in excess of 5,000,000 gallons. All fluids will be stored on site in a combination of vertical 210-barrel tanks and portable 500-barrel tanks. The pad site design will include at least 3 but as many as 5 tanks used during drilling operations and additional tanks during the hydraulic fracturing operation. In addition to the tank storage, portable tanks and hauling will be utilized to supply the larger volumes during hydraulic fracturing.

Estimated Cost: $25,000 Planning Phase

Drilling Plan/Exploratory/Horizontal

It is WLMG's intent to drill a vertical well which will be used as the first well in the development and design of the additional horizontal wells to be drilled from the pad site. The initial vertical well will be drilled deep enough to penetrate through the Marcellus Shale formation with a vertical depth estimated at 7,000 to 8,000 feet. It will be drilled with appropriate blow out prevention equipment and well control and testing devices to evaluate the reservoir's potential as well as analyze the needs associated with the development of the lateral to be added to the initial vertical well and the additional horizontal wells to be drilled on the pad. The plan prior to drilling the initial well will include the layout and associated equipment needed for drilling including the hook load and depth capability of the drilling rig which will be used in contracting the appropriate drilling contractor. It will also include the initial drilling and casing of the wellbore to prevent any contamination between deeper gas reservoirs, water zones and other formations. The casing design will include multiple casing strings ranging in size from 24 inches in diameter for the conductor casing to 5-1/2 inches in diameter for the production casing. Additional casings of 13-3/8 inches and 9-5/8 inches will be utilized to isolate freshwater zones and other zones that may be of concern. These casing strings are nested grading from the largest size at shallowest depth to the smallest size to total depth. All casings are cemented in place using the pump and plug method which will provide a secure seal between the drilled hole and the casing. A smaller rig may be used to set the initial conductor casing along with the water protection casing depending on the needs of the final design. Cement bond logs will be used to evaluate cement integrity after casings are cemented. Final drilling of the vertical well along with the initial lateral will be performed with a large rig commonly referred to as a triple in reference to the amount of drill pipe it can stand in the derrick. Initially, the lateral to be drilled will be between 4,000 to 5,000 feet with a final length dictated by the well pad layout after the well is surveyed and permitted. During drilling, a logging while drilling system will be utilized to maintain wellbore integrity within the Marcellus formation and upon completion of the drilling, a logging suite including gamma ray, resistivity, temperature, caliper and density logs will be utilized to evaluate the reservoir potential and finalize the completion design for the well.

Estimated Cost: $50,000 Planning Phase
$2,000,000 Final

Completions Plan

WLMG will hire a Completions Consultant to develop a proposed completion plan utilizing hydraulic fracturing with water, sand and some chemicals to stimulate the reservoir encountered with the horizontal wellbore. The plan will be consistent with proposed water and waste management plans to develop the shale reservoir. The plan will include specific guidelines based on the thickness of the formation as well as the lateral distance between completion stages also considering fluid volumes, rates and pressure limits to be utilized during the operation. The design will be consistent with all permitted limits and will be specific to the wellbore length and structure. It is intended that the lateral will be developed utilizing between 17 to 20 stages covering approximately 200 feet of wellbore for each stage. This section will be perforated and isolated during individual stage treatment at pressures in excess of 7,000 psig and fluid pump rates in excess of 70 barrel per minute. Stages of approximately 250,000 gallons of fluid with up to 2 pounds of sand per gallon of fluid will be pumped during hydraulic fracturing to treat each of the stages. Additional chemicals utilized to control corrosion, friction and bacteria growth will be stored on site and mixed at the recommended concentrations with the water and sand during treatment. After the well is hydraulically fractured, a flowback crew will be contracted to flow the well and provide initial production testing.

Estimated Cost: $30,000 Planning Phase
Final costs associated with the completion can vary depending on final lateral length, stage length and stage treatment size, but is expected to be around $3,000,000.

Wastewater Management

As part of the drilling, completion and production operations, it is mandatory that WLMG develop a wastewater management plan. All wastes associated with drilling and completion will be stored on site in tanks. Offsite disposal utilizing tractor trailers specifically permitted and supplied by waste haulers will be included in the initial plan. Drilling wastes will be consolidated and hauled to permitted and approved disposal sites. Fracturing fluids that are recovered during flowback will be delivered to recycling facilities when available or shipped to either permitted injection sites or surface disposal facilities. The plan will include a minimization component to lessen impacts of handling and hauling. Drilling wastes may amount to multiple truckloads of solid and liquid wastes with liquid wastes resulting from the hydraulic fracturing treatment amounting to approximately 700,000 to 1,000,000 gallons to be hauled for disposal or treatment by truck.

Estimated Cost $10,000 Planning Phase

Lenape Resources, Inc.

John C. Holko
President

EXHIBIT "12"

VERITEXT LEGAL SOLUTIONS

Deposition of:

John C. Holko

August 28, 2019

In the Matter of:

Wayne Land and Mineral Group, LLCv. Delaware River Basin Commission et al

Veritext Legal Solutions

JOHN C. HOLKO - BY MR. WARREN

MR. NESTOR: Objection to form.
Go ahead and answer.
A. No.
Q. Okay. So the first item is the "Final Well Prognosis." What does that mean?
A. Prior to drilling an exploratory well, you summarize the geologic information so that you can estimate depth and other things that are involved in the drilling side.
Q. Okay. What geological information would you anticipate would be summarized?
A. A background geology review of the area as well as any offsetting or near adjacent information from existing wells and an extrapolation to our point of interest.
Q. Has any of that been done to date?
A. It's -- no.
Q. Do you know which geologist will be retained to do that work?
A. No.
Q. To the best of your knowledge, has any geologist been contacted to date?
A. Specific to this project, no.
Q. That first sentence under the paragraph we're looking at talks about a final analysis. Has there been any non-final analysis performed?

JOHN C. HOLKO - BY MR. WARREN

A. Which sentence are you referring to?
Q. The first sentence, (as read): WLMG will hire a geologist to provide a final analysis.
Has any preliminary or other non-final analysis been performed?
A. It's all been discussion between the parties.
Q. The parties being you and Mr. Coccodrilli?
A. Yes. And -- and other service providers I utilize.
Q. What other service providers have been involved in these discussions?
A. Like I said, none specific to this one.
Q. Meaning specific to this project?
A. You need to realize that Lenape is an E&P company, exploration and production company, so we don't just work with one party. So we were actively looking at the entire northern tier of Pennsylvania.
Q. Okay. The sentence we're looking at uses the term "reservoir objective." What does that mean?
A. I was trying to say that currently in northern tier Pennsylvania there are two zones of interest, the Utica and the Marcellus. Once we decide which is the focus, then you extrapolate the technical information to that.

JOHN C. HOLKO - BY MR. WARREN

Q. Okay. As of June 18, 2019, had a decision been made as to whether the Marcellus or Utica Shale would be the focus?
A. Since most of the development in the area is Marcellus, that has been our focus to date.
Q. Did you expect that to change after the geologist provided an analysis?
A. There's a lot of time between when we started this review and now because of the quagmire with the DRBC. The industry has evolved. So to answer that question, there are other opportunities we would not want to pass up.
Q. So at the present time you don't know whether or not the Marcellus or the Utica will be the primary objective; is that correct?
MR. NESTOR: Objection to the form.
Go ahead and answer. That's not his testimony.
A. As of today, based on changes and information in the industry, I don't want to give up every opportunity.

JOHN C. HOLKO - BY MR. WARREN

Q. Okay. So am I correct that you don't know which formation will be the focus?
MR. NESTOR: Objection to the form.
A. What I'm saying is we will pursue the best opportunity in the wellbore.
Q. And today you don't know which is the best opportunity, correct?
A. Yup.
Q. Am I correct that you need the analysis from the geologist to develop the casing and wellbore design?
A. The final casing and wellbore design, yes.
Q. Let's move down the page to the paragraph called "Site Plan."
A. Uh-huh.
Q. You state, (as read): WLMG will hire construction and environmental engineers.
Have you tried to identify which ones will be retained?
A. No.
Q. But that's not work that Lenape is going to do; you're going to somehow bring in other engineers?
MR. NESTOR: Objection to the form.

Go ahead and answer if you understand.
A. Lenape is a general contractor. A lot of the specific services are supplied by subcontractors.
Q. Okay. And the site plan is one of those?
A. Yes.
Q. You used the term in the first sentence "to minimize environmental impact." What do you mean by that?
A. In developing natural gas and other resources, the first thing we do is look at the regulatory obligations and overlay that with our ability to minimize things that aren't even covered in the regulatory environment. So we minimize everything we historically understand that may have an impact.
Q. Can you give me some examples of those things that historically may have an impact?
A. In developing the -- the various water and site plans, access and equipment come into play. So as you develop the final plan, you understand the size and the quantity of equipment being used. So in doing that, what you do is you understand the amount of impaction and pad development you need for that equipment.
Q. And how does environmental impact come

into play?
MR. NESTOR: Objection to the form.
You can answer if you understand.
A. I'm not sure I understand that question.
Q. Okay. I'll rephrase it.
Your first sentence talks about minimizing environmental impact. What environmental impact are you referencing?
A. The regulatory structure is an overview of soil, land and water. Everything you do can -- can impact that. The regulatory structure that the DEP has minimizes that. Like I say, our overview layer is to make sure that that's done.
Q. So it's your intent to take those actions and employ those facilities that are necessary to minimize environmental impact; is that correct?
A. Yes.
Q. What's a plat and drainage evaluation as referenced in the next sentence?
A. The -- the plat is a survey location for the wellbore itself, which lays out the -- the outline of the land, the wellbore's -- the wellbore location, the pad location in relationship to both surface access and at-depth formation access and the -- what

was the --
Q. Drainage evaluation?
A. Yeah. The drainage evaluation goes to development of the stormwater permitting that's required by the DEP.
Q. Does the stormwater permitting require stormwater controls be placed on-site?
A. Yes.
Q. What types of stormwater controls?
A. Everything from diking to compaction of soil to pit liners to tank storage.
Q. What do you mean by pit liners?
A. The pad itself can be unlined, lined. In some way -- I refer to a pit liner as a plastic liner that's used in a diked environment.
Q. Okay. And how are pits used in natural gas development?
A. In some natural gas development -- and remember, this hasn't been finalized. So in some areas, because of the location and other things, pits are not allowed, okay. And most of the time what we've -- what we're using is surface tanks that are referred to as pits. But pits are used to accumulate waste fluids so that they can be treated and removed

and handled properly.
Q. Are there other kind of pits other than tanks?
A. In some cases there are pits that are built on the ground using, you know, dikes and surface facilities. And they're lined with pit liners.
Q. And what types of fluids would be held in such pits?
A. Most of the fluids held in pits are the drilling fluids during the drilling operations.
Q. The drilling fluids prior to being injected into the wellbore?
A. No. Drilling fluids as in recovery.
Q. The production waters?
A. No. The drilling fluids.
Q. So are you talking about formation waters, flowback waters, production waters?
A. No. No. No. During the drilling operation, most of the drilling -- some drilling is done with air, some drilling is done with fluid. It's a combination of bentonite muds and water. And that's used to recover the cuttings to keep them out of the wellbore.
Q. So it's the fluids that are facilitating

the drilling process?
A. Right.
Q. Has a decision been made to not use these kinds of pits here?
A. These -- when you say "these kinds," what do you mean?
Q. Pits for the drilling fluids.
MR. NESTOR: Objection to form.
I think the confusion, Mr. Warren, is that he generically referred to pits to meaning both pits the way you're thinking them and tanks. So I'm not sure. There might be a disconnect in the way you're asking the question.
Q. Okay. What I'm asking is, with respect to those pits that are placed in the ground --
A. Okay.
Q. -- might they be used at this site?
A. Probably not.
Q. But might they be used?
A. No.
Q. Why not?
A. Because from the initial review -- and nothing here's been finalized -- but the initial review had some surface limitations. So our intent is

to minimize any disturbance below surface whether it's from the surface to a pit or anything. So the intent here is to utilize either aboveground man-made pits or aboveground tank pits.
And when I say "aboveground," I mean above an impermeable layer.
Q. What's the difference between an aboveground man-made pit and an aboveground tank?
A. The -- the industry -- the industry has utilized in the past and sometimes certain locations it's acceptable that you can buy what are called dikes. Those are a man-made plastic thing, that instead of a metal tank, you can build these tanks.
And the nice part about them is they're -- you can calculate a volume and use a specific area of your impermeable pad and make it more impermeable by taking these dikes and lining them with an impermeable liner, thus having an aboveground pit that functions as a tank would.
Q. Okay. Is that planned for the WLMG site?
A. We're not sure because the final drilling plan hasn't been done. And a lot of the utilization of the horizontal tanks versus more vertical tanks is contingent on the cuttings that are recovered from the

wellbore during drilling.
Q. So until you know what the cuttings are, you can't make a final decision?
A. Until we -- until we have the prognosis of what we may encounter during the drilling operation, yeah, it's tough to say.
Q. Okay. The next sentence -- again, we're on page 2229, says, (as read): It will include designing surface collection and protection systems for handling possible spills.
A. Uh-huh.
Q. What did you mean by that?
A. All of -- all of surface design of facilities are designed so that you can accumulate and handle whether it's spills, oil droppings out of a pump or some drum that gets knocked over. All of those things are handled specific to what they are and where they are.
So when you look at -- when I was talking about the drilling, when you look at the needs of the materials to create the proper drilling fluid, those specific items may be stored in drums.
So what we'll have on location is a secondary containment for drums, because we have

drums. If our materials are dry and in bags, what we typically have is a secondary containment around a storage facility for the dry bagged material. So once you know what you're using, you design the system to handle any issues relating to that.
Q. Okay. So the system is designed with any substance that might be on the well pad in mind?
A. It's designed with every substance on the well pad.
Q. That would include, in addition to what you've discussed, chemicals that would be mixed with water to form the fracturing fluid?
A. This -- the site plan evolves from the drilling site plan to the completion site plan. And the answer is yes, as you -- as you design and possibly change to the completion site pad.
Q. Okay. So the completion site pad would be designed to handle the produced water coming out of the well, correct?
A. Yes.
Q. Because there is a potential that some of that material would be spilled, correct?
MR. NESTOR: Objection to the form. Calls for speculation.

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JOHN C. HOLKO - BY MR. WARREN
else to minimize the tank storage on location but still maximize the completion opportunity, that'll be done. Because it has -- it has less of an impact for storage.
Q. Have you explored what locations might be used as the source of this water that might be piped onto the site?
MR. NESTOR: Objection to the form.
Go ahead.
A. We started -- we started to. And that's been -- we stopped.
Q. Okay. Did you identify any locations for water storage when you started the analysis?
A. For water storage?
Q. Right. The storage location from which the water will be piped to the well pad site.
A. I didn't say a storage location.
Q. Where is the source of the water?
A. It could be a pond. It could be an existing water supply that's permitted to be utilized.
Q. There is a pond on the WLMG property; isn't that correct?
A. I'm not familiar.
Q. What pond do you have in mind that might

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JOHN C. HOLKO - BY MR. WARREN
be a source of water to the WLMG site?
A. We haven't gotten to that point in the analysis.
Q. Okay. There's a possibility you might identify a pond and then pipe the water to the site; is that what your testimony is?
A. If there's an opportunity to minimize tank storage and prevent, you know, any sort of environmental issues, we will utilize whatever the best methodology is.
Q. Would the possible methodologies include using groundwater at the site?
A. No.
Q. Why not?
A. Typically the groundwater flow isn't high enough.
Q. Have you explored what the flow might be at this site?
A. No.
Q. How close is the closest permitted water source to the WLMG site?
A. I haven't really researched it.
Q. So these are all decisions that will be made down the road?

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JOHN C. HOLKO - BY MR. WARREN
MR. NESTOR: Objection to the form.
Go ahead and answer.
A. These are all part of the final process for the equipment to start moving in, yes.
Q. Okay. On the sentence that we're looking at at the top of page 2230, it talks about the pad being partially aligned?
A. Uh-huh.
Q. What part of the pad will be lined and what part won't?
A. In some cases if there's no -- if there's no opportunity for spill or damage, that part of what we consider the pad won't be lined. Typically in the development, access and buffers are all considered part of the pad and most of those aren't lined.
Q. Okay. The impermeable layer, is that a plastic layer that you have in mind?
A. There's a combination of plastic and there are materials that are actually sprayed on that create an impermeable layer.
Q. You haven't determined which material you'll use yet?
A. No.
Q. You do contemplate using earthen or

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manufactured berms?
A. Yes.
Q. Let's move down to the "Water Management Plan."
A. Uh-huh.
Q. Are you aware that the Pennsylvania Department of Environmental Protection requires a water management plan?
A. Yes.
Q. Is that what you mean by water management plan here?
A. That, in addition to the company's plan on meeting the regulatory requirements.
Q. Are the regulatory requirements the ones that PDEP identifies in the water management plan or do they go beyond that?
A. I didn't understand that question.
Q. What I'm trying to understand is, this water management plan, does it meet the regulatory requirements of PDEP's water management plan only or is it designed to meet other regulatory requirements as well?
MR. NESTOR: What other regulatory requirements?

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MR. WARREN: Of PDEP.
MR. NESTOR: Okay.
A. That's a -- we -- these plans are all part of a concert of things to meet all the DEP requirements. So the answer to that is, I guess, yes. It meets the water plan plus whatever other plans are necessary covering this operation.
Q. Is there any final water management plan in existence for the WLMG property?
A. No.
Q. Is there any draft water management plan --
A. No.
Q. -- in existence for the WLMG property?
No?
A. No.
Q. When do you expect that to be prepared?
A. That would be prepared once the decision is made to go forth with the drilling. These plans and their associated work are quite costly.
Q. Okay. The plan is to utilize water and chemicals as the fracturing fluid; is that correct?
A. The plan -- this specific water plan?
Q. WLMG's plan, it's going to use water and

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chemicals as the fracturing fluid; isn't that correct?
A. This plan is specific to the water handling whether it's utilized for drilling completion or not. The completion plan will take that access to fluid because the fluid may be freshwater, it may be recycled water. And it will develop a completion plan defining the chemicals that work well with the fluid plan.
Q. Are there any alternatives to using water in a completion plan?
A. Not that are economic at this time.
Q. Have you done that evaluation?
A. On this specific project, no.
Q. More generally you have?
A. Yes.
Q. Is that reflected in any documents?
A. No.
Q. With respect to the water management plan again, there's going to be a consultant hired by WLMG?
A. Yes.
Q. Do you intend that to be a subcontractor?
A. Yes.
Q. To Lenape?
A. Yes.

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Q. So Lenape will be the general contractor and each of these contractors or consultants that are referenced here will be your subcontractors?
A. The final joint venture document, once the decision is made to move, will reflect the role of the joint venture partners. At this point in time my expertise lies in that and Lenape's expertise lies in that. So my answer would be initially yes.
Q. Okay. The water needs during the drilling phase in your language "may amount to 50,000 barrels"?
A. Yeah. I think I may have had a typo. That may be gallons.
Q. I was going to ask.
A. Yeah. Now that you put this in front of me and I read that, I may have had a typo.
Q. So you meant gallons?
A. Probably.
Q. Are you sure you meant gallons or are you not so sure?
A. I'd like to go back and read a little. But looking at it initially, we're not going to use 50,000 gallons in the drilling phase -- or 50,000 barrels in the drilling phase. It's about 50,000 gallons.

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Q. How many gallons are in a barrel?
A. 42.
Q. What is drilling mud?
A. It's a fluid designed based on the formation you're drilling through to recover the cuttings.
Q. What does it consist of?
A. It depends on what you're drilling through.
Q. In the case of the WLMG property, do you know what the drilling muds will consist of?
A. Not in specifics. Because we haven't fine-tuned the geologic prognosis.
Q. Do you know generally what the composition will be?
A. In most cases it's going to be water with a -- a lot of times a bentonite mud or some, you know, coagulant to help carry the cuttings out.
Q. And the drilling mud and cuttings come back up the wellbore?
A. Yes.
Q. How are they captured?
A. They're captured in a surface facility and then they're separated.

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Q. How do you separate them?

A. Depending on the -- depending on what you're drilling through and what's in the cuttings, everything from shale shakers to just manual gravity segregation.

Q. And then there's a waste generated from that?

A. There's a fluid, the drilling fluid which is recirculated, reused. And then there's a cutting, which are the rock, so-called rock or the formation that comes out.

Q. Is that considered a waste?

A. Yes.

Q. And how is it stored on-site?

A. It's stored in tanks.

Q. Okay. And then what happens to it?

A. Then it's -- depending on the plan, okay, and who you've contacted and how you've handled it, it's usually removed off site and taken to a permanent disposal.

Q. What types of tanks do you intend to use at the WLMG site for drilling muds?

A. A combination of open-top tanks and vertical tanks.

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Q. What capacity?

A. Maximum capacity of 500 barrels --

Q. Okay. How many tanks?

A. -- or 21,000 gallons.

Q. How many tanks?

A. In this case -- and we haven't finalized the drilling plan. So some of these numbers are very hard to come up with. But the intent is tanks for clean fluid, tanks for -- a tank for cleaning, a tank for recirculate, a tank for cuttings.

Q. Would these be metal tanks?

A. Yes.

Q. Talking about the completion stage in your water management plan, you say volumes can be as much as 500,000 gallons per treatment stage. How is the volume of water determined?

A. By the -- the length of the completion zone.

Q. The longer the completion zone, the more water that's needed?

A. Yes.

Q. What length of completion zone is contemplated here?

A. It hasn't been finalized. But upwards

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anywhere between 5,000 and 7,000 foot as a lateral. And the completion zone's technology today will focus on between 250 to 300-foot stages. And the quantity of stages will be contingent on the quality of reservoir.

Q. So until you know that additional information, no final decision can be made; is that correct?

MR. NESTOR: Objection to the form.

Go ahead and answer.

A. Yeah.

Q. Okay. And if there were neighboring landowners further than 7,000 feet from the well pad who Mr. Coccodrilli was able to solicit to participate in this activity, would you extend the laterals longer than 7,000 feet?

A. Right now, it -- it's all about contact area. If you can extend the lateral and contact more reservoir and it's quality reservoir, you try to contact as much as you can.

Q. Technically how far can you go?

A. The numbers are getting pretty big.

Q. Into the 20,000 --

A. Yeah.

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Q. -- feet?

A. 20, 25,000-foot laterals.

Q. And that's a potential in this case, isn't it?

MR. NESTOR: Objection to the form.

Go ahead and answer if you can.

A. It's all contingent on a final prognosis. Because it's a relationship of hydraulic application for cutting and drag on the drill bit and a whole lot of other stuff as to how far you can get.

Q. And we don't know that yet, correct?

A. No.

Q. And the total stimulation volumes can vary from as little as 1 million gallons to in excess of 5 million gallons; is that correct?

A. Yup.

Q. And that's dependent upon factors that you don't have knowledge of today, correct?

MR. NESTOR: Objection to the form.

Go ahead and answer.

A. Correct.

Q. Okay. The fluids that are being referenced as stored in a combination of vertical 210-barrel tanks and portable 500-barrel tanks are

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what fluids?
A. What line are you referring to?
Q. If you go -- start with four lines from the bottom of page 2230.
A. It's a reference to all the fluids both drilling and completion.
Q. Are there some fluids that will go into the 210-barrel tanks and others that will go into the 500 or are they interchangeable?
A. The utilization of the tanks is interchangeable. In practicality, the drilling fluids go into the vertical and the completion fluids typically go into the wheelie tanks.
Q. The wheelie tanks are the --
A. Are the 500 barrel portals.
Q. And why is that usually done?
A. Because the completion fluids are after the fact. So those tanks will be brought in later. The -- the drilling fluids are used during the whole drilling application and the vertical tank takes up less surface area within the pad.
Q. You talk about additional tanks during the hydraulic fracturing operation on page 2230. How many tanks do you have in mind?

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A. Again, the plan had -- the water management plan hasn't been finalized. So it will depend on access to water and how long it takes to get it to and from the location. But it could be up as much as 100 tanks.
Q. Okay. Can 100 tanks fit on the well pad?
A. I haven't really looked at that.
Q. Okay. Let's talk about the portable tanks. What do you have in mind there on the top of page 2231?
A. That we're going to -- we'll utilize them during the completion operation. That's what that's intended to mean.
Q. Are those intended to refer to the 500-barrel tanks?
A. Yes.
Q. And what is the reference to hauling? It says, "Portable tanks and hauling."
A. In the development of the plan, as you know, not all that water is on-site, so it has to be hauled in. If the round trip is a certain amount of time, then we'll know based on the pump rates how much can be hauled during the operation and how much has to be stored.

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Q. Am I correct that has not yet been determined?
A. No.
Q. I'm correct?
A. Yes. You're correct.
Q. So then the next category is "Drilling Plan/Exploratory/Horizontal."
A. Yes.
Q. The purpose of the exploratory well is to prove up the natural gas on the property?
A. Yup.
MR. NESTOR: Objection to the form.
Go ahead and answer.
A. Yes.
Q. There's a reference in the second sentence to the initial vertical well?
A. Yup.
Q. Is there more than one vertical well anticipated for this site?
A. That's just -- that's just an adjective. There's no -- it hasn't been discussed.
Q. How many wells can the well pad accommodate?
A. We haven't looked at that.

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Q. In your experience, how many wells have been placed on well pads?
A. I'm trying to think what's the most I've seen. I'm not sure I have a number for a pad site this size.
Q. More than one though, right?
A. There's been multiple, yes.
Q. How will you make the determination as to how many wells will be placed on this site?
A. The quality and test results of the initial test well.
Q. Okay. So until you get those results, it would be premature to make a decision as to the number of wells?
A. Yes.
Q. Is it anticipated that if the exploratory well finds economically recoverable gas that that exploratory well will be converted to a production well?
MR. NESTOR: Objection to the form.
Go ahead and answer.
A. That's the intent.
Q. Okay. There's a reference to appropriate blowout prevention equipment. What does that mean?

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been contacted for the WLMG property?

A. No.

Q. And therefore, if I'm reading the sentence correctly, there's no completions plan yet created?

A. Nope.

Q. Okay. The completions plan, as you've noted it, is going to be consistent with the proposed water management plan; is that right?

A. Uh-huh.

Q. So you can't create a completions plan until you have a water management plan; is that right?

MR. NESTOR: Objection to the form.

Go ahead and answer if you understand.

THE WITNESS: I understand it.

A. But most of these things work in concert. So a lot of the water management plan comes out of the drilling plan to the completion plan and you create this -- this concerted, everything is functional.

Q. So am I correct then that you prepare these various plans simultaneously?

A. In a lot of cases, yes.

Q. What is a waste management plan?

A. You mentioned earlier the -- the waste encountered in drilling. And there has to be a

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handling protocol for that material that meets all the regulatory requirements as well as anything else we want to look at.

Q. Has a waste management plan yet been prepared for the WLMG site?

A. Nope.

Q. In order to prepare the various plans we've -- excuse me. In order to prepare the completions plan, you need to know the thickness of the formation, correct?

A. Yes.

Q. Do you know the thickness of the formation today?

A. No.

Q. Do you know the lateral distance between completion stages?

A. No.

Q. There's a sentence in this paragraph under completions plan that says, (as read): The design will be consistent with all permitted limits.

What did you mean by permitted limit?

A. Once you design your plan, in some cases you're limited -- you're limited to access, you're limited to, you know, weights, you're limited to other

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things. All of those things that fall into the water plan, completion plan, the chemical handling, if there's any permit requirements, they will all be met.

Q. Okay. So you're contemplating 17 to 20 stages?

A. It -- yes.

Q. And that may change based upon the information that you --

A. Absolutely.

Q. -- recover going forward?

MR. NESTOR: You just have to let him finish his question. I know you're anticipating. Speaking over each other is going to give the court reporter a problem, so let him finish.

Go ahead and answer.

A. Yes.

Q. And you're contemplating stages of approximately 250,000 gallons of fluid?

A. Yes.

Q. Can you turn back for a minute to page 2230?

A. Yup.

Q. In the middle of the paragraph on water management plan, it says, (as read): Volumes can be

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as much as 500,000 gallons per treatment stage?

A. Uh-huh.

Q. How do you reconcile that statement with the 250,000 gallons on page 2232?

A. What I've done is the completion plan is looking at what's currently going on. The water management plan is looking at the entire opportunity.

Q. Okay. I'm still unclear. So maybe you can help me with this, how the 250,000 gallons on page 2232 is reconciled with the 500,000 gallons on page 2230.

MR. NESTOR: Objection. Asked and answered.

Go ahead.

A. The 250,000 gallons is the current industry standard with the understanding that that can change depending on the final prognosis and the drilling of the wellbore. So the water management plan allows the upper limits. The completion plan is my discussion of what's going on today.

Q. What do you mean by today?

A. In industry literature that is available to everybody, the discussions of stage volumes is running around 250,000 gallons. The designs of a well

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treatment is to minimize costs. The more fluid you use, the higher your costs.
So if we can get away with using less fluid and achieve the completion we're looking at, depending on the completion plan, then we'll utilize less volume.
Q. The fracturing fluid contains chemicals, correct?
A. Uh-huh.
Q. What chemicals do you anticipate would be in WLMG's fracturing fluid?
A. I haven't finalized the chemicals.
Q. Do you have a preliminary list of chemicals that would be included?
A. I don't have a list because it's contingent on the completion company.
Q. Am I correct that there will be chemicals used to control corrosion?
A. Yes.
Q. And for friction?
A. Yes.
Q. And for bacteria growth?
A. Yes.
Q. For any other purpose?

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A. Some viscosity enhancers for sand transport.
Q. Anything else?
A. Those are the basics, depending again on the final plan.
Q. So the final plan could include different categories or additional categories of chemicals?
A. Not -- not intended, but we look at everything.
Q. There's a reference in the last sentence in the completions plan paragraph to a flowback crew. Do you see that?
A. Uh-huh.
Q. Again, you anticipate retaining a flowback crew as a subcontractor?
A. Yes.
Q. What does it mean to flow the well?
A. You bring the fluid you pump in back out.
Q. Something needed to do that or does it occur as a result of a release of pressure?
A. Typically occurs as a release of pressure.
Q. What does initial production testing entail?
A. The quantifying of initial volumes of gas

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or other hydrocarbons.
Q. You have an estimated cost of $30,000 for the planning phase of the completions plan; is that correct?
A. Uh-huh.
Q. And then you note that it can vary depending on final lateral length, stage length and stage treatment size. Am I correct that those three items have not yet been finally determined?
A. Yes.
Q. All right. Moving on to the last page, 2233, which is wastewater management. You note that it's mandatory that a wastewater management plan be developed. Is that because the Pennsylvania DEP requires it?
A. And we require it.
Q. "We" being Lenape?
A. Yeah.
Q. Okay. Has the wastewater management plan been developed?
A. No.
Q. Who will be developing that?
A. Probably Lenape.
Q. When do you plan on doing it?

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A. Once the other plans and the size and the volumes are all analyzed and the wastewater plan is outlined for the DEP and then finalized by the operator.
Q. Are the number of the tanks and the size of tanks going to be reflected in the wastewater management plan?
A. Ask that question again.
Q. Will the wastewater management plan set forth the number of tanks to be used and the size of the tanks?
A. I don't think it will.
Q. Will there be any plan that sets forth the number and size of tanks to be used for wastewater management?
A. Yes.
Q. Which plan?
A. It will be part of the water management plan in the beginning.
Q. Okay. There's a reference to drilling wastes in the middle of that paragraph.
A. Yup.
Q. Which wastes do you have in mind in that reference?

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A. Cuttings and fluids.
Q. Fluids from the drilling process?
A. Yes.
Q. Do you distinguish flowback from production waters?
A. I do, yes.
Q. Okay. What's the difference?
A. It's just a point in time at which you define going into production versus still cleanup and completion.
Q. Is there any difference in the composition of flowback waters and production waters?
A. A little.
Q. What's the difference?
A. Production water is typically longer in the ground so it retains some of the materials natural to the formation.
Q. And flowback water is predominantly the materials that are injected into the wellbore?
A. Yes.
Q. What is the composition that you expect of the production waters at this site?
A. Predominantly old seawater.
Q. Brine?

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A. Brine.
Q. What other components do you expect to be in the production water?
A. I'm not sure. And won't be known until we test it.
Q. What other materials in your experience have existed in production water in Pennsylvania that you want to take into account at this site?
A. All of the limitations of the regulatory water system, they have -- a lot of what's tested for are so-called drinking water contaminants.
Q. And which ones have been present in production water that need to be anticipated in your view at this site?
A. The -- the complete spectrum of salts, some of the heavier metals.
Q. Can you give me examples of what you mean by the heavier metals?
A. Barium, strontium.
Q. Are there any radioactive materials in the shale formations?
A. Very low levels.
Q. Are you anticipating that there will be low levels of radioactive materials recovered in the

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produced water?
A. In the produced water?
Q. Yes.
A. Probably minor quantities.
Q. Does the term NORM, N-O-R-M, mean anything to you?
A. Yeah.
Q. What is it?
A. Natural occurring radioactive material.
Q. Do you expect that to be present in the shale formations that are going to be fracked at this site?
A. Yes.
Q. The assumption of 700 to 1 million gallons at the bottom of this paragraph --
A. Yes.
Q. -- what's that based on?
A. Recovery factor for most shale formations.
Q. What recovery factor did you use in calculating this number?
A. Give or -- give or take, you know, 10, 20 percent.
Q. Okay. Over what time period do you expect this volume to be generated?

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A. It's hard to predict because it's contingent on the performance of the reservoir.
Q. Do you have an estimate of what percentage of it you would expect to be recovered in the first year?
A. I haven't really looked at it.
Q. Is there more wastewater coming out of the well shortly after it's fracked than many years later?
A. The flowback water is at higher rates than long-term production flow.
Q. The total volume of wastewater coming out of the well initially is higher than the volume that comes out years later; isn't that right?
A. Yes.
Q. So you would expect the gallons recovered to be skewed towards the earlier years?
A. Yes.
Q. Are there any plans as to how the wastewater will be disposed or recycled?
A. No plans set yet.
Q. Were there any plans -- have there been any plans discussed?
A. Just in general.
Q. What has that general discussion been?

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A. Do we have access to recycling facilities. And that answer is, there are recycling facilities in your area.

Q. You can put one on the WLMG site as well, couldn't you?

A. What kind of facility?

Q. Recycling facility to recycle the water that's coming out of WLMG's well.

A. Which water?

Q. Produced water.

A. Long-term production water?

Q. Or short-term production water or flowback water.

A. I'm not really sure the economics pan out.

Q. You don't know one way or the other?

MR. NESTOR: Objection to the form. That's not what he said, Counsel.

A. I -- what I was saying is, we haven't reviewed on the site wastewater treatment because we've been focusing on the initial drilling of one well.

Q. Okay. And those are decisions that will be made after you know the results of the exploratory well?

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A. Yes.

Q. You mentioned you've been to the site once?

A. Yup.

Q. What was the purpose?

A. Meet with the neighbor.

Q. Which neighbor?

A. The one across the street.

Q. Do you know his name?

A. I don't remember.

Q. Did you meet with him?

A. Yeah.

Q. What was the nature of that discussion?

A. If he would -- if he would consider -- he's in the energy business, so we were talking to him about two things, the possibility of his involvement, if there's any role he could play. And two, bearing the idea that this works, you know, how interested is he in possibly participating.

Q. What was the result of that meeting?

A. It was a good meeting.

Q. He expressed interest?

A. Yes.

Q. How far is the neighbor's house from the

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well pad site?

A. I don't know. I didn't measure it out.

Q. Is it miles away or --

A. Oh, no.

Q. -- feet away?

A. Oh, no. It's, you know, thousands of feet.

Q. How many thousands of feet?

A. I don't know.

Q. Okay. Is that neighbor on a drinking water well?

A. I don't know.

Q. Do you know if there's any public water in the area?

A. Don't know.

Q. Did you meet with the neighbor at his house?

A. Yup.

Q. Does WLMG have any plans for restoration of the well pad site?

A. Not at this time.

Q. Has WLMG created an emergency response plan?

A. They -- we haven't yet.

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Q. Do you expect to?

A. Yeah.

Q. Will there be diesel fuel stored on the site?

A. That's a pretty broad question. What do you consider diesel fuel storage?

Q. Any container that is retaining diesel fuel for use in a piece of equipment.

A. Probably.

Q. How much diesel fuel will be stored on the site?

A. As little as possible.

Q. In your experience, how much is as little as possible?

A. If we can utilize some of the more modern technology for drilling and everything else, it could be -- it could be pretty small.

Q. Could you give me a range of gallons?

A. 1,000 gallons.

Q. Okay. But it's premature to really know until you understand the technology that will be employed?

MR. NESTOR: Objection to form.

Go ahead and answer.

EXHIBIT "13"

VERITEXT
LEGAL SOLUTIONS

Deposition of:

A.J. Sandone , III

September 3, 2019

In the Matter of:

**Wayne Land And Mineral Group Vs.
Delaware River Basin Commission**

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paragraph 26 of the complaint on page nine. Do you see there's a reference there to the well pad and appurtenant facilities?
A. I need to read it.
Q. Sure. Read paragraph 26, and why don't you read 27 at the same time?
A. Thank you.
(Pause in proceedings.)
THE WITNESS: Okay.
BY MR. WARREN:
Q. What is your understanding of the meaning of the term appurtenant facilities in paragraph 26?
A. I don't know.
Q. What is your understanding of the term appurtenant facilities in paragraph 27?
A. I don't know.
Q. Turn, if you would, to the last page of the document, page 18. It contains a prayer for relief, which is what follows the word "wherefor." Do you see that?
A. Yes.
Q. I'll give you a minute to read that to yourself.
(Pause in proceedings.)

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THE WITNESS: Okay.
BY MR. WARREN:
Q. Do you see the term appurtenant facilities in paragraph one of the prayer for relief?
A. I do.
Q. What does that term mean in the context of that paragraph, if you know?
A. I don't know.
Q. And what does the term "related activities" mean, again, if you know?
A. The process of constructing and building and fracking -- a well pad and fracking.
Q. Anything else?
A. No.
Q. What do you understand the fracking process to be as contemplated for WLMG's property? What would it entail?
A. From the beginning, the first step would be the well pad and then bringing in drilling equipment. Drilling, vertical first, down through -- and encasing the aquifers. I know that part of the process, to make sure we don't pollute anything.
Then at certain depths, they would make a turn to do horizontal. Once they complete the

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drilling process, then the hydraulic fracking process would start. Then upon completion of that, the gas would work its way back up; and there will be a well head and some condensation reclaiming tanks, one for each well, I believe.
Q. How many wells were contemplated?
A. That I do not know.
Q. You don't know the number of condensation reclaiming tanks?
A. That's correct.
Q. How much water does WLMG intend to use in the fracking process?
A. I would have to defer that to the company, if it's John Holko who is doing it, to determine that. I mean I know, from reading and knowing from what we did before, an average. An average amount of water used is about -- almost four million gallons, between three and a half to four million gallons.
Q. And would you expect at the WLMG site water to be mixed with chemicals?
A. Yes.
Q. And the mixture of water and chemicals is generally called a fracturing fluid, correct?
A. Correct.

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Q. Do you have any expectation regarding the composition of the fracturing fluid besides the water?
A. I don't understand the question.
Q. What chemicals will be used and mixed with the water?
A. I don't know.
Q. Has it been determined yet?
A. I would say yes. They've been doing this for a long time.
Q. Does the chemical mixture vary from site to site?
A. That I don't know.
Q. Do you know whether the particular chemical mixture to be used at the WLMG site has been determined?
A. I do not know.
Q. Whose responsibility will it be to determine the composition of the fracturing fluid?
A. I would say Lenape Industries would be, the drilling company.
Q. Which may or may not be Lenape?
A. May or may not be, true.
Q. Will the four million gallons or so of water brought to the site be stored on site?

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Q. Does WLMG know the size of tanks it's going to use?
A. I don't know.
Q. Has WLMG had any contact with any wastewater recycling companies?
A. I would have to defer that to Curt and John Holko.
Q. You don't know?
A. I don't know.
Q. Has WLMG had any communications with any wastewater disposal companies?
A. I don't know.
Q. Does WLMG know the composition of the flowback water that's going to return following fracking?
A. I don't know.
Q. Does WLMG know the composition of the production water that will return following the fracking?
A. I don't know.
Q. For how long will production water emanate from the well floor?
A. I don't know.
Q. Are there any plans to deal with the wastewater at this time?

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A. I don't know.
Q. What steps does WLMG plan to take to prevent spills of wastewater?
A. I don't know.
Q. Well, is it your understanding that some steps to prevent spills of wastewater are required?
A. I would say yes.
Q. Why?
A. I would say -- I would say that's probably what the requirements are. I don't know.
Q. What relief is WLMG seeking in this case?
A. Well, the relief would be to be able to follow through with our plans, to be able to use the property as we intend to, a return on our investment. The relief would be to be able to go through with our plans.
Q. Is WLMG asking the Court to issue a declaration in this case?
MR. NESTOR: Objection to the form. Go ahead and answer it.
THE WITNESS: I don't know.
BY MR. WARREN:
Q. Is WLMG seeking declaratory relief?
A. I don't understand the question.

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Q. Are you seeking a determination from the Court?
A. Yes.
Q. Which will have future implications to WLMG?
A. Yes.
Q. Are you asking the Court to decide that WLMG's proposed activities and facilities are not a project?
A. Yes.
Q. What do you understand a project to be?
A. I understand it to be a bit ambiguous at this point; and in the Commission's terms, a project is anything that has to do with water. It's pretty, again, ambiguous and broad.
You know, the fracking process is a temporary use of water. We're not in the water business. We're not asking for permits to handle water forever, or whatever. We're only using water for a short period of time and, you know, a certain amount of gallons of water; and once we're done, we're done. So...
Q. Is it your understanding that that use of water is not a project?
A. A project is drilling and fracking.

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Q. Okay. And the drilling and fracking uses water, does it not?
A. It does.
Q. And then it involves wastewater, does it not?
A. Yes.
Q. And then it involves the use of storage facilities for the wastewater, doesn't it?
MR. NESTOR: Objection to the form. Go ahead.
THE WITNESS: I don't know.
BY MR. WARREN:
Q. Okay. Is WLMG asking the District Court to determine whether or not WLMG's activities will have a substantial effect on the water resources in the basin?
MR. NESTOR: Objection to the form. You can go ahead and answer if you understand.
THE WITNESS: I don't understand.
BY MR. WARREN:
Q. Is the relief that WLMG is seeking limited to a determination that their activities are not a project?
MR. NESTOR: Objection to the form. Answer if you understand.

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Q. Did you sit down with anybody and talk about the response?
A. No.
Q. No?
A. No.
Q. Have you ever had any communication with anyone at WLMG regarding the response to Interrogatory No. 1?
A. No.
Q. Let me focus then on the answer to Interrogatory No. 2 which asks for the identity of each chemical component of the fracturing fluid that WLMG intends to introduce into the well bore.
The answer to that Interrogatory is incorporating the supplemental response to Interrogatory No. 1 that we just described.
Did you see anything in the response to Interrogatory No. 1 that talked about the chemical components of the fracturing fluid?
A. No.
Q. When you verified the answer to Interrogatory No. 2, why were you verifying a reference to the response to Interrogatory No. 1?
MR. NESTOR: Objection to the form.
THE WITNESS: I don't know.

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BY MR. WARREN:
Q. Is it fair to say that WLMG does not know the chemical components of the fracturing fluid that it intends to introduce into the well bore?
MR. NESTOR: Objection to form. Asked and answered. Answer if you know.
THE WITNESS: I don't know.
BY MR. WARREN:
Q. With respect to Interrogatory No. 3, is there anything about the size of the tanks that is provided by the answer to Interrogatory No. 1?
A. I don't recall.
Q. Let's move to Interrogatory No. 4, which talks about the total amount of wastewater; and, again, the response is by reference to Interrogatory No. 1.
Is there anything in the response to Interrogatory No. 1 that talks about the total amount of wastewater?
A. The exact amount of -- the total amount of wastewater? I don't know.
Q. How about generally the amount of wastewater?
A. I believe somewhere in here there was a reference to a percentage of it. I think that

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would be -- the total amount of wastewater would probably vary according to -- from well to well. I don't think there's going to be an exact number.
Q. Okay. The response to Interrogatory No. 1 doesn't say anything about the amount of wastewater varying from well to well, does it?
MR. NESTOR: Objection to form.
THE WITNESS: It just states the amount of wastewater.
BY MR. WARREN:
Q. And what's that amount?
A. I don't know.
Q. And with respect to Interrogatory 4-C, there's no methodology for calculating any amounts contained in the response to Interrogatory No. 1; is that correct?
MR. NESTOR: Objection to form.
THE WITNESS: The methodology of calculating?
BY MR. WARREN:
Q. Yes.
A. The best I think I can do is guess. I mean, the amounts vary from well to well on the amount of moisture there is in the gas when it comes out. Some may do more wet gas than others.

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Q. Let's take a look at Interrogatory No. 5. I believe you've told me that you don't know what the appurtenant facilities are that are referenced in the complaint; is that correct?
A. It's correct to the point where I don't understand the definition of the appurtenant facilities. My interpretation of it would be a -- would be the full scope of the process.
So if you're talking about well pads, access roads, if that's what that term -- the definition of that term is, then that's what it is. When I look at that, I look at the whole fracturing, the whole thing.
Q. Okay. So where are those facilities referenced in response to Interrogatory No. 1?
MR. NESTOR: Objection to the form.
BY MR. WARREN:
Q. Are those facilities referenced in response to Interrogatory No. 1?
MR. NESTOR: Same objection.
THE WITNESS: I would need to look over this here.
(Pause in proceedings.)
THE WITNESS: No.
MR. NESTOR: Let's take a break.

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MR. NESTOR: For the record, we objected to the Notice of Deposition in that regard prior to; but go ahead and answer.
THE WITNESS: Well, again, I would have to defer this to Counsel to answer that.
BY MR. YEAGER:
Q. No. My question is whether you reviewed that material, sir.
A. No.
Q. Now, what is Wayne Land and Mineral Group's interpretation of the Tahoe Regional Planning Compact?
MR. NESTOR: Objection. Go ahead and answer if you can.
THE WITNESS: I don't know.
BY MR. YEAGER:
Q. So if I went through each of the documents that were contained within the addendum, would you have the same answer?
A. Yes.
Q. If I went through each of the documents that were contained within the joint appendix, would you have the same answer?
A. Yes.
Q. Paragraph 14 references a variety of

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executive director determinations and related documents from the DRBC.
If I asked you that same question with regard to each of those about what Wayne Land and Mineral Group's interpretation is of those documents, would your answer be the same, that you don't know?
MR. NESTOR: Objection to the form; and, again, Jordan, we objected to that category and to the Notice of Deposition at the time that the Deposition Notice was served.
Go ahead and answer.
THE WITNESS: I answered the question before. All these documents, we're not familiar with. No. 2, they existed before we even got together as Wayne Land and Mineral Group, which was September 2015. We're not familiar with any of these.
BY MR. YEAGER:
Q. And because you're not familiar with them, you can't offer what Wayne Land and Mineral Group's interpretation of any of them is, correct?
MR. NESTOR: Objection to the form. Go ahead and answer.
THE WITNESS: Correct.

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BY MR. YEAGER:
Q. You indicated that there are pipelines that are constructed or being constructed that would allow for the transport of natural gas from the property to the markets, correct?
A. Correct.
Q. And you understand -- well, do you have any understanding as to whether such pipelines are necessary for the production of gas so that that gas can then get to market?
MR. NESTOR: Objection to the form. Go ahead.
THE WITNESS: The other alternative would be what they call a virtual pipeline. That's the trucking of it.
BY MR. YEAGER:
Q. And are you aware of any well sites in northeastern Pennsylvania or the region that are using virtual pipelines?
MR. NESTOR: Objection to form. Go ahead.
THE WITNESS: My answer is I -- it's my understanding that there are, but did I witness it or see it? No.
BY MR. YEAGER:
Q. Do you know whether additional processing

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needs to happen to be able to utilize --
A. I don't know.
Q. Let me finish my question.
-- to be able to utilize a virtual pipeline, trucking of natural gas, off a Marcellus shale well site?
A. I do not know.
Q. Do you have any understanding as to how much land area is required for the development of a pipeline to get gas from the property, Wayne Land and Mineral Group's property, to market?
A. I do not.
Q. Do you know how many well pads or well holes are required to make it economically feasible to develop a pipeline to get gas to market?
MR. NESTOR: Objection to the form and foundation. Go ahead and answer if you can.
THE WITNESS: I don't know.
BY MR. YEAGER:
Q. The relief that Wayne Land and Mineral Group is seeking, does it include relief to allow for pipelines to be constructed?
MR. NESTOR: Objection to the form.
THE WITNESS: I don't know.

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A. Because it makes it almost worthless as an investor.
Q. Is that an important bit of information to know when you're making an investment, whether there's regulatory constraints?
MR. NESTOR: Objection to form. Go ahead.
THE WITNESS: Yes.
BY MR. YEAGER:
Q. Do you know what Dave Jones paid for -- paid when he purchased the property?
A. No.
Q. Did you make any inquiry?
A. No.
Q. Did anyone search the property records?
A. I believe so. I believe Curt did.
Q. So Curt made an inquiry?
A. Yes.
Q. Do you have an understanding of what Curt found out?
A. At the time, David was asking a lot more. I think he was asking for somewhat close to what he probably paid, which I didn't agree to negotiate a deal at that point; and after -- we were negotiating for a while.
At that price, we weren't interested. So

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as time -- we would go back and forth, until we negotiated a lower price; and I explained before what happened.
Q. And so what price were you originally?
A. I don't know exactly.
Q. Roughly?
MR. NESTOR: Don't guess if you don't recall.
THE WITNESS: I don't remember.
BY MR. YEAGER:
Q. Roughly, what was it?
A. I would say somewhere in the 700s.
Q. Do you know what your -- the 700,000 range?
A. (Witness nods head.)
Q. Yes? Is that your testimony?
A. Yes.
Q. And that's based on information that you got from Mr. Jones or from Mr. Curt Coccodrilli?
A. I would say from Mr. Coccodrilli of what Mr. Jones was asking for at the time.
Q. And how much time passed between when you understood that was his asking price versus when you ultimately settled?
A. I don't recall.

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Q. A matter of years?
A. No.
Q. Less?
A. It was within one year.
Q. Did you ever -- do you have an understanding as to whether Mr. Jones bought the property prior to the actions of the Delaware River Basin Commission in 2010 or 2009?
MR. NESTOR: Objection to the form. Go ahead and answer.
THE WITNESS: I would say yes because the property had a lease on it.
BY MR. YEAGER:
Q. How does the fact that the property had a lease on it tell you probably yes, tell you that that's the answer?
A. Because I don't think a company, like any of these companies, would come in and lease a property that they couldn't produce gas from.
Q. Okay.
A. It wouldn't make sense.
Q. Did you buy a property that you couldn't make -- couldn't lease gas from?
A. No.
MR. NESTOR: Objection to form.

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BY MR. YEAGER:
Q. And it's your testimony that you didn't know prior to the purchase that there were regulatory constraints on the development of the property?
MR. NESTOR: Objection to the form. Go ahead.
THE WITNESS: Correct.
BY MR. YEAGER:
Q. Did you rely on somebody to do that investigation for you?
A. Yes.
Q. Mr. Coccodrilli?
A. Mr. Coccodrilli.
Q. Did you ever have any conversations with Mr. Coccodrilli when you found out that there were regulatory restraints about why that hadn't been disclosed earlier?
MR. NESTOR: Objection to the form.
THE WITNESS: Yes. There was conversation, but it kind of moved right into the whole scenario at that point.
BY MR. YEAGER:
Q. What whole scenario?
A. Buying the property and then moving

EXHIBIT "14"

VERITEXT LEGAL SOLUTIONS

Deposition of:

Emily Greenwald , Ph.D.

March 3, 2020

In the Matter of:

Wayne Land and Mineral Group, LLCv. Delaware River Basin Commission et al

Veritext Legal Solutions

Do you see that?
A. Yes.
Q. What is a watershed project?
A. I don't have a specific example. I don't know.
Q. Then you have a table of the purposes of projects, right?
A. Yes.
Q. And looking at the second box down, among the purposes of projects are stream quality control and abatement of pollution, correct?
A. Yes.
Q. And going to page 13, the Commission is authorized to construct, operate and maintain projects and facilities to control potential pollution and abate or dilute existing pollution, is that true?
A. Are you looking at a specific item on this table?
Q. Yes, I'm on the very first item on page 13, associated with section 5.1.
A. Okay. Let's go back to your question.
Q. The Commission is authorized to construct, operate and maintain projects and facilities to control potential pollution and

abate or dilute existing pollution of the water resources of the basin, correct?

A. Yes.

Q. What are the types of projects to control potential pollution?

A. I didn't make a study of this, but one of them would be construction of a waste water treatment facility.

That's -- since it also says dilution, I would imagine dam and reservoir also that allows control of water flow would be part of that.

Q. We'll all agree that waste water treatment facility is not a dam or a reservoir, correct?

A. Correct.

Q. And a waste water treatment facility is also not a hydro power facility, right?

A. Correct.

Q. And a waste water treatment facility is not the type of facility that was constructed by the Army Corp of Engineers, correct?

A. I don't -- I don't know if the Corp constructed waste water treatment plants.

Q. Have you seen any document which shows that the Corp did construct waste water treatment plants?

A. No.

Q. In the third item down, associated with Section 7.1, there are -- there is a reference to projects and facilities to retard runoff and water flow and prevent soil erosion.

Can you give me some examples of those types of projects and facilities?

A. I did not examine this. I can only bring common sense to it. But I don't have an example for you.

Q. You just don't know what it means, is that what you're saying?

MR. NESTOR: Objection to form. That's not what she said, Counsel.

THE DEPONENT: I understand what this says here, but I'm not -- I'm not coming up with an example of a project or facility to retard runoff.

BY MR. WARREN:

Q. Would a berm retard runoff?

A. I don't know. I'm not an expert in this area. I don't know.

Q. But you don't think this means dams and reservoirs only, do you?

A. No.
Q. Okay. Moving down to the next box, you reference facilities and projects to encourage soil conservation, prevent and control erosion and to promote land reclamation and sound forestry practices.
Do you see that?
A. Yes.
Q. Can you give me an example of a project or facility that would fit this category?
A. No.
Q. Would you agree with me that it's not only dams and reservoirs?
A. Yes.
Q. Moving to the next box, associated with Section 7.3 of the Compact, it talks about projects and facilities for the maintenance and improvement of fish and wildlife habitats related to the water resources of the basin.
Can you give me some examples of those projects and facilities?
A. I don't know specifically what might have been intended here, but I know that there are fish passages and fish ladders used to help maintain fish -- fish habitat, fish health.

So that could be an example.

Q. Can you think of an example of a project and facility for the maintenance and improvement of wildlife habitat?

A. Not offhand, no.

Q. Would you agree with me that those facilities and projects are not dams and reservoirs?

A. I would say that dams and reservoirs could create some kinds of habitat, but they don't generally maintain existing habitat. They generally interfere with it.

Q. So this is referring to something other than dams and reservoirs, correct?

A. Most likely.

Q. And the next paragraph, Section 13.1, talks about a Comprehensive Plan shall include all public and private projects and facilities and it goes on from there.

Could those private projects and facilities include the projects and facilities in the categories we've previously discussed?

A. Yes.

Q. And so those projects and facilities referenced in Section 13.1 are not only dams and

reservoirs, correct?
A. Correct.
Q. And they're not only dams and reservoirs and hydro electric facilities, correct?
A. Correct.
Q. And there's a reference to the water resources program in Section 13.2.
Do you see that?
A. Yes.
Q. And it's referring to all public and private projects to be anticipated, right?
A. That those were to be included in the water resources program.
Q. Correct.
And those public and private projects could include any of the projects that we've talked about in the previous categories, correct?
A. Yes.
Q. So they're not restricted to dams, reservoirs and hydro electric facilities, correct?
A. Correct.
Q. Now, I think we've talked about the definition of facilities as we're getting to the next paragraph.
So I don't think we need to do that