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September 12, 2016

Via eFiling on www.ferc.gov (FERC Docket No. CP15-558-000)

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

RE: PennEast Pipeline Company, LLC, Proposed PennEast Pipeline Project
FERC/EIS-0271D
Docket No. CP15-558-000

Dear Ms. Bose:

On behalf of Citizens for Pennsylvania's Future (PennFuture) and the Sierra Club and its New Jersey and Pennsylvania Chapters, we write to offer comments on the Federal Energy Regulatory Commission's (FERC's or the Commission's) draft Environmental Impact Statement (DEIS) regarding PennEast Pipeline Company's (PennEast's) proposed PennEast pipeline project (the Project).

PennFuture is an environmental public interest organization, whose activities include advocating and advancing legislative action on a state and federal level; providing education for the public; and assisting citizens in public advocacy. PennFuture is concerned with the use of Pennsylvania's lands and the conservation of its resources for future generations. PennFuture has intervened in the FERC docket referenced above.

Sierra Club is a national nonprofit organization with 67 chapters and over 635,000 members dedicated to exploring, enjoying, and protecting the wild places of the earth; to practicing and promoting the responsible use of the earth's ecosystems and resources; to educating and enlisting humanity to protect and restore the quality of the natural and human environment; and to using all lawful means to carry out those objectives. Sierra Club has approximately 25,000 members in Pennsylvania and approximately 17,400 members in New Jersey, including members who live, work, and recreate in the vicinity of the Project. Sierra Club, through its New Jersey and Pennsylvania Chapters, has intervened in the FERC docket referenced above.

The National Environmental Policy Act (NEPA) is one of the earliest federal environmental protection statues. It requires that "an agency must – to the fullest extent possible under its statutory obligations – consider alternatives to its actions which would reduce environmental damage." *Calvert*

*Cliffs Coordinating Committee v. U.S. Atomic Energy Commission*, 449 F.2d 1109 (D.C. Cir. 1971). As part of its obligations under NEPA, a federal agency must provide a detailed statement of environmental impacts for any major federal action significantly affecting the quality of the environment. 42 U.S.C. § 4332(C). When completing an environmental impact statement, FERC must adequately consider and disclose the environmental impacts of its proposed action – in this case granting a Certificate of Public Convenience and Necessity for the Project – and not act in a manner that is arbitrary and capricious. *Baltimore Gas & Elec. Co. v. Natural Resources Defense Council, Inc.*, 462 U.S. 87, 97-98 (1983).

PennFuture and Sierra Club appreciate the Commission's efforts to document and analyze the many adverse environmental impacts that would result from the Project. For the reasons discussed below, however, we disagree with FERC's proposed conclusion that the Project's impacts would be "less than significant." FERC's analysis of interior forest impacts, alternatives, climate, and threatened and endangered species, among other things, are deficient. A more careful analysis of these impacts would reveal that the overall impact of the Project is, in fact, significant. In some cases, FERC's analysis directly demonstrates that the impacts of the Project are significant; in others, FERC's analysis omits important information that, if included, would make apparent the significance of the Project's impacts. We ask that the Commission re-evaluate its conclusion and incorporate the comments below into the final environmental impact statement.

**1. The direct, indirect, and cumulative impacts to interior forests should be quantified so that their significance can be properly evaluated.**

Interior forest areas are critical habitat for many species. *See* DEIS at 4-78. Many species are dependent on interior forest for their habitat. Pennsylvania Department of Conservation and Natural Resources, "Forest Wildlife Trends" (March 7, 2007) at 1, *available at* http://www.nrc.gov/docs/ML0707/ML070730105.pdf (last accessed: June 27, 2016). Some of those species have experienced significant population declines (on the order of 3% per year) in Pennsylvania in recent years, possibly due to loss of interior forest habitat. *Id.* at 2.

The DEIS acknowledges the fact that the Project will impact interior forest (see, e.g., DEIS at 4-78), but it does not quantify the number of acres of interior forest that would be disturbed and provides no context for decision-makers or the public to evaluate the scope of those impacts. It also fails to consider the indirect impacts of the Project, such as methane emissions and disturbance for drilling natural gas wells, resulting from increased production of natural gas induced by the pipeline capacity the Project would provide.

a. Direct Impacts to Interior Forest Habitat

The DEIS notes that the Project will result in the permanent loss of 451.5 acres during operation and the temporary loss of 632.8 acres of forests/woodlands during construction. DEIS at 4-121 to 4-122 (Table 4.7.1-1). The DEIS further acknowledges that the impacts on forest habitat may go beyond the area actually cleared because of fragmentation and edge effects. DEIS at 4-78. The DEIS does not, however, contain an estimate of the amount of interior forest that would be lost (through a combination of direct loss resulting from clearing of interior forest and indirect loss resulting from

conversion of interior forest to edge forest as a result of nearby clearing). This information is important, because as discussed above, interior forest habitat is critical to many types of wildlife. Further, the loss of interior forest can often dwarf the total amount of forest acres cleared.

For example, in the DEIS for the Atlantic Sunrise pipeline project also being considered by FERC (Docket No. CP15-138-000), FERC estimated that 270.4 acres of interior forest area would be directly impacted during construction, and 118.9 of those acres would remain permanently affected during operations. Atlantic Sunrise Pipeline Project DEIS ("Atlantic Sunrise DEIS"), FERC Docket No. CP15-138-000, at ES-6, *available at* http://elibrary.ferc.gov/idmws/common/OpenNat.asp?fileID=14240175. Because a clearing of land adjacent to interior forest would bring additional light, wind, humidity, and predation to the adjacent areas of the forest, FERC estimated that a full 1,993.8 acres of interior forest would be indirectly affected – primarily by being converted to forest edge habitat. Atlantic Sunrise DEIS at 4-81. The ratio between expected interior forest lost to estimated permanent forest cleared in that case was over 16:1. In its comments discussing the "insufficient information" provided in the DEIS in that case, the Environmental Protection Agency (EPA) expressed concerns that even this estimate may have been too low. Letter from Jeffrey D. Lapp, EPA, to Nathaniel J. Davis, FERC, re: Atlantic Sunrise Draft EIS (June 27, 2016) Enclosure 1 at 4-5 (attached hereto as Exhibit A).

Although the DEIS notes that PennEast attempted to minimize disturbance of interior forest by, among other things, co-locating the Project in existing rights-of-way (an effort that PennFuture and Sierra Club generally support, if the pipeline must be built at all), it is impossible for the public or the decision-maker to evaluate the true effects on interior forests because those impacts were not quantified in the DEIS.

As the DEIS acknowledges, interior forest is important habitat for many species. Before determining that the Project will have "less than significant" environmental impacts, FERC should quantify the acreage of interior forest that will be lost and report it to the public in the DEIS. Without that information, no assessment of the significance of the Project's environmental impact can be properly made.

The potential significance of the loss of interior forests becomes even more stark when considered in the context of the many other existing and projected projects – pipelines and otherwise – that reduce the amount of interior forest. We address those indirect and cumulative impacts immediately below.

b. Indirect Effects to Interior Forest Habitat

Among the factors that a federal agency must consider when preparing an environmental impact statement are "indirect impacts." 40 C.F.R. § 1502.16(b). Indirect impacts are "caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems." 40 C.F.R. § 1508.8. When evaluating causation of indirect impacts, courts have looked for a reasonably close causal relationship between the federal action and the

indirect effect; this relationship has been analogized to the doctrine of proximate cause in tort law. *Department of Transp. v. Public Citizen*, 541 U.S. 752, 767 (2004). FERC fails to satisfy this requirement, because it does not account for the indirect effects of natural gas drilling projects that would be made feasible by the Project.

FERC recognizes that, "Construction of the [Project] would potentially increase demand for natural gas, which could increase Marcellus Shale natural gas extraction and therefore increase the negative environmental impacts associated with such development." DEIS at 4-274. FERC declined to analyze the impacts of such induced Marcellus Shale development, because, remarkably, the Commission determined that these impacts were neither "reasonably foreseeable" nor an "effect of the Project." DEIS at 1-18. FERC tries to justify this conclusion by asserting that it is the production of natural gas that is driving the need for pipelines, not pipelines causing the production of natural gas. *Id.* FERC proceeds to argue that it is impossible to foresee how much natural gas delivered by PennEast will come from current/existing production and how much would result from new production attributable to the Project. *Id.* It argues that the Project does not depend on additional shale gas production. *Id.*

FERC's arguments are specious and belied by both common sense and facts presented elsewhere in the DEIS. In describing the purpose and need for the project, FERC explains that PennEast has executed contracts with shippers to deliver "new" natural gas to markets, undermining its argument that much of the natural gas transported by the Project will come from existing production. DEIS at 1-3. FERC also recognizes that the Project could increase Marcellus Shale natural gas extraction. DEIS at 4-274. Regardless of how one resolves the chicken-and-egg argument over whether pipeline capacity drives more drilling or vice versa, it is difficult to deny that drilling and pipeline capacity are almost sure to increase together. As such, an increase in pipeline capacity will cause an increase in production as a result of the increased ability to transport the product to market. As Pennsylvania's Pipeline Infrastructure Task Force recognized, one of the primary factors limiting the natural gas industry in Pennsylvania has been capacity to transport the gas to market. Pennsylvania Department of Environmental Protection, Governor's Pipeline Infrastructure Task Force Report (February 2016) at 20 of PDF, *available at* http://files.dep.state.pa.us/ProgramIntegration/PITF/PITF%20Report%20Final.pdf (last accessed: September 12, 2016) ("Almost a third of the wells that have been drilled in Pennsylvania since 2004 are shut in because the pipelines to move that gas from the well to end users have not caught up with the pace of drilling. So, the primary challenge the industry faces now is to get the gas around or out of Pennsylvania to connect it to customers."). Put another way, because transportation capacity is creating a bottleneck in the natural gas production market, natural gas production will undoubtedly increase to fill the expanded transportation capacity once that transportation bottleneck is removed. It is extremely likely that a significant portion of that natural gas will come from new drilling.

Even if one assumes, however, that all natural gas to be transported through the PennEast pipeline will come from existing wells, and no new drilling will occur as a result of the Project, there are still environmental impacts that must be considered. Studies have shown that there are significant methane emissions (about 47% of all methane emissions from the natural gas industry) during the processing and transmission and storage phases of natural gas development. Garvin Heath, et al., Estimating U.S. Methane Emissions from the Natural Gas Supply Chain: Approaches, Uncertainties,

Current Estimates, and Future Studies, Joint Institute for Strategic Energy Analysis, Technical Report NREL/TP-6A50-62820, at vi (August 2015), *available at* http://www.nrel.gov/docs/fy16osti/62820.pdf (last accessed: September 12, 2016). Even if drilling impacts are excluded, these methane emissions that occur from the time the natural gas is removed from the ground until it arrives at the PennEast pipeline will still occur, and they should be included in the DEIS.

The environmental impacts from an increase in natural gas production in the Marcellus Shale region as a result of the Project are eminently foreseeable, and these impacts are exactly the type of impacts "caused by the action and are later in time or farther removed in distance" contemplated by the regulatory definition of indirect impact. *See* 40 C.F.R. § 1508.8. These impacts will affect forest fragmentation in northern and western Pennsylvania where Marcellus Shale drilling is prevalent. Importantly, there is no intervening federal approval (e.g., for export of natural gas) needed before the transportation and use of the natural gas transported by the pipeline will occur. Thus, the approval of a Certificate of Public Convenience and Necessity is a proximate cause of these impacts. Even though they are "farther removed in distance" from other project impacts, FERC must account for these indirect impacts in its final EIS.

c. Cumulative Impacts to Interior Forest Habitat

Evaluating cumulative impacts is one of the most challenging aspects of conducting an analysis of environmental impacts; it is also the most important. Nearly two decades ago, the Council on Environmental Quality cautioned that, "Evidence is increasing that the most devastating environmental effects may result not from the direct effects of a particular action, but from the combination of individually minor effects of multiple actions over time." Council on Environmental Quality, *Considering Cumulative Effects under the National Environmental Policy Act* (January 1997), p. 1, *available at* http://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-ConsidCumulEffects.pdf (last accessed: September 12, 2016).

Cumulative impacts are defined by regulation as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." 40 C.F.R. § 1508.7. "Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." *Id.* Essentially, the cumulative impacts analysis focuses on the resources affected rather than the specific effects of a particular project, and is designed to help decision-makers assess the ability of the impacted resources and environmental systems to continue to function properly once all development is taken into account. "A 'meaningful cumulative impact analysis must identify' five things: '(1) the area in which the effects of the proposed project will be felt; (2) the impacts that are expected in that area from the proposed project; (3) other actions - past, present, and proposed, and reasonably foreseeable - that have had or are expected to have impacts in the same area; (4) the impacts or expected impacts from these other actions; and (5) the overall impact that can be expected if the individual impacts are allowed to accumulate.'" *Tomac v. Norton*, 433 F.3d 852, 864 (D.C. Cir. 2006), *quoting Grand Canyon Trust v. FAA*, 290 F.3d 339, 345 (D.C. Cir. 2002).

FERC discussed a number of other projects in the vicinity of the Project area that could be expected to contribute to cumulative impacts to forest habitat, and recognized that these projects could collectively create edge effects that could "reduce habitat available to species that prefer deep forests" and result in the spread of invasive species in the Project area. DEIS at 4-280. FERC ultimately concluded that although, "some long-term cumulative impacts would occur on wetland and forested and upland vegetation and associated wildlife habitats," as a result of PennEast's mitigation efforts, "minimal cumulative effects are anticipated when the impacts of the PennEast Pipeline Project are added to those of the other identified projects in the immediate area." DEIS at 4-287. As discussed in more detail below, however, FERC's analysis is deficient because it does not fully account for all interior forest loss in the Project area and because it does not provide any perspective on the scope of the anticipated interior forest loss.

*i. FERC's Failure to Quantify Cumulative Interior Forest Impacts*

As discussed above, interior forest areas are critical habitat for many species that are not adapted to living in other ecosystems, such as forest edge. *See* DEIS at 4-78. The DEIS notes the significant impacts anticipated from several other projects in the general vicinity of the Project. Collectively, these projects would impact large areas of land, but it is unclear from the information in the DEIS for most of these projects just how many of these acres are currently forested. *See generally* DEIS Table 4.12-1. Without information about the quantity of <u>forested acres lost generally</u>, it is impossible to quantify the cumulative impacts on <u>interior</u> forest or to place those impacts in context.

It is not surprising then that FERC did not attempt to determine how many acres of <u>interior</u> forest would be lost due to other projects in the area. Given the data for the Atlantic Sunrise project discussed above, it is reasonable to expect that a substantial portion of the forest loss resulting from these additional projects will be interior forest. Likewise, for each of the additional projects, the amount of interior forest lost indirectly due to proximity to cleared areas can be expected to be significant, and likely even to exceed the interior forest lost to direct impacts from the projects. Given the importance of interior forest as habitat for many species, these numbers should have been quantified for all relevant projects to evaluate the cumulative impact expected on interior forests in the region.

Further, the DEIS does not contain information about the total area of <u>existing</u> forest in the Project area so that the relative impact of the projects considered can be properly evaluated in context. Although this comparison would be helpful for all types of forest, it is especially important for interior forest, which is in shorter supply and much more vulnerable to loss due to indirect effects of forest clearing in the vicinity. The Commission should calculate the amount of forest and interior forest in the area of the projects enumerated in Table 4.12-1 and report that alongside the cumulative area of forest lost to those projects. This quantification would provide the decision-maker and the public with necessary context to evaluate the impact of deforestation anticipated from the cumulative actions of these projects.

Even quantifying the impacts of the projects listed in Table 4.12-1 alone, however, would not be adequate. As discussed below, FERC also must expand the scope of its review for the cumulative impacts on interior forests.

*ii. Inadequate Scope of FERC's Review*

With respect to consideration of interior forest loss, FERC's analysis fails to account for relevant projects because it artificially limits its analysis to projects that would be under construction at the same time as the Project.

As discussed above, cumulative impacts are defined by regulation as "the impact on the environment which results from the incremental impact of the action when added to ***other past***, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." 40 C.F.R. § 1508.7 (emphasis added). FERC states that it limited its cumulative impacts analysis to actions that "cause an impact within all, or part of, the time span for the potential impact from the proposed Project." DEIS at 4-265. It construed that criterion to limit its cumulative impacts analysis to projects "that have been recently constructed, are being constructed presently, or are planned or proposed near the PennEast Pipeline Project facilities." *Id.* Although such a limitation to projects with construction activities temporally proximate to the Project may be reasonable for certain environmental impacts (such as construction noise) that are primarily a by-product of construction activities, this limitation is unreasonable for effects (such as deforestation) which remain permanently, long after construction is complete. FERC's limited interpretation clearly omits from consideration "other past" projects that continue to impact the environment today. Consideration of these projects is explicitly required by CEQ regulation. *See* 40 C.F.R. § 1508.7.

FERC should revise its cumulative impacts analysis to account for all impacts to interior forest habitat from past projects in the area of the Project. The Environmental Protection Agency (EPA) has recommended a baseline timeframe of 30 or 50 years in the past. Letter from Jeffrey D. Lapp, EPA, to Nathaniel J. Davis, FERC, re: Atlantic Sunrise Draft EIS (June 27, 2016) Enclosure 1 at 7 (attached hereto as Exhibit A).

*iii. Additional Data*

There are data available that can help FERC to adequately accumulate and quantify information about interior forest habitat impacts from all direct, indirect, and cumulative impacts of the Project.

In a study commissioned by the Clean Air Council, CNA Analysis and Solutions analyzed the cumulative impacts of the land cover impacts resulting from transmission pipelines in the Delaware River Watershed. This study contains information about the cumulative impacts to forests, wetlands, streams, etc., resulting from transmission line projects in the watershed (including several that were not considered in FERC's cumulative impacts analysis). Lars Hanson and Steven Habicht, "Cumulative Land Cover Impacts of Proposed Transmission Pipelines in the Delaware River Basin" (May 2016), *available at* https://www.cna.org/CNA_files/PDF/IRM-2016-U-013158.pdf (last accessed: September 12, 2016). This report is attached to this letter as Exhibit B.

The Nature Conservancy has done a study about the environmental impacts that are likely to result from Marcellus Shale development in northern and western Pennsylvania. The Nature Conservancy projects that 300,000 acres of Pennsylvania land – a full 1% of all land area in Pennsylvania – will be disturbed for the installation of natural gas gathering lines by 2030. The Nature Conservancy Pennsylvania Chapter, "Natural Gas Pipelines" (December 16, 2011) at 8, *available at* http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/pennsylvania/ng-pipelines.pdf (last accessed: September 12, 2016). This report is attached to this letter as Exhibit C. Many of the gathering lines can be expected to be installed in rural portions of northern and western Pennsylvania that remain relatively undeveloped. Those same regions currently contain most of Pennsylvania's interior forest area, so it is likely that there will be a significant loss of interior forest as a result of these activities. This loss will have a cumulative impact with the impacts of the Project.

*iv. Collective Environmental Impact Statement*

Another, perhaps more efficient, means of evaluating the cumulative impacts of all past, present, and reasonably foreseeable FERC-regulated pipeline projects would be to conduct a collective EIS that evaluates the combined impacts of all FERC-regulated pipelines on the environment.[1] The advantage of such an analysis is that it would provide a more robust and comprehensive view of the environmental impact of the industry as a whole. It would allow FERC to put into context the full scope of the environmental impact caused by this industry. For example, it would allow FERC to compare the total supply and demand being reported by industry. It would also allow FERC to evaluate the amount of fossil fuels that industry is seeking to bring to market and evaluate how that quantity impacts the government's climate change goals. It would also provide a more comprehensive look at the deforestation impacts resulting from fossil fuel transportation. FERC could then use that information to more holistically evaluate the environmental impacts resulting from pipeline construction.

**2. FERC's alternatives analysis is deficient, because it does not provide adequate consideration to the required "no action" alternative.**

An essential part of its NEPA analysis is consideration of alternatives. Courts have described the alternatives analysis as the "linchpin" of the NEPA documents. *Dubois v. United States Dep't of Agric.*, 102 F.3d 1273, 1286 (1st Cir. 1996). As part of this essential analysis, FERC is required to consider a "no action" alternative as part of its alternatives analysis under NEPA. 40 C.F.R. § 1502.14(d). For situations such as this where approval of a new project is being considered, the no action alternative simply means that no project would be undertaken. In evaluating the no action alternative, FERC used circular logic of a type that has been rejected by a United States Courts of Appeals. FERC must revise its no action alternative analysis in its final EIS.

The purpose of a no action alternative is to provide the decision-maker with information about the effects of not approving the action under consideration. In an action reviewing the adequacy of an

[1] Although this collective EIS may be able to be incorporated by reference into the cumulative impacts sections of EIS's for individual projects, it would not obviate the need for individual cumulative impacts analyses that would account for other projects in addition to the FERC-regulated pipelines considered in the collective EIS.

environmental impact statement drafted pursuant to the regulations of the Department of the Interior, the Ninth Circuit held that the no action alternative should not assume "the existence of the very plan being proposed." *Friends of Yosemite Valley v. Kempthorne*, 520 F.3d 1024, 1038 (9th Cir. 2008) (internal quotes omitted). In that case, the National Park Service drafted a supplemental environmental impact statement to assess the environmental impacts of its second draft of a Comprehensive Management Plan for protecting the values of the Merced River, after a previous plan had been held invalid in previous court proceedings. *Id.* at 1030-31. In analyzing the "no action" alternative for its subsequent plan, the agency considered what would happen if it implemented the previous version of its plan, instead of approving the modified version. *Id.* at 1037-38. The Court held that the agency's no action alternative analysis was improper because it assumed as its baseline the implementation of a version of the very plan that was under consideration. *Id.* at 1038.

Here, in evaluating the no action alternative, FERC rejects as irrelevant suggestions about renewable energy sources that would "eliminate the need for the Project." DEIS at 3-3. FERC reasons that, "because the purpose of the Project is to transport natural gas, and the generation of electricity from renewable energy sources or the gains realized from increased energy efficiency and conservation are not transportation alternatives, they are not considered or evaluated further in this analysis." *Id.* But, as recognized in *Friends of Yosemite Valley*, the very purpose of evaluating the no action alternative is to consider what would happen if the Project were not approved. Thus, alternatives (even non-transportation alternatives) that would "eliminate the need for the project" are not only relevant, they are essential to the proper consideration of the no action alternative.

By asserting otherwise and limiting its review to "transportation alternatives," FERC is making the same error in logic that the Ninth Circuit rejected in *Friends of Yosemite Valley*. Like the National Park Service did in that case, FERC is assuming as a baseline the implementation of the federal action being considered – in this case, approval of the infrastructure to transport additional quantities of natural gas. FERC's narrow consideration of the purpose of the Project being "to transport natural gas" renders the no action alternative a nullity – especially in light of the fact that it is the very transportation of natural gas that so many citizens and intervenors find concerning about the Project. Alternative sources of energy that would replace the need for natural gas are vital to a proper evaluation of what would happen in the event that the Project were not approved, and FERC's blithe unwillingness to consider these alternatives[2] renders its analysis of the no action alternative deficient.

**3. FERC does not adequately account for the effect on climate change from the Project.**

It is indisputable that climate change is one of the most significant challenges facing not just the environment, but all of society. Because of the global scale of both the contribution to and effects of climate change, evaluating the contribution of one particular project to climate change can be challenging. Recognizing that, the Council on Environmental Quality has published a guidance document

[2] As discussed below, in Section 3(b), FERC's revised consideration of the no action alternative should include, among other things, an analysis of the amounts of greenhouse gases that would be expected to be emitted under the no action alternative, including an alternative where the energy otherwise generated from natural gas transported by the Project would instead be derived from renewable energy sources.

outlining guidance for how federal agencies should account for climate change in environmental analyses performed under NEPA. Christina Goldfuss, Council on Environmental Quality, "Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews," (August 1, 2016) (CEQ Guidance), *available at* http://energy.gov/sites/prod/files/2016/08/f33/nepa_final_ghg_guidance.pdf.

As the Commission notes in the DEIS, the social, public health, and environmental consequences of climate change are severe, and in many cases, they have already started to occur. DEIS at 4-284 and 4-286. FERC's attempt analyze the impacts of this project on climate change fails to satisfy the requirements of NEPA and the CEQ Guidance in two primary ways. First, it fails to fully account for the reasonably foreseeable indirect effects of this Project by failing to incorporate the effects of the development and production of natural gas that will be transported through the pipeline. Second, it fails to provide proper perspective for the significant greenhouse gas (GHG) emissions it does account for.

a. Indirect Effects

In evaluating cumulative impacts, FERC fails to adequately account for all indirect effects of the Project. FERC calculates that, in addition to the GHG emissions released during construction of the pipeline, the Project would contribute almost 23,800,000 tons carbon dioxide equivalent ($CO_2e$) per year of GHG emissions (including 23,500,000 tons $CO_2e$ per year from end-use of natural gas transported and an additional 274,057 tons $CO_2e$ per year from the operation of the pipeline). DEIS at 4-285. EPA has requested that FERC consider the GHG emissions from the development and production of natural gas to be transported through a proposed pipeline. DEIS at 4-285. Despite this recommendation from the sister federal agency charged with environmental protection, FERC acknowledges that it does not attempt to do so. DEIS at 4-285. FERC recognizes that it is reasonably foreseeable that its approval of construction of the PennEast pipeline will lead to development and production of natural gas, but it claims that "actual scope and extent of potential GHG emissions from upstream natural gas production" are not reasonably foreseeable. *Id.* Thus, by FERC's own admission, even the estimate of almost 23,800,000 tons $CO_2e$ per year does not fully account for the GHG emissions from all reasonably foreseeable activity that would result from the construction of the PennEast pipeline. As discussed above, indirect impacts of the Project must be considered in the Commission's EIS, and FERC's failure to consider these emissions renders the DEIS deficient.

Although there is uncertainty inherent in any analysis of reasonably foreseeable future events, FERC must attempt to make a reasoned determination of how those events will impact climate change. At a minimum, FERC should make clear in its assessment that its estimates for GHG emissions are necessarily low because they do not account for the GHG emissions from the natural gas development and production that will necessarily be caused to generate the natural gas that will be transmitted through the newly constructed pipeline.

b. Insufficient Quantification of GHG emissions in Alternatives Analysis

The CEQ Guidance emphasizes the importance of the alternatives analysis to the NEPA process. CEQ Guidance at 14. CEQ recognizes that that alternatives analysis process should include a comparison of the GHG emissions likely to result from each alternative, including the "no action" alternative. CEQ Guidance at 15 ("When conducting the analysis, an agency should compare the anticipated levels of GHG emissions from each alternative – including the no-action alternative – and mitigation actions to provide information to the public and enable the decision maker to make an informed choice.") FERC does not even discuss (and certainly does not attempt to quantify) the GHG emissions expected to result from any of the alternatives it considered. *See* DEIS 3-1 to 3-28. Although FERC should correct this oversight with respect to each of the alternatives, its omission is particularly critical for the "no action alternative."[3]

FERC dismissed the "no action alternative" in part because "construction of new pipelines or other energy infrastructure [needed to compensate for the loss of energy that the Project would provide] would result in environmental impacts that could be equal to or greater than those of the Project." DEIS at 3-3. The DEIS fails to in any way substantiate how it determined that the net environmental impact of creating infrastructure for renewable energy projects could result in impacts equal to or greater than those of constructing a new natural gas pipeline. Although it is true that construction of necessary wind turbines and/or solar panels and related infrastructure would have some environmental impacts, once in operation, those technologies can be expected to have minimal GHG emissions. Contrasting those minimal emissions to the nearly 24,000,000 tons $CO_2e$ per year expected from the combustion of natural gas from the PennEast pipeline, it is difficult to fathom how renewable energy projects would "result in environmental impacts that could be equal to or greater than those of the Project."

At the very least, FERC should revise its alternatives analysis to provide a quantification of the GHG emissions expected from the "no action alternative." Specifically, FERC should compare the GHG emissions expected to result from the Project (nearly 24,000,000 tons $CO_2e$ per year) with the anticipated emissions that would result from generating the same amount of energy using renewable resources. As suggested by the CEQ Guidance, this would provide the decision-maker and the public with very important information they can use to evaluate the Project. Once it has done that, FERC should revisit its conclusion that impacts from the no action alternative could be equal to or greater than those from the Project in light of those data.

c. Frame of Reference for Emissions

The CEQ Guidance calls for federal agencies to provide a "frame of reference" for GHG emissions anticipated to result from a project. CEQ Guidance at 28-29. The CEQ Guidance specifically suggests that, "[a]gencies should discuss relevant approved federal, regional, state, tribal, or local plans, policies, or laws for GHG emission reductions or climate adaptation to make clear whether a proposed

[3] This letter discusses other shortcomings with respect to FERC's evaluation of the "no action alternative" in Section 2.

project's GHG emissions are consistent with such plans or laws." *Id.* The DEIS does not provide a discussion of relevant GHG emission goals to provide the necessary context for the decision-maker to evaluate the harm anticipated from approving this Project.

By simply reporting the quantity of GHG emissions expected to result from this Project (*see* DEIS at 4-285), FERC does not provide information necessary to determine how that quantity of emissions would affect existing efforts to reduce carbon emissions. The global community set ambitious but critically important goals in the Paris Climate Agreement, recently signed by the United States and nearly 200 other countries. That accord sets a goal of limiting global warming to 1.5 to 2 degrees Celsius. Achieving that goal would require significant reductions in GHG emissions from current levels. Thus, the relevant question for assessing the significance of the impacts from this Project is how the cumulative GHG emissions will affect the attainment of the necessary emission reductions.

In this case, when we consider the globally recognized need to reduce GHG emissions, it becomes clear that a project that, on its own without properly accounting for the indirect and cumulative emissions, would increase GHG emissions by nearly 24,000,000 tons $CO_2e$ per year over its lifetime will have a significant adverse impact on climate goals. Estimating a 50-year useful lifespan,[4] that would result in the release of nearly 1.2 billion tons of $CO_2e$ over its lifetime. This is, simply put, an enormous hindrance to global efforts to reduce carbon pollution.

This impact becomes more apparent when we consider the long-term impacts of the Project and put it into context with other projects, as FERC must do as part of a proper cumulative impacts analysis. The pipeline constructed as part of this Project can be expected to remain in service – transporting fossil fuels that will be burned, generating GHGs – for many decades to come. The same is true for many of the other pipeline and natural gas infrastructure projects listed in Table 4.12-1 (and many more similar projects happening around the globe). This Project and others like it will create additional infrastructure that will lock us in to the use of fossil fuels for many years, thus creating an additional obstacle to the United States' urgent efforts to convert to renewable energy sources in an effort to mitigate the effects of climate change.

The impact on climate from this Project and other past, present, and reasonably foreseeable projects is clearly significant, and FERC should consider it as such in its final EIS.

[4] Some pipeline companies assert that pipelines can have much longer lifespans, claiming that they can be operated "indefinitely" if they are properly maintained. Spectra Energy, Natural Gas FAQs, "What is the life expectancy of the pipe in the ground before it has to be replaced?", *available at* http://www.spectraenergy.com/Safety/Natural-Gas-Pipeline-FAQs/ (last accessed: September 12, 2016). A copy of this webpage is attached to this letter as Exhibit D. Of course, if the pipeline continues to be used "indefinitely," the long-term impacts will be even greater.

**4. The Project's anticipated adverse impact on threatened and endangered species belies FERC's contention that adverse impacts from the Project would be reduced to "less-than-significant" levels.**

The DEIS recognizes that the Project is likely to have adverse impacts on two endangered species and two threatened species. These impacts are significant impacts that should be acknowledged as such.

a. Northern Long-eared Bat

The northern long-eared bat was listed as a "threatened" species under the Endangered Species Act in 2015, largely as a result of the spread of white-nose syndrome, which is a deadly fungal disease that infects the skin of the muzzle, ears, and wings of hibernating bats. United States Geological Survey, "White-nose Syndrome," *available at* http://www.nwhc.usgs.gov/disease_information/white-nose_syndrome/ (last accessed: September 7, 2016). The quick spread of white-nose syndrome from its origin in New York State across the country to Washington State in less than ten years has severely impacted bat populations. "Track White Nose Syndrome through Time", *available at* https://www.sciencebase.gov/gisviewer/wns/ (last accessed: September 7, 2016). If it continues to spread as it is expected to, the disease is likely to place further strain on bat species, including the northern long-eared bat. The impact of white-nose syndrome is exacerbated by human activities, such as contamination and habitat disturbance. Thus, it is critically important to avoid placing additional stress on the declining population of northern long-eared bats.

Instead of avoiding further harm, the Project would unnecessarily add stress to bat populations. As proposed by PennEast, the Project would come within 0.25 miles of three different hibernacula. DEIS at 4-97. In total, the Project would also clear 633 acres of suitable northern long-eared bat habitat. DEIS at 4-98. The combined attempts of FERC and PennEast to minimize the Project's harms by re-routing the Project away from known hibernacula (DEIS at 4-98) fail to completely address all potential impacts to the species, as FERC recognizes in its conclusion that the Project "may affect and is likely to adversely affect ESA listed bat species."

The loss of over 600 acres of habitat area, as well as impacts to hibernacula, for a threatened species with declining population certainly appears to be significant. *See* DEIS at 4-99. The final EIS should expressly recognize it as such.

b. Bog Turtle

The bog turtle is a species listed as threatened under the federal Endangered Species Act and as endangered by the states of Pennsylvania and New Jersey. DEIS at 4-99. Its habitat includes certain wetlands with distinct types of hydrology. *Id.* PennEast is still in the process of conducting surveys to determine whether bog turtles may exist in wetlands expected to be crossed by the Project. DEIS 4-100. FERC determined that, because the Project could impact wetlands where bog turtles live or could live, the Project may have an adverse impact on the bog turtle. This adverse impact should be acknowledged as significant in the final EIS.

c. Dwarf Wedgemussel

The dwarf wedgemussel is a federal and state-listed endangered mussel that lives in the vicinity of the Delaware River and its tributaries. DEIS at 4-101. PennEast has not done surveys to determine the presence of the dwarf wedgemussel in the vicinity of the Project, and Project activities could adversely impact the species, either directly or indirectly. DEIS at 4-101. These impacts should be deemed significant in the final draft of the EIS.

d. Northeastern Bulrush

The northeastern bulrush is a member of the sedge family of plants that is listed as an endangered species by the federal government and the state of Pennsylvania. The northeastern bulrush lives in wet habitat often characterized by seasonally fluctuating water levels. DEIS at 4-102. At this time, PennEast has not surveyed all areas of the Project site to determine whether the northeastern bulrush is present. DEIS at 4-102. The Commission determined that if PennEast is unable to avoid conducting activities in or near wetlands or waterways known to be inhabited by the northern bulrush, the Project may affect local hydrology and/or composition in a manner that could harm the northeastern bulrush. DEIS at 4-103.

As a result of the harms discussed above, FERC rightly acknowledges that the Project "may affect, and is likely to adversely affect" the threatened northern long-eared bat, the threatened bog turtle, the endangered dwarf wedgemussel, and the endangered northeastern bulrush. DEIS at 4-99 to 4-103. Despite that recognition, however, FERC determined that the Project as a whole would have impacts that could be reduced to "less than significant levels" with appropriate mitigation measures. PennFuture and Sierra Club strongly disagree that any project that is expected to have an adverse impact on threatened or endangered species can be said to have impacts that are "less than significant." *See Tennessee Valley Auth. v. Hill*, 437 U.S. 153 (1978) (discussing Congress's intent in enacting the Endangered Species Act to avoid harm to endangered and threatened species from federal actions). As a result of these acknowledged impacts, we respectfully request that FERC revise its overall finding to show that the Project is expected to have significant adverse impacts on the environment.

**5. Technical reviews of the DEIS identified numerous deficiencies.**

With support from PennFuture, the New Jersey Conservation Foundation and Eastern Environmental Law Center commissioned technical reviews of the DEIS. Those reviews identified numerous technical deficiencies with the DEIS.

In their report dated September 12, 2016, Princeton Hydro, LLC, reviewed identified, among other things, the following inadequacies in the DEIS:

- FERC's conclusion that "the Project is not expected to significantly impact groundwater, surface water, or wetland quality or quantity" is not scientifically credible and not supported by evidence in the record.

- The DEIS does not adequately analyze water quality impacts of the possible alternatives to the proposed Project.
- The DEIS places too much emphasis on mitigation, as opposed to avoidance or minimization. Data in the DEIS do not demonstrate that mitigation will prevent all significant impacts resulting from the Project.
- Specific watershed assessments of individual portions of the Project's proposed pipeline route reveal an increase in suspended solids, stormwater runoff volume, and increased potential for soil erosion.

Princeton Hydro's full report and analysis are incorporated by reference into this letter and attached as Exhibit E.

Hydroquest reviewed the DEIS and identified several problems with the DEIS's handling of matters related to hydrogeology. Among other things, Hydroquest found the following deficiencies:

- PennEast's Karst Mitigation Plan is inadequate to address likely adverse impacts from karst geology along the Project's proposed route.
- The DEIS fails to adequately account for hydrologic impacts that can be expected to result from the changed drainage patterns in the disturbed areas immediately surrounding the pipeline. The nature of pipeline trenches may cause them to act as interceptor trenches that will adversely affect the hydrology of the surrounding area.
- The DEIS does not contain sufficient data to analyze the likelihood of pipeline failure at crossings of water bodies.
- Additional questions about the location and characteristics of mines in the Project area need to be addressed.

Hydroquest's full report is incorporated by reference into this letter and attached as Exhibit F.

**6. Additional Miscellaneous Comments**

PennFuture and Sierra Club raise the following additional comments for FERC's consideration:

- The purpose and need statement (Section 1.1) should be expanded to provide more information to allow the public to evaluate the need for the Project and to determine the full range of alternatives available. The purpose and need statement includes a list of shippers with which PennEast has executed precedent agreements, but it notes that the precedent agreements can be terminated "if certain conditions such as receipt of regulatory approvals, are not met." DEIS at 1-3 n.6. It does not provide more information about those contracts. The DEIS also does not contain information about where exactly these shippers will receive gas from the pipeline. The public needs this information to evaluate the depth of the need for the gas to be transported by the PennEast pipeline as well as whether there may be any redundancy with the need asserted for other proposed pipelines in the area.
- The DEIS should ensure proper consideration is given to areas that have not been field surveyed by PennEast. The DEIS reluctantly notes that there are areas of the proposed pipeline route

where "survey access has not been granted to PennEast." *See*, *e.g.*, DEIS at 4-36 and 4-65. In Pennsylvania Department of Environmental Protection documents related to PennEast's Section 401 water quality certification application reviewed by PennFuture earlier this summer, PennEast noted that, as of February 2016, it had been able to access only 78.6% of the proposed route. *See* PennEast Section 401 Water Quality Certification Application, Environmental Assessment at 1-23 (on file with the Pennsylvania Department of Environmental Protection). That leaves over 21% of the Project area without a proper field survey. Without knowing the full extent of the wetlands and waterbodies that the Project will impact, neither FERC nor the public can fully evaluate the Project's impacts or the proposed mitigation measures proposed by PennEast. FERC should ensure that these surveys are completed and made available to the public with an opportunity to comment and, further, that proper measures are in place to provide adequate protections for all sections of the proposed pipeline before issuing a certificate of Public Convenience and Necessity.

## Conclusion

In light of the significant adverse impacts to forests, wildlife, and climate that would result from the Project, PennFuture and Sierra Club respectfully request that the Commission revise its draft EIS to address the many inadequacies addressed in this letter. FERC should then make the revised draft EIS available to the public for comment. Only then can the Commission properly evaluate environmental harms as it determines whether it is appropriate to issue a Certificate of Public Convenience and Necessity for the Project.

Thank you for your time and consideration.

Sincerely,

/s/ *Michael Helbing*

Michael Helbing
Staff Attorney
Citizens for Pennsylvania's Future

/s/ *Thomas Au*

Thomas Au
Conservation Chair
Sierra Club, Pennsylvania Chapter

/s/ *Jeff Tittel*

Jeff Tittel
Chapter Director
Sierra Club, New Jersey Chapter

# EXHIBIT A

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**
**REGION III**
**1650 Arch Street**
**Philadelphia, Pennsylvania 19103-2029**

Nathaniel J. Davis, Sr., Deputy Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, DC 20426

JUN 2 7 2016

Re: Atlantic Sunrise Project Draft Environmental Impact Statement; Pennsylvania, Maryland, Virginia, North Carolina and South Carolina; May 2016 (FERC Docket No. CP15-138; CEQ# 2016-11223)

Dear Deputy Secretary Davis:

In accordance with the National Environmental Policy Act (NEPA) of 1969, Section 309 of the Clean Air Act and the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR 1500-1508), the U.S. Environmental Protection Agency (EPA) has reviewed the Draft Environmental Impact Statement (DEIS) for Transcontinental Gas Pipe Line Company, LLC's (Transco or the applicant) Atlantic Sunrise Project. The DEIS has been prepared by the Federal Energy Regulatory Commission (FERC) tasked with approving certificates for interstate natural gas pipeline facilities. Additionally, EPA is concurrently reviewing the Clean Water Act Section 404 Public Notice (PN) issued by the U.S. Army Corps of Engineers (Corps or USACE) Baltimore District, a cooperating agency on the DEIS, and will also be providing comments on the proposed project in response to the PN.

Transco proposes to construct and operate an expansion of its existing natural gas transmission system in Pennsylvania, Virginia, Maryland, North Carolina, and South Carolina. Transco's project purpose is to provide an incremental 1.7 million dekatherms per day (MMDth/d) of year-round firm transportation capacity from the Marcellus Shale production area in northern PA to Transco's existing market areas, extending to the Station 85 Pooling Point in Choctaw County, Alabama. The EIS will not determine whether the need for the Project exists, as this will be determined by the Commission later; however the purpose of NEPA is informed decision making, using relevant information and public engagement in the process, which could be compromised by deferring this analysis.

The Atlantic Sunrise project, in the alignment of Transco's preferred alternative, includes the construction and operation of 197.7 miles of pipeline to provide ability to transport 1.7 MMDth/d natural gas. Atlantic Sunrise is proposed to be collocated for 54.6 miles (28 percent) with or adjacent to existing pipelines and/or electric transmission utility rights-of-way. The

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majority of the line is new 30 inch and 42 inch natural gas pipeline. Atlantic Sunrise also proposes the construction and operation of two new compressor stations in Wyoming and Columbia Counties, PA, and modification to three existing compressor stations in Columbia and Lycoming Counties, PA and Howard County, MD. Minor modifications at existing aboveground facilities at various locations in Pennsylvania, North Carolina, South Carolina, and Virginia to allow for bi-directional flow and the installation of supplemental odorization, odor detection, and/or odor masking/deodorization equipment are also proposed.

The DEIS presented alternatives beyond the applicant's preferred alternative, including the no-action alternative, two system alternatives, three major route alternatives, other minor route modifications and variations, and aboveground facility site alternatives. FERC has recommended that several minor modifications be incorporated beyond those that were incorporated by Transco. Beyond these minor modifications, all other system and major route alternatives were dismissed. Only the applicant's preferred alternative was carried forward for detailed analysis in the DEIS. It is not clear if there are additional route modifications that could be made to the applicant's alternative which may reduce adverse environmental impacts.

The alternatives analysis presented in the DEIS seems to include reasonable alternatives which were not carried forward for detailed consideration. Based on the information provided in the study, EPA recommends two system alternatives be retained for further detailed study, including the Transco system alternative, which is collocated for 91% of its route, and the expanded PennEast alternative, which would expand the 111 mile PennEast pipeline by 80 miles and eliminate the need for the Atlantic Sunrise pipeline. EPA recommends FERC fully consider these two alternatives and include the analysis in the EIS. These two alternatives appear to have the potential to meet the project purpose and need while minimizing adverse environmental impacts. Without additional analysis of alternatives, it is not clear that the preferred alternative is the only one to meet the stated purpose and need.

EPA is concerned by the statement in the EIS that project need will not be vetted in the EIS, but outside of the NEPA process by FERC. The purpose and need is the basis for the alternatives analysis and is the foundation for the analysis under NEPA. Assessing the need and a full suite of alternatives is a critical component of the NEPA process, and a component in which the public has shown great interest as well as concern. We recommend FERC provide transparency in the decision-making process and include as much of this information within the NEPA document for full disclosure to the public and afford the public the opportunity to provide comment.

EPA is concerned about the amount of detailed information that has yet to be filed and is not evaluated in the DEIS. This includes surveys for land, rare species, historic resources, water supplies, air modeling, mitigation measures to manage and dispose of contaminated groundwater, proposed mitigation measures for source water protection areas, geotechnical feasibility studies for HDD crossing locations and mitigation measures to minimize drilling risks, and a detailed aquatic resource compensatory mitigation plan. This information is relevant and critical to evaluation of potential impacts. EPA is concerned that a fully informed decision may not be made without this information. EPA is interested in discussing with FERC when and how this information will be assessed and disclosed to the public.

EPA is concerned about direct, secondary and cumulative impacts to aquatic resources, groundwater, and water quality. Aquatic resources have the potential to be impacted by many activities, including waterbody crossings, clearing, blasting, and water withdraws for hydrostatic testing. Some of the resources within the project are high quality and sensitive resources, including Exceptional Value (EV) and trout streams. The full assessment of these simultaneously occurring impacts to resources needs to be conducted. With the potential for complex impacts to occur, such as changes in recharge patterns and flow status, additional avoidance and minimization measures may be necessary to protect the aquatic ecosystem. Additional comments on aquatic resources can be found within the enclosures to this document.

The EIS reports that a total of 50.4 acres of wetlands would be either crossed by the Project, affected by temporary extra workspaces, or located within the construction right-of-way. The Project would involve 331 waterbody crossings. EPA believes additional information on aquatic resources should be included in the EIS, including impact breakdowns and compensatory mitigation concepts, which are provided in the Corps' PN, detailed stream and wetland assessment data on the quality or functions of the systems, and detailed, or at a minimum conceptual, compensatory mitigation plans. Additionally, as part of the Section 404, CWA permit process, a detailed compensatory mitigation needs to be prepared and submitted. Without more detailed information it is uncertain if the proposed mitigation will compensate for the functions lost.

Large impacts to terrestrial resources, including forest and forest interior dwelling species (FIDS) habitat, are also of concern to EPA. Construction of the Project would disturb about 3,905.8 acres of land, including pipeline facilities, aboveground facilities, pipe yards, contractor yards, and staging areas, temporary and permanent construction access roads, and right of way. Permanent operations would require about 1,208.3 acres of the 3,905.8 acres of construction lands. The Project would cross 45 interior forests along CPL North and South and would affect 270.4 acres of interior forest habitat during construction. About 118.9 acres of the affected interior forest would be permanently eliminated due to Transco's maintenance of the right-of-way during operation of the pipeline facilities. Using the distance of 30 feet from the edges of newly created edge habitat into interior forest, the DEIS estimates that 1,993.8 acres of interior forest would be indirectly impacted. This may be an underestimation of indirect interior forest impacts, as the use of only a 30 foot buffer is not supported or documented in the EIS. Mitigation should address the loss of mature forest and FIDS, which may take decades to replace.

EPA acknowledges that the DEIS cumulative impact analysis included natural gas infrastructure, including gathering lines, FERC-jurisdictional natural gas transmission projects, and natural gas wells. Consideration of natural gas production, transmission and use could be expanded in the analysis to provide a more comprehensive understanding of impacts. It is recommended that FERC actively seek to unravel and describe the highly complicated, inter-related network of pipelines. This is important for public understanding and also a step toward identifying cumulative impacts from combinations of past, present and reasonably foreseeable infrastructure and non-infrastructure activities. Please consider our detailed comments regarding cumulative impacts presented in enclosure to this document.

EPA is concerned that the selection of the current preferred alternative may result in significant adverse environmental impacts. EPA recommends that available systems alternatives be retained for detailed study. EPA also recommends that the information not currently included in the DEIS be disseminated and appropriately evaluated with the resource agencies and public stakeholder participation prior to the issuance of any certificates by FERC. EPA is interested in discussing with FERC the most appropriate way for system alternatives and other information to be considered and included for public information and agency consideration, which may possibly be accomplished through the use of a revised DEIS.

Based on our review of the DEIS and the amount of detailed information which has not been included or completed, EPA has rated the environmental impacts associated with all of the action alternative corridors as Environmental Concerns ("EC") and the adequacy of the impact statement as "2" (Insufficient Information). This rating is due to the direct, indirect and cumulative impacts of the proposed corridors on terrestrial resources, including interior forests, aquatic resources, rare, threatened and endangered species. EPA recommends additional alternatives be explored to help further reduce impacts to resources resulting from the proposed action. Details on the basis for this rating are contained in the remainder of this letter. A description of our rating system can be found at: www.epa.gov/compliance/nepa/comments/ratings.html.

Please consider the issues, questions and comments included in this letter and enclosure. We recognize the complexity of the analysis needed and difficulty in balancing impacts to natural resources, farmland and communities for any build alternative. We would appreciate the opportunity to discuss the comments provided here, at your convenience. Thank you for allowing EPA with the opportunity to review and comment on the Atlantic Sunrise DEIS. If you have questions regarding these comments, the contact for this project is Ms. Alaina McCurdy; she can be reached at (215) 814-2741 or mccurdy.alaina@epa.gov.

Sincerely,

Jeffery D. Lapp
Associate Director
Office of Environmental Programs

Enclosure (1) Narrative Technical Comments
(2) Detailed Technical Comments

Enclosure 1 – Narrative Technical Comments
Atlantic Sunrise DEIS

Enclosure 1 includes Narrative Technical Comments on the following topics:

1) Purpose and Need
2) Alternatives
3) Geology
4) Streams and Wetlands
5) Vegetation
6) Rare, Threatened and Endangered Species
7) Land Use, Recreation and Public Lands
8) Conservation and Visual
9) Cumulative Impacts
10) Climate Change

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Detailed Technical comments on these and other topics are provided in Enclosure 2.

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## 1) Purpose and Need

EPA is concerned that the need is not part of the calculus in combination with the stated purpose to provide transport ability of 1.7 MMDth/d natural gas. The purpose alone may narrow and limit the range of available alternatives to need a prescribed need. As stated in the above letter, establishing a project need is critical to help determine alternatives that should be studied and the degree to which the proposed action or other alternatives may meet the stated purpose and need. Specific dekatherm capacities are provided, although it is unclear how these units were determined or generated. In the absence of this type of supporting documentation (markets, etc), it is unclear if the stated purpose and need is too narrow thereby limiting the available range of alternatives. We suggest that a broader purpose and need statement be developed which would allow for a broader range of alternatives to be considered in the EIS. For example alternatives which include a lesser diameter pipe, or a different capacity level could meet needs.

The EIS notes that there are precedent agreements for 1.7 MMDth/d of capacity, which are able to be terminated under certain conditions are not met, including regulatory approvals. Additional information on these agreements should be provided, and clarification provided to identify if these agreements are duplicative of other agreements entered into by the applicant for other pipeline projects in this region. Table 1.1 provides the shippers and contract quantities. Information on the receipt points and gas receivers has not been provided, which is essential to understanding the purpose and need of the proposed project.

## 2) Alternatives

EPA is concerned that there may be alternatives to the applicant's preferred alternative that may meet the project objectives which were not considered in detail in the DEIS. Some alternatives which at the screening level would have similar impact may need to be considered further for detailed study. A higher level of study would allow for complex resources and

project impacts to be fully evaluated and considered. The alternatives analysis should describe alternatives that were dismissed from further study as well as the rationale for their dismissal. Alternative locations for project beginning and end points should also be evaluated.

We believe FERC should consider in greater detail available system alternatives, including PennEast and the Transco system alternative. Based on the limited information provided, it appears that the system alternative has potential to meet the stated purpose and need/objectives of the applicant's preferred alternative and could be a reasonable alternative which should be considered in the DEIS. We encourage FERC to consider this system alternative in greater detail alongside of the proposed project in the EIS. Upon detailed evaluation it is possible that there are environmental advantages or that there are less damaging practicable alternatives to the applicant's preferred alternative.

The Transco system alternative included several of the same components as the applicant's proposal (the Unity and Chapman loops, portions of CPL North, compression at CS 517 and 520, and pipe replacement) as well as additional compression and 10 pipeline loops. The Transco system Alternative would be co-located for about 91% of its length. The total amount of compression estimated for this system alternative would be 183,000hp, which is approximately a 25% increase above the compression for the preferred alternative. It is concluded that the Transco system alternative has environmental disadvantages that outweigh the environmental advantages and is not considered to be preferable to the proposed project. It may be beneficial to note that these estimates have not included efforts to avoid and minimize adverse impacts, as was done for the preferred alternative, which could identify additional potential to reduce adverse impacts of the system alternative. Table 3.2.3-1 shows that the Transco system alternative has greater mileage and construction ROW than the preferred alternative; a more detailed analysis could reveal that the collocated project minimizes impacts. It appears that the system alternative has potential to meet the stated purpose and need/objectives of the applicant's preferred alternative. We encourage FERC to consider this system alternative in greater detail alongside of the proposed project in the EIS. Upon detailed evaluation it is possible that there are environmental advantages or that there are less damaging practicable alternatives. EPA is uncomfortable dismissing this alternative without additional information.

An expanded PennEast Project was briefly discussed in Section 3.2.2. The expanded PennEast Project would requiring 80 additional miles of pipeline to the currently proposed PennEast Project, which is 111 miles and would also connect to the Transco Pipeline. As the Atlantic Sunrise pipeline is 198 miles long, if the expanded PennEast project moved forward and Atlantic Sunrise did not, it appears that PennEast would result in approximately the same mileage as Atlantic Sunrise. It is not clear why this alternative has been dismissed as it appears to have the potential to eliminate the construction and operation of 110+ miles. Considering an expanded PennEast route may have the potential to meet the project purpose and need as well as potentially reduce adverse impacts. EPA recommends FERC consider this system alternative in further detail.

We recommend that an alternatives analysis for above-ground facilities, including all compressor stations, be conducted and included in the EIS to potentially minimize impacts to forest and FIDS habitat, aquatic resources, RTE species and air quality. Alternate locations for

compressor stations beyond those included in the proposed action should be considered and included in the EIS. Rationales for why alternative sites were dismissed from further consideration should also be included. Additional detail on the siting criteria used should also be provided. Further comments on alternatives, including system alternatives, major route alternatives and aboveground facility alternatives can be found in Enclosure 2.

### 3) Geology

Challenging geologic conditions are likely to be encountered during project construction. Steep slopes (15% or greater) or side slopes cross or comprise about 58.1 miles of the proposed route. The EIS notes that there is significant karst topography along portions of Atlantic Sunrise, with approximately 28 miles of CPL South crossing karst topography and one HDD location proposed in karst areas. Sinkholes, subsidence and caves are also noted as common. Rock removal is anticipated as 138 miles (about 70%) of PA pipeline facilities will encounter shallow bedrock. Of these, about 120 miles potentially could require blasting and could require blasting in 55 streams. Twenty-two mine pool drainages were identified close proximity to the workspace; twelve of these are within the workspace.

Blasting, in combination with steep slopes, karst topography, Abandoned Mine Land (AML) and mine pools, has the potential to result in adverse impacts that were not considered or fully evaluated in the EIS. We recommend that the EIS describe the nature, extent, frequency of potential blasting impacts water wells, springs, wetlands, nearby aboveground facilities, and adjacent pipelines and utility lines. It is unclear if there are resources of special concern that may be impacted by blasting, as it does not appear that detailed analysis was conducted. Changes to geology resulting from blasting may directly and indirectly affect wildlife and local residents, which should also be considered within the scope of the EIS. The potential effects of these geologic hazards, including AML related subsidence, landslides and flash flooding, on pipeline construction and operation should also be evaluated. We recommend that impacts, especially in high risk areas, be evaluated specific to this project. Further avoidance and minimization of impacts to effected lands might be appropriate; contingencies should be made clear in the NEPA analysis. Further comments on geology can be found in Enclosure 2.

### 4) Streams and Wetlands

Avoidance and minimization of adverse impacts to wetlands and streams have been detailed in the Section 404 public notice (PN). The DEIS did not include the same level of detail as the PN, therefore the DEIS should clearly describe the avoidance and minimization efforts are being incorporated into the project design and construction. For analysis in the EIS avoidance and minimization measures not only apply to direct impacts, such as the discharge of fill material or crossings, but also indirect impacts (e.g. potential increased downstream sedimentation), as well as by the proposed water withdrawal. Water withdrawal can affect recreational and biological uses, stream flow, and result in impacts to stream and wetland habitat. EPA recommends that FERC conduct further detailed analysis of specific streams and wetlands of concern or high sensitivity and work with the resource agencies to determine if additional avoidance and minimization efforts may be necessary to reduce impacts to these important resources.

Page 4-101 states that a detailed site-specific blasting plan will be prepared for each location requiring blasting in or near a stream. We suggest that these plans be approved by both FERC and the USACE, and if appropriate, other regulatory agencies, in advance of blasting. Site specific plans should identify special resource considerations during blasting to determine if a pre-blasting, and post blasting monitoring plan is appropriate, including the need for secondary impacts including effects to stream base flow. A map with the waterbody locations that may require blasting, including karst topography, wetlands and water withdrawal locations should be include.

At this time the entire proposed project corridor has not been surveyed. Remote sensing of wetlands was used for areas that were not surveyed in the field. It is stated that about 29% of the surface waters were identified via remote sensing. Please clarify how much of the proposed project was field surveyed. EPA recommends that these surveys be completed and verified prior to the issuance of a CWA Section 404 permit or the FERC certificate. The applicant should use an appropriate functional assessment to evaluate the impacts, both temporary and secondary, to the aquatic ecosystem. Using an appropriate assessment will ensure that functions and values are accounted for in the impact assessment and that the proposed compensation plan is adequate to offset the loss, including temporary loss, of aquatic resource functions. Without completed surveys and a functional assessment of the aquatic resources, it is unclear if sufficient wetland and stream information has been collected to support informed decision-making.

Transco is proposing off-site permittee-responsible compensatory mitigation for palustrine forested wetlands disturbed by construction and operation of the Project. The DEIS indicates an impact ratio of 2:1 is proposed for palustrine forested conversions and exceptional value palustrine forested wetlands would be mitigated at a ratio of 2.5:1. Additional conceptual mitigation information was provided in the PN which was not incorporated into the EIS. A detailed compensatory mitigation plan (CMP) has not been included as part of the EIS or the PN. EPA requests an opportunity to review and comment on the CMP. We suggest that additional detailed information included in the PN be incorporated in the EIS. It is unknown if the proposed mitigation to address the conversion and temporal loss of wetlands and aquatic resources will be adequate. Information is not provided on how the success of these proposed mitigation sites will be determined. The CMP should include appropriate success criteria as well as a monitoring plan of the converted wetlands to assure that they remain waters. FERC may wish to consider whether additional mitigation to address impacts to aquatic resources beyond the CWA Section 404 context may be appropriate.

**5) <u>Vegetation</u>**

Transco determined it would cross 45 interior forests along CPL North and South and Chapman Loop would affect 270.4 acres of interior forest habitat during construction. About 118.9 acres of the affected interior forest would be permanently eliminated and converted to forest edge habitat due to Transco's maintenance of the right-of-way during operation of the pipeline facilities. Approximately 28% of the forests impacted during construction are interior forests. Newly created edge habitats would be established by maintenance of the permanent right-of-way, and the indirect impacts could extend for 300 feet on each side (600 feet total) of

the new corridor into the remaining interior forest blocks. Transco calculated indirect impacts as a measurement of the acreage 30 feet laterally from the edges of the construction workspaces into interior forests. The Project would indirectly affect 1,993.8 acres of interior forest in this manner. It is unclear how this method of calculating indirect impacts to interior forest was determined. Although the EIS states that indirect impacts could extend 300 feet, a distance of only 30 feet was selected. EPA is concerned that the indirect impacts to interior forests may have been underestimated.

The EIS should consider any state specific vegetation/tree laws and requirements as well as any state specific definitions of interior forest. For example, interior forests that are habitat for forest interior dwelling species are protected under the Maryland Critical Area law, which defines forest tracts which are greater than 50 acres in size. Maryland defines interior forest habitat as forest greater than 300 feet from the nearest forest edge. How would using this definition compare with the method used in the EIS?

**6) <u>Rare, Threatened and Endangered Species</u>**

Several surveys were incomplete and survey reports for RTE species were not available for the DEIS, including Indiana bat and the Alleghany wood rat. However, in some cases, FERC has recommended that this information be filed prior to the end of the DEIS comment period. We further recommend that this report and all associated data be reviewed and incorporated as appropriate into the Final EIS. It is not clear what specific avoidance and minimization efforts or route and construction changes have been incorporated with regard to RTE species, including the Indiana bat and northern long-eared bat. Please update the status of consultation with US FWS, and include all correspondence relating to ESA requirements in the EIS. If any avoidance and minimization measures are committed to, please be sure to capture those in the Record of Decision. The EIS doesn't not conclude whether impacts to RTE species will be significant.

Bog turtles are present, however not all areas have been surveyed, partially due to access restrictions. It appears that some surveys would be completed in 2016. The phase 2/3 report has not been submitted for FWS/FERC review. The DEIS states that Bog turtles are not using the portion of the wetland that will be impacted by the project. What avoidance and minimization measures were taken in order to reduce the potential impact to wetland habitat being used by the bog turtle? Are any ATWS or ROW width being requested for this particular wetland? It is not clear how the conclusion that the project may affect, but not likely to adversely affect the bog turtle was reached.

EPA is concerned that as a result of the many incomplete surveys, there may not be sufficient information for FERC to make a fully informed decision as to the projects effect on RTE species. It is unclear if this information will be available prior to FERCs decision and how survey information once available will be reviewed and incorporated into the decision-making process. Information on the potential impact to RTE species, including the Indiana bat, northern long-eared bat, bog turtle and Alleghany wood rat, should be available to the public, other stakeholders and regulatory agencies for consideration and comment during the NEPA process. This information should be considered, in consultation with FWS and other agencies, and factored into any decisions made by FERC on this project.

## 7) Land use, Recreation and Public lands

The Project would cross a total of 4.0 miles of state game land (SGL) and forest, and would temporarily affect 80.9 acres of SGL and forestland. In four of the five areas, the pipeline route would follow three existing pipelines and one existing electric transmission line rights-of-way; the new permanent right-of-way would abut the existing rights-of-way in these areas. The project would also cross the Appalachian Trail within SGL 211. Ricketts Glen State Park would be crossed in two locations by the proposed project; this entire length will be collocated with Transco's existing Leidy Line system, resulting in an additional 1.7 acres to be maintained as permanent ROW adjacent to the existing ROW. The Glens Natural Area, a National Natural Landmark, is located 0.4 miles from the proposed route.

Limited discussion of impacts and concerns from PGC and DCNR have been included, although it appears that concern has been voiced regarding the affected state game lands (SGL) and Sproul State Forest. It does not appear that any avoidance and minimization has been considered. Clarify if any of the potential blasting areas are within this pipeline segment. EPA is concerned that pipeline construction may alter ground or surface water flow conditions, which may impact the park resources. It is unclear that appropriate compensatory mitigation has been developed for impacts occurring on these lands. Site specific crossing plans are not available for Ricketts Glen, SGL 206, and others. Please update this information and consider the potential impacts from crossings in the EIS.

## 8) Conservation and Visual

The proposed action would cross several lands that are part of conservation programs. An unknown amount of lands are enrolled in the CRP and CREP programs which are in the process of being identified. Page 4-153 makes the conclusion that construction across herbaceous CRP and CREP lands will not negatively affect enrollment and that forested lands on the permanent ROW would be permanently effected. Unknown restoration measures would be implemented to ensure that properties remain eligible. It is unclear how many lands enrolled in these programs will be affected, if herbaceous lands within the permanent ROW will remain eligible, and what restoration measures are being proposed. We recommend considering all of this information prior to making the determination that impacts on these conserved lands will not be significantly impacted.

## 9) Cumulative Impacts

EPA is concerned that the temporal and geographic scope of the study is narrow, which has led to a limited analysis of cumulative impacts. Defining the geographic and temporal framework is the starting point of a cumulative impacts analysis. Establishing appropriate spatial and temporal boundaries is at the very core of the study, the selection of inappropriate boundaries leads to subsequent fundamentally flawed analysis and documentation. It is critical to assess past and future impacts. We suggest defining the geographic and temporal scope (or the region of influence) of the analysis early in cumulative impact section, which can vary depending on the resource being evaluated. For example it appears that 0.5 miles for minor

actions, 10 miles for major actions (including gas wells), within watersheds for major actions that would be crossed by the Project, and within the AQCR crossed by the project for actions with potential to result in longer-term impacts on air quality (for example, natural gas pipeline compressor stations).

Some of the resources included in the cumulative impact analysis appears to only consider impacts that occur during construction of Atlantic Sunrise as the temporal boundary and within the project footprint as the geographic boundary. However, cumulative impacts can occur to resources even if impacts do not occur concurrently. Though construction impacts can be short-termed, there are likely prolonged impacts for instance associated with forest fragmentation, invasive species, etc. Even projects that do not overlap geographically can contribute to cumulative impacts to streams, wetlands, forests, habitat, and other resources. We recommend FERC consider expanding the cumulative impact study beyond what is currently considered in the DEIS. Cumulative impacts temporal boundaries are often set a few decades into past and future to include appropriate trend and facility life expectancy. It is typical to use a baseline time frame of 30 to 50 years past, prior to sprawl and extensive highway networks. It is important to analyze the trends in resources, to identify if there have been repeated impacts or degradation of the resources. A thorough analysis of impacts could help guide the selection or placement of appropriate mitigation for Atlantic Sunrise impacts or highlight areas where additional avoidance and minimization may be warranted. EPA would be interested in discussing the selection of a more appropriate and inclusive boundary with FERC.

EPA is concerned about cumulative impacts to aquatic resources, groundwater, and water quality. We recommend that the cumulative impact analysis of surface and groundwater be expanded, including cumulative impacts to water quality, headwater streams, high quality and/or sensitive aquatic resources. Aquatic resources have the potential to be cumulatively impacted by many factors, including waterbody crossings, change in recharge patterns, clearing, blasting, and water withdraws for hydrostatic testing. It may be prudent to consider these impacts in combination with other past, present and reasonably foreseeable actions at the watershed scale.

The cumulative impact analysis of the DEIS considered natural gas wells, gathering lines, and other FERC jurisdictional and non-jurisdiction projects. It was estimated that 1,135 gas wells were permitted in Pennsylvania counties within 10 miles of the project between 2011 and 2015. The DEIS assumes the same rate of permit issuance, which is approximately 260 per year, and projects that between 700 and 800 new wells could be drilled by the time the Atlantic Sunrise Project is scheduled to be completed. Please include the rationale for selecting this timeframe and distance. EPA appreciates that efforts were made to include a more comprehensive cumulative effects analysis of past, present and reasonably foreseeable natural gas related actions.

EPA is concerned by the potential cumulative impact which could result from the preferred alternative, Marcellus Shale development, and other FERC-regulated and non-jurisdictional actions. The DEIS estimated about 340 gas wells will be needed to supply the Atlantic Sunrise Project, using median production rates for wells. It also noted that production over time goes down, so more wells would likely be necessary to maintain supply. Most wells are located in Susquehanna and Wyoming Counties. There are many of the other natural gas transmission

projects which cross or are nearby to the proposed action. The DEIS concludes that in areas of rapid development like Susquehanna County moderate cumulative impacts on vegetation and wildlife would occur. In areas like Susquehanna County which have the potential for cumulative impacts occur, EPA recommends that a more detailed cumulative impact analysis in this area be conducted. A more detailed consideration of cumulative impacts may include a more detailed breakdown of past, present, and reasonably foreseeable actions, consideration of additional avoidance and minimization efforts, as well as looking for additional opportunities to collocate. Presenting the collocation rate by county or watershed may be a useful way to begin considering avoidance and minimization efforts in areas with cumulative impact potential.

The cumulative impact analysis relies on possible state and federal measures, restrictions and requirements for other past, present and reasonably foreseeable actions to minimize the potential for long-term resource losses, such as for fisheries, aquatic resources, RTE, and land use. The EIS also relies on the Atlantic Sunrise ECP and Plans and Procedures to minimize and mitigate for resource-specific cumulative impacts. We recommend that the cumulative impact analysis consider potential cumulative impacts regardless of the various prepared or required plans to be implemented by the project or other actions, or permits or regulatory thresholds. While it may be appropriate to recognize or consider the relation to these, please keep in mind that this is not sufficient to determine potential effects of past, current and reasonably foreseeable future activities to resources or if/ how project impacts can be mitigated.

**10) Climate Change**

The climate change section is within the cumulative impact portion of the EIS, which concludes that the project would not significantly contribute to GHG cumulative effects or climate change. EPA is concerned that this conclusion is not well supported and that the discussion presented could be improved by considering in further detail the potential impacts of the project contributing to climate change as well as the potential impact of climate change on the proposed action.

The EIS describes and compares the magnitude of Pennsylvania statewide GHG emissions, concluding that the project would have minor emissions when compared to the PA GHG emission inventory (less than 0.1 percent of the 2005 PA total). We do not recommend comparing project level GHG emissions to total state or U.S. emissions because these comparisons obscure rather than explain how to consider GHG emissions under NEPA and do not provide meaningful information for a project level analysis. We recommend using estimated direct and indirect GHG emissions levels as a general proxy to compare emissions levels from the proposal, alternatives, and potential mitigation.

The DEIS does not contain estimates of methane leakage during operation of the proposal. We recommend that FERC estimate expected GHG emissions from leakage and consider potential BMPs to reduce leakage of methane associated with operation of the expansion facilities. EPA has compiled useful information on technologies and practices that can help reduce methane emissions from natural gas systems, including specific information regarding emission reduction options for natural gas transmission operations. This information may be found at http://www3.epa.gov/gasstar/mehtaneemissions/index.html.

The discussion on climate change in the DEIS generally states what constitutes climate change, summarizes the IPCC and USGCRP and some of their associated findings and reports. Some general observations of environmental impacts to the northeast region were described. The EIS should describe potential changes to the affected environment that may result from climate change. Including future climate scenarios in the EIS would help decision makers and the public consider whether the environmental impacts of the alternatives would be exacerbated by climate change. If impacts may be exacerbated by climate change, additional mitigation measures may be warranted.

The EIS further states that other major projects considered in the cumulative impact analysis would have air permits and that these permits would minimize GHG emissions in accordance with air permitting requirements. Although not specifically mentioned in Section 4.13.8.10 Climate Change, other activities such as development and production of natural gas were included in the cumulative impact analysis and could be better represented in the discussion of climate change. We recommend the EIS also estimate GHG emissions from the development and production of natural gas being transported through the proposed pipeline, as well as estimate the GHG emissions associated with the end use of the gas due to the reasonably close causal relationship of this activity to the project. In Section 4.13.8.10, FERC states that "Natural gas is a lower CO2 emitting fuel when compared to other fuel sources." While combustion of natural gas results in lower amounts of GHG emissions than combustion of coal or fuel oil, lower relative levels of impacts do not exempt consideration of the indirect impacts of the proposal and measures to avoid, reduce, or compensate for those effects. Section 4.13.3.1 Wells estimates the number of wells permitted within 10 miles of the project, the rate that new wells could be added, and the number of wells required to provide quantities of gas to supply the project. We recommend that the GHG emissions be estimated the wells, gathering systems, and other natural gas pipeline projects that are included in the cumulative impact analysis.

EPA has recommended that FERC consider additional alternatives beyond the applicant's preferred alternative. Should additional alternatives be retained for detailed study, we recommend that the EIS estimate the GHG emissions potentially caused by these alternatives. These emissions levels can serve as a basis for comparison of the alternatives with respect to GHG impacts. There are a considerable resources, tools and methodologies to estimate project contribution to climate change. We strongly recommend that these be utilized in the EIS. Example tools for estimating and quantifying GHG emissions can be found on CEQ's NEPA.gov website.[1]

Climate adaptation measures based on how future climate scenarios may impact the project in the EIS should be considered. The National Climate Assessment (NCA), released by the U.S. Global Change Resource Program, contains scenarios for regions and sectors, including energy and transportation. Use of NCA or other peer reviewed climate scenarios can inform alternatives analysis and possible changes to the proposal which may improve resilience and preparedness for climate change.

Enclosure 2- Detailed Technical Comments
Atlantic Sunrise DEIS

EPA would like to provide the detailed technical comments on the following topics:

1) Alternatives – General
2) System and Major Route Alternatives
3) Aboveground Facility Alternatives
4) Construction, Testing and Restoration
5) Hazardous Geology and Soils
6) Groundwater, Wellhead Protection Areas, and Surface Waters
7) Streams and Wetlands
8) Vegetation
9) Wildlife and Aquatic Resources
10) Rare, Threatened, and Endangered Species
11) Land Use, Recreation and Public Lands
12) Conservation, Historic and Visual
13) Socioeconomics
14) Air
15) Noise
16) Reliability and Safety
17) Cumulative Impacts

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1) Alternatives – General

- Some of the criteria used to compare alternatives appears to be limiting the range of reasonable alternatives. The third listed criterion is "Does the alternative offer a significant advantage over the Project?" It is unclear what is meant by significant advantage, or how much information is used to make this determination. EPA believes the EIS should carry reasonable alternatives forward for detailed study and that reasonable alternatives should not be dismissed prior to detailed analysis. The use of this criterion seems to imply that alternatives deemed to be of similar or equivalent adverse impact would be discarded. Even if it can be determined at a screening level that alternatives would have similar impacts, it would be unlikely that this low level of detail would consider the function, value, or quality of a resource. EPA reminds FERC and the applicant that resources have varying degrees of function, value or quality, which should also be taken into consideration in addition to estimated impact totals (acreage, miles, etc).
- Page 3-1 notes that not all conceivable alternatives are technically feasible or practical, giving limitations as to why alternatives may be incapable or impractical. While this may be correct, it is still necessary for the alternatives analysis to present the alternatives

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considered as well as the rationale for dismissal from further consideration. Please include the various alternatives to the proposed action that may have been considered but were dismissed from further consideration. The potential to provide a significant environmental advantage over the project is also mentioned on pg 3-1. Please clarify how this potential is determined and if this determination is made within the context of the NEPA document. State why it is assumed that significant environmental advantages over the proposed action do not occur. The differences in impacts between alternatives, particularly for alternatives that may have similar impacts, would best be evaluated in NEPA alongside of the applicant's preferred alternative. EPA suggests that the alternatives analysis be expanded to include additional alternatives that may have been dismissed from consideration.

- Please clarify how the start and end point locations for the proposed project were determined. Consider if system alternatives that utilize different start or end points may meet the project purpose and need. Receipt and delivery points were briefly mentioned over page 3-7 to 3-8, as well as determinations on the optimum location to aggregate the 1.7 MMDth/d and optimum point to tie CPL South into Transco's Mainline system. This discussion should be expanded upon as it provides insight into the rationale for the selected locations of the proposed action.

2) System and Major Route Alternatives

- System alternatives would need to provide additional 1.7 MMDth/d of natural gas to the delivery points required by the precedent agreements and provide services within a similar timeframe in order to be considered viable. Please clarify why these things are needed in order to be a viable system alternative.
- Although Table 3.2.3-1 presents impact amount which in some cases are greater than the proposed alternative, FERC should also consider that the impacts to these resources are not the same. For example, a greenfield alternative which impacts forests has a different impact on forest/habitat fragmentation than collocating a pipeline which would likely effect forest edge habitat as opposed to uninterrupted interior forest habitat. Please consider these types of differences as it may be preferable in some instances to have a greater edge effect than a lesser interior forest effect. Without considering the resource in greater detail it should not be assumed it is always preferable to impact fewer resources. Quality of resources should also be considered.
- It is not clear that the presented system alternative considered upgrading/expanding components of the existing pipeline diameter. This may have the potential to reduce ROW widths and impact amounts presented in Table 3.2.3-1.
- Many of the above comments and systems alternatives comments provided in Enclosure 1 also applies to the evaluation of major route alternatives.

3) Aboveground Facility Alternatives

- Please provide the siting criteria used for aboveground facilities, including compressor stations. Please provide a map of the alternate aboveground facility locations that were considered. It is stated in section 3.4 that FERC evaluated locations for proposed aboveground facilities, which involved desktop review and site visits, however it is not

clear how this evaluation informed the above-ground facility alternatives analysis. Please provide additional information on the evaluation process, as this appears to conflict with the statement in paragraph two of this section that "we did not identify or evaluate alternative locations for the new compressor station facilities."

- Please describe how the amount of horsepower needed at each compressor station was determined, as well as how the spacing and distribution of stations along the proposed route was determined.
- It is stated on page 3-51 that the locations of the 605 and 610 CSs were being carried forward due to the lack of comments requesting for the stations to be relocated. The lack of comments or concerns about station locations during pre-filing does not eliminate the separate need for a fair alternatives analysis for above-ground facilities to take place. We recommend that an alternatives analysis for above-ground facilities, including compressor stations 605 and 610, be conducted and included in the EIS.

4) Construction, Testing and Restoration

- It is stated that 2,697.5 acres of land disturbed during construction would be restored and allowed to revert to its former use. Please clarify if there will be active work and replanting in these temporary workspaces. What does 'allowed to revert' mean? It seems to imply that it will be abandoned in place.
- Construction Right of Way (ROW) widths are given in section 2.2.2. Please clarify if the proposed construction ROW widths are equal to or greater than the standard FERC allowed width. Appendix C lists the locations where additional construction ROW has been requested. It appears that for large portions of the construction ROW additional/extra workspace is requested. For what portion of the ROW is Transco requesting additional workspace? As it seems that additional workspace has been requested for much of the ROW, please clarify how this does not represent the typical construction condition. It seems disingenuous to provide construction ROW widths in Section 2.2.2 although these widths do not appear to be applicable to the majority of the ROW.
- Evaluate impacts related to modifications to existing roads including tree, brush, or structure removal; widening; grading; installation or replacement of culverts; and addition of gravel.
- Table 2.3-1 – for the request modification to procedure:
    - V.B.3.c- clarify if the request is to decrease the 15 foot buffer to waterbodies or eliminate the buffer entirely. In these locations, were modifications to the pipeline considered as opposed to modifying this procedure? Please specify how Transco would ensure each waterbody is adequately protected.
    - VI.A.3 – it is unclear why soil storage must occur in wetlands. Clarify if upland locations were considered, and if why those locations were not utilized.
- We recommend minimizing the use of heavy equipment in environmentally sensitive areas, including wetlands. Hand clearing of vegetation should be considered as one way to reduce the use of heavy equipment in these areas.
- It is stated that wood chips may be spread across the ROW in a manner that does not inhibit vegetation growth. Please clarify if this is referring to a possible maximum depth of wood chips to be spread.

- Section 2.3.1.4 states that where necessary, the entire width of the ROW and ATWL would be graded. Please include information on how much of the ATWS will be graded.
- Is anything contained in the protective coating that could be considered hazardous?
- During backfilling is it anticipated that all excavated material will be placed back into the trench? If not, please state where this material will be placed. Where will rock and other items deemed not suitable for backfill be placed?
- It is stated that hydrostatic test water withdrawal location and rates would be in accordance with applicable permits. Although the locations, rates, sequence and timing of withdraws and testing may not be finalized, the currently proposed information is relevant to the EIS and should be included in order for potential adverse impacts to be fully analyzed and available to the public.
- Will test water be recycled from one segment to another? It would also be beneficial to add the flow rates of each water body to better understand if hydrostatic testing will impact water flow in streams and creeks. Please specify if test water will enter and exit the pipeline at the same locations or if different locations.
- It is not clear what will happen with the water after the drilling mud is separated. Will water be discharged back into the waterbody? How much water will be recovered or lost?
- It is stated that areas would be revegetated and would be monitored, evaluated and correct areas requiring remediation, however few specific details are provided. EPA suggests that a detailed revegetation plan, which includes monitoring, performance standards, plans, and an adaptive management plan, be prepared and finalized prior to the start of construction.
- What process or criteria was used in order to identify sensitive resources? Was it determined that all aquatic resources were to be considered sensitive?
- Post-construction monitoring is addressed in section 2.5.5. EPA suggests that a specific monitoring plan, which details monitoring frequency, content, methodologies, performance standards and report contents, be prepared and finalized prior to the start of construction.
- Page 2-38 states that if restoration activities are not adequate at the end of the respective timeframes, the post-monitoring program would be extended. In the event that restoration is not adequate, we recommend that additional restoration or compensatory mitigation be required. The temporal loss of resources should also be considered.
- Page 4-67 states that chemical may be added to test waters to eradicate non-native aquatic species. However it is unclear what specifically chemicals may be added to the water and what they are targeting. It is also unclear if these chemicals have the potential to affect native species as well as non-native species. Will biocides be used before water enters the pipeline or as it exits the pipeline and expelled into surface waterways. Biocides would have a great impact on the environment if used especially into surface waters.
- Page 4-67 states that test waters would be discharged into well-vegetated, upland areas or to receiving waters using energy dissipation devices to minimize the potential for stream scour. We encourage energy dissipation devices to be used both for upland and instream discharges. The discharge of water into uplands may create erosional features contributing sediment into nearby waterway, affect habitat, and become a source of erosion in the future if left unrestored. How will this be monitored, identified and restored if found? After water is used for testing, will it be immediately discharged?

Please explain if the testing process will result in higher water temperatures; if so, consider the potential impact of discharging warmer waters into receiving streams.

5) Hazardous Geology and Soils

- Please evaluate the potential impacts of HDD frack out. The last bullet on pg 4-25 seems to describe a construction monitoring and adaptive management plan. These should be developed and finalized in advance of any construction.
- Active mines and AML were identified. We recommend that a table of all the mines, quarries, and wells and their proximity to the project be provided in the EIS, which can be easily found without having to search for another document in FERC's elibrary.
- We also recommend identifying UST that may be within the ROW. Unanticipated UST may be encountered during construction and we recommend that the *Unanticipated Discovery of Contamination Plan* include USTs.
- Could the discharge or drainage of mine pool water be affected by blasting or other construction related operations? Is there potential for unanticipated new or shifting discharge or drainage locations to develop?
- Please clarify the term "susceptibility moderate" and its difference to "moderate" as used in Table 4.1.5-2.
- Please describe the areas along the pipeline route (construction or operation) that will be impacted by flash flooding, include the distance from the mile markers that the flood area is closest, if there incidences of flash flooding in the past, and a figure showing where flooding occurs.
- Please include a figure of areas along the pipeline project with the potential of landslides. Steep slopes are considered to be 30 percent or great, however it is unclear how this was determined.
- Pg 4-44 states that "Dewatering of trenches may result in temporary fluctuations in local groundwater levels. Trench water would be discharged into well-vegetated upland areas to allow infiltration and to minimize effects on the water table." Consider if the fluctuations in GW levels noted may affect any nearby wells, seeps, streams or wetlands. The discharge of water into uplands may create erosional features contributing sediment into nearby waterway, affect habitat, and become a source of erosion in the future if left unrestored. How will this be monitored, identified and restored if found?
- Testing of wells within 150ft is noted and expected to mitigate any damages caused by construction. EPA recommends that well testing and mitigation should be formalized in an appropriate plan and finalized in advance of construction.
- Vibration associated with blasting does not appear to have been considered, although it is stated that blasts would not be expected to adverse effect pipelines greater than 12ft away from the blast site. Vibration should be clearly addressed in the EIS.
- How will geophysical features in high risk areas be identified? A detailed long term monitoring plan is needed (mentioned on page 4-24). We recommend that a monitoring plan be developed and finalized in advance of construction.
- There are several maps and tables within Appendix J for areas of karst and concerns for karst seems to be missing (examples, Table 1-1 and Figure 1-1). These maps and tables are pertinent that they are included with the DEIS as there are a necessary portion of the

evaluation. Additionally, the DEIS should discuss how and when Transco will obtain access to survey the 12.3 miles to complete the MASW survey.

- The DEIS mentions in Table 4.1.2-2 that "*Compressor Station 155 would require limited or no subsurface disturbance and are, therefore, excluded from this table*." On the other hand in Table 2.2-1 "the Summary of Land Requirements", mentioned that Compressor Station 155 will affect 17.7 acres during construction. The FEIS should clarify and explain this information.
- General: A map that includes the Prime farmland of the Commonwealth should be included in the DEIS.
- A figure should be included of the areas of the project that have highly erodible soils. The figure should include the range of highly sloped areas within the project construction area to help the reader understand where the most hazardous places would be. With almost half to the project determined to be highly water erodible, the DEIS should discuss the impacts soil erosion should have on the environment from construction and operation such impacts to water quality, pipeline structure, vegetation, and habitat. If this information is in the construction manual, it should be put into the DEIS. The DEIS should pull the examples from the appendixes of the different mitigation measures used to prevent erosion in construction/operation areas of high gradient and/or highly erodible areas. Because of the safety concerns of construction, the DEIS should also list where these BMP's will be used in conjunction with the high slope and erodible areas. Additionally, the DEIS should discuss what was done to avoid the most highly sloped areas.

6) Groundwater, Wellhead Protection Areas, and Surface Waters

- Preventing negative impacts to aquifers during construction and other pipeline related activities should be among the highest priorities. While the DEIS identifies five principal aquifer systems, as well as minor systems, it does not specify if these aquifers are Underground Sources of Drinking Water (USDW) under the Safe Drinking Water Act. All groundwater with TDS (total dissolved solids) of less than or equal to 10,000 mg/L is presumed to be a USDW.
- We recommend including which aquifers are used for what purposes, and the water quality and yield information available for each aquifer. Describe the recharge and discharge zones for each aquifer and depict on a map, if possible.
- We recommend including water quality data for the groundwater. Summarize the data and provide references for each aquifer (e.g., USGS, State agency reports, or state geological survey reports.)
- There are 90 identified private wells or springs within 150 feet of the proposed route, and in Pennsylvania 8 of the wells are located in areas of known karst. Please provide a map of these private supplies.
- The propose construction will cross 9 Zone II Wellhead Protection Areas (WHPA) in Pennsylvania, with crossing lengths of 0.3 mile to 1.2 mile. As such, the project has the potential to impact private well drinking water supplies. The DEIS states that Transco has committed to testing water supply wells and springs within 150' of construction, subject to landowner permission. EPA also advises that in-depth hydrogeological impact

studies may be required to assess potential contamination impacts, in addition to the proposed monitoring plan.

- Groundwater in shallow aquifers and karst terrain is also present in areas along the pipeline route, including in the area of 8 known private water supplies. Due to its connection with surface water through sinkholes, caves and swallets, groundwater in karst geologic terrains is especially vulnerable to contamination. EPA recommends that to prevent impacts on public and private water supplies, the pipeline should avoid karst terrain, and consider route alternatives.
- It is noted in the DEIS that "If possible, Transco would locate trench spoil piles on the downhill side of the karst feature to prevent direct runoff into uncovered features." EPA recommends that spoil piles be located downhill of the karst feature, or removed from the site if that placement is not possible. It is not recommended that spoils be placed uphill of these features.
- EPA anticipates that impacts to wells may occur where Transco has not conducted this pre-monitoring and Transco should be prepared to fairly address these situations should they occur. The EIS should communicate how those impacts may be mitigated
- It is noted in the DEIS that blasting along the proposed route may potentially impact yields and/or increase turbidity. Groundwater flow impacts should also be considered. EPA recommends that alternatives to blasting be fully explored. We also recommend that blasting within close proximity to bedrock wells and in karst terrain be avoided and/or should not be conducted.
- Preventing negative impacts to surface waters during construction and other pipeline related activities should be among Transco's highest priorities.
- The pipeline facilities would cross 9 watersheds or drainage basins. These are properly identified by name, HUC-8, drainage area and location. The 8 watersheds crossed in Pennsylvania are identified as discharging into the Chesapeake Bay.
- The DEIS includes information on the CWA section 303(d) listings for Pennsylvania and Virginia. This information does not appear for other impacted areas.
- The DEIS identifies four potable surface water intakes within 3 miles downstream of waterbody crossings impacted by this project. These intakes are identified by facility, waterbody ID, waterbody name, milepost location, distance to intake structure, water intake operator and the primary use of the four surface water intakes.
- EPA recommends that maps of the source water protection zones be included in the EIS.
- EPA does not recommend that projects pass through any identified Source Water Protection Area, and alternative routing should be considered. For crossings in major waterbodies and SWPAs where route alternatives are not possible, sediment modeling can be conducted to indicate the predicted fate and transport of excavated or dredged sediments. The EIS should also include descriptions of site-specific BMPs that will be employed within each SWPA and WHPA to mitigate any construction or stormwater runoff related impacts.

7) Streams and Wetlands

- It is not clear that the determination that the effects on surface water from hydrostatic testing would be minimized and not significant. It does not appear that any minimization efforts or practices have been included to address the withdrawal of large volumes of

water from streams leading to effects of recreational and biological use, especially when diversions constitute a large percentage of the source's total flow or volume. It does not appear that effects to minimize or avoid loss of habitat, change in water temperature and dissolved oxygen levels, and entrainment or impingement of fish or other aquatic organisms have been considered or included. Without further analysis to specific streams of concern, it should not be assumed that impacts have been minimized and are not significant. EPA is particularly concerned about Fishing Creek, which is a high quality water and fishery. Fishing Creek could face complex impacts resulting from a combination of activities, including water withdrawals, blasting, vegetation removal. The combination of impacts from these activities should be considered, especially for sensitive resources like Fishing Creek.

- Table K-3 in appendix K identifies the waterbody/floodplain locations that would be crossed by the proposed pipeline, however it does not appear that the effects of removing floodplain vegetation have been considered. It is not clear if construction or operation or the pipeline in floodplains will result in increased flooding on adjacent properties. EPA recommends this be evaluated prior to construction, especially as the alternatives analysis states that route variations were specifically included due to placement of the pipeline in a floodplain and flooding concerns associated with vegetation removal.
- Would revegetation along waterbodies be limited to shrub/scrub vegetation or would areas that were previously forested be reforested?
- Please clarify if, where, and the amount of water that will be discharged from stormwater, dewatering structures, or hydrostatic testing. What efforts or practices have been incorporated to reduce potential adverse effects to water quality from these discharges?
- The Public Notice briefly states that additional temporary workspace maybe needed. Table K-5 in Appendix K lists additional temporary workspace requests within 50ft of a waterbody and provides a justification for this modification. These locations should be identified within the CWA Section 404 application so that the impacts can be accounted for and the locations monitored for successful restoration after the project's completion.
- Transco has made more than 190 requests for additional temporary workspace within 50ft of waterbodies. This constitutes a request for additional temporary workspace for greater than 50 percent of the crossings proposed by Transco. Although Table K-5 includes Transco's justification, in many cases it does not appear that this modification request is fully supported. Many requests state that there would be less impact than transporting material to be stockpiled elsewhere. What other locations were considered? Include material placement as part of the alternatives analysis.
- Robust success criteria for successful wetland restoration after construction is needed. There are a few limited measures included but they are limited to vegetative success. We suggest that successful wetland restoration also be tied to the CWA Section 404 permit. In the event that wetland restoration is unsuccessful within an appropriate timeframe, we suggest that additional compensatory mitigation be required or evaluated if appropriate
- The EIS states that the primary impact on wetlands from pipeline construction and right-of-way maintenance activities would be the temporary alteration of wetland vegetation and permanent conversion of forested wetland to scrub shrub or emergent wetlands. The EIS also noted that soil compaction may alter hydrology and soil conditions. We recommend the EIS include how these impacts would be minimized, or mitigated, which appears to have been part of the information provided in the PN. Please consider how to

restore preconstruction wetland hydrology. EPA is concerned that impacts have not been accurately characterized within the EIS.

- The EIS suggests that plowing could be conducted to de-compact soils affected during construction. We suggest that additional information on the proposed plowing, including depth of plow. In areas where compaction is of concern, pre and post construction testing can be conducted in order to measure changes in compaction rate.
- Fifty-one of the 251 total wetlands crossed by the proposed pipelines in Pennsylvania are classified as exceptional value (EV), with 15 of these containing a forest component. The acreage of EV wetlands impacted or crossed by the proposed project has not been provided. It isn't clear what avoidance and minimization measures have been taken with respect to these resources. Were any route alternatives evaluated to reduce impacts to EV waters? It is unclear that the CMP sufficiently addresses EV wetland impacts. It is unclear if CMP includes streams.
- No maps have been provided. EPA recommends that maps of EV areas be provided as they would be particularly helpful.
- Approximately 41.22 acres of wetlands will be temporarily impacted. The applicant should evaluate the temporal functional loss for all wetland types, including PEM, and provide mitigation for these losses.
- The mitigation plan needs to address how the applicant will monitor and control the threat of invasive vegetation within the project boundaries. Disturbed soils offer an excellent opportunity for invasive species to take hold of a sensitive area and can quickly impact the natural flora of the ecosystem.
- Page 13 of the Public Notice states that wetlands will be seeded with annual rye grass. We recommend the disturbed wetland areas be replanted with a wetland seed mix that is appropriate for the location of the impacts, as well as annual rye grass. The rye grass will provide quick stabilization, and the wetland mix will provide seed source for the successful restoration of the impacted area. Additionally, mitigation should discuss seeding will include native pollinator vegetation that will forward the cause for pollinator species such as bees.
- Clearly state when remaining surveys will be completed? Please describe how discrepancies between the remote sensing and field verification will be shared in the event that surveys are not completed prior to the FEIS. Page 4-69 states that the remote sensing methodology was tested for accuracy on field-delineated land area. The EIS does not describe the results of this comparison and testing.

8) Vegetation

- We recommend including a figure of the different types of vegetation communities in a map with an overlay of the pipeline project. This will help the reader better understand the range effect the project will have on the different vegetation types and the variety of vegetation that will be covered by the area of the project.
- Page 4-76 states that modifications to existing compressor stations would have limited effects on vegetation communities. Modifications at CS 517 will impact a total of 32 acres during construction. Modifications at CS 520 will impact a total of 36.1 acres during construction. Modifications at CS 190 will impact a total of 30 acres during construction. Considering that these 3 stations will impact greater than 90 acres

combined, we suggest that vegetative impacts to these areas be considered and described in the EIS.

- Page 4-80 references figure B-2 from the Draft Migratory Bird Plan found in Appendix M. However this figure is located in Appendix B of the Draft Migratory Bird Plan. The appendices for the plan have not been included in the EIS.
- Please include a map of the interior forests that will be affected by the project. The DEIS should include an explanation of the method used to identify interior forest patches. Additionally, this section of the DEIS should list species that will be affected by the destruction of interior forests habitat and if any of those species are on Federal or state endangered species lists. If this is mentioned in another section in the DEIS, it should be referenced in this section.
- Agricultural lands including specialty crops (orchard and tree farms) and organic and no-till farms were mentioned earlier in the document, however they were not addressed in the vegetation section although impacts to agricultural lands are determined to be temporary to short-term.
- Please formalize the revegetation plan(s), which should include adaptive management. The DEIS does not include Transco Project-specific Noxious and Invasive Plant Management Plan. This plan should be included in the appendixes. This section should include a brief discussion on how the project will reduce the spread of invasive species along edge habitat.
- Some portions of the EIS indicate that forest impacts may take decades to recover to pre-construction conditions. It appears that impacts to forests would be long term if not permanent. Minimization efforts and mitigation for these impacts are not presented, and should be included in the EIS. Despite this, it is concluded that the permanent conversion of forested lands would not result in significant impacts. It is not clear what this conclusion is supported by. We suggest that FERC consider if significant impacts to interior forests may occur as a result of the proposed project.

9) Wildlife and Aquatic Resources

- 171 waterbodies have been identified by PFBC as containing sensitive fisheries in PA. All but 4 of these special concern waterbodies will be crossed using a dry crossing method. While direct instream work for crossings would have the potential to impact fisheries, there are other construction related activities that may impact fisheries and aquatic resources that should be considered. Vegetation clearing adjacent to streams and in the riparian corridor has the potential to reduce shade over stream, increase stream temperature, reduce carbon inputs to stream, etc. Shading impacts mentioned as temporary, earlier stated that forested areas could take decades to be restored. It is unclear that any active planting is planned.
- Unclear if the construction timing windows in fisheries of concern in PA are focused on fish spawning or recreational fishing.
- The aquatic resources considered only included fisheries. This is a limited consideration of aquatic resources, which can also include benthic macroinvertebrates, salamanders, and other species. No discussion on freshwater mussels was included in the EIS.

- Please be sure that all references noted in the EIS are included in Appendix Q References. Page 4-100 references Beschta and Taylor, 1988, however it does not appear to be included in Appendix Q References.

10) Rare, Threatened, and Endangered Species

- The FWS Pennsylvania Field Office has noted that the Project is within 5 miles of five known Northern Long-eared bat hibernacula in Schuylkill, Northumberland, and either Lancaster or York Counties (Shellenberger, 2015a). Two of the hibernacula are within 0.25 mile of the Project in Northumberland County between CPL South MPs 84.9 and 85.5. FERC has recommended that complete Northern long-eared bat survey data be filed prior to the end of the DEIS comment period. Mist net surveys conducted resulted in the capture of 70 northern long-eared bats. More than 1,000 acres of northern long-eared bat habitat would be impacted by the proposed project. It is not clear what specific avoidance and minimization efforts or route changes have been incorporated with regard to the northern long-eared bat. FERC has determined that the proposed project is likely to adversely affect the northern long-eared bat. Will any additional surveys be completed for this bat, considering that not all parcels were available for survey? Is FWS comfortable moving forward with not all areas surveyed?
- Please clarify if the recommended frequency, duration, and timing of all ESA surveys were followed. Have any of the recommended surveys not been conducted?
- Page 4-113 states that Transco will conduct wetland delineations on all parcels without survey access with potential northeastern bulrush habitat once they become accessible in 2016. Route was modified to avoid impacts to northern bulrush. Please clarify why the FWS recommended 300ft set back will not be attained.
- Incomplete surveys for Alleghany wood rat; the surveys should be finalized prior to decision-making and shared with public and agencies.
- While Transco anticipates avoiding impacts at the Susquehanna River due to the use of the HDD crossing method at the two crossing locations, Transco is considering conducting baseline mussel surveys in case an alternative crossing method becomes necessary or other unanticipated impacts could occur. Please explain how impacts will be assessed and provided to the public. Will further NEPA assessment be made public?
- Concern with how to address changes in crossing methods and unanticipated impacts in the event that a different unevaluated crossing type was necessary.
- No main conclusions were drawn about the impacts to RTE species. It is critical that potential impacts be identified, presented, and acceptable avoidance and mitigation determined.

11) Land Use, Recreation and Public Lands

- The proposed action crosses the Appalachian Trail at MP M-200 0.1 on SGL 211. The permanent right-of-way would create a new corridor although a forested buffer may be maintained along the right-of-way on either side of the Appalachian Trail, pending further evaluation of crossing methods and consultation with the PGC. Concern with crossing AT, and lack of certainty about buffer and veg along trail. Please clarify what the technical limitations of the conventional bore. Although the crossing will use a bore

method, it does not appear that impacts from construction on trail use and user experience has been considered.

- It is stated that Transco will develop a site-specific crossing plan, clarify which of the streams within Ricketts Glen State Park will be crossed and provide any available data about stream characteristics and quality. It is not clear that the user experience has been considered. Is the proposed crossing near any trails, trailheads, or other recreational locations? How will construction impact park users?
- PGC requested no work within October 1- December 30, which has not yet been agreed to. EPA encourages FERC and the applicant to incorporate and comply with the TOY restrictions suggested by PGC for each of the requested SGLs. If work is conducted during this period, please consider and address worker and user safety as appropriate.
- Lebanon Valley Rail – Trail states that since the crossing will be in agricultural land use and would therefore not affect the surrounding landscape. It is not clear why this has been assumed. The proposed action would preclude these areas from becoming forested in the future.
- The Chapman loop would cross Sproul State Forest at four locations, additionally the installation of a new MLV and communication tower is proposed in the SF. Although portions of the loop would be collocated, it is unclear if other avoidance and minimization measures have been considered in order to reduce impacts to the SF. A site specific crossing plan is not available. The EIS states that the looping was sited away from active recreational areas, however no maps or detailed information was presented. It is unclear if recreation within the SF will be impacted.
- Page 4-135 notes that concern from commenters about possible effects on septic systems/drain fields during construction. The EIS concludes that consultation by Transco with landowners to identify and avoid systems as well as compensate or damage that occurs during construction that impacts would be less than significant. Linear projects have the potential to impact these systems. Pipeline construction or maintenance may result in the need for systems to be relocated, or result in systems becoming unviable if it isn't possible for them to be relocated. EPA recommends that an evaluation of these types of impacts to systems be included in the EIS. This could be particularly important where systems are can no longer operate and result in additional displacements.

12) Conservation, Historic and Visual

- It is stated that there is one known WRP is near the construction area and one known FRPP easement is crossed by it. Please clarify if all lands within the construction area have been evaluated for WRP and FRPP easements. Please provide the restoration measures relating to the FRPP crossing.
- The DEIS mentioned that Transco contacted every SHPO's office and that: *"Transco submitted a revised plan for unanticipated discoveries during construction. To date, Transco has not filed the North Carolina SHPO response regarding this plan."* It seems that this statement is the same for each state affected in the DEIS. We recommend including the final concurrence statement from each SHPO office regarding the appropriateness of these plans.

- Please clarify why it was not feasible to use the conventional bore method to cross Tucquan Creek, a State designated Wild and Scenic River. What were the results of the geotechnical investigations that limited this method?
- Please describe the methodology used to identify and evaluate impacts to visual resources. It is unclear if a consistent approach was used to assess visual impacts. Specify if the same method was used for pipeline and aboveground facilities.
- Height information is only provided for communication towers, which will range from 40-190 feet in height. Do communication towers represent a hazard for birds and bats? Are guy wires necessary for communication towers?
- What will be the maximum height of facilities at above-ground facilities, including compressor stations? From what distance will compressor stations be visible? Clarify if compressor stations will be visible from residences, recreational areas, or other key viewpoints. It may be useful to develop a table for compressor stations that is similar to Table 4.8.8-1.
- Please clarify if the vegetation that is stated to provide visual screening will provide screening in all seasons or just through the spring and summer months. Please address facilities that will be visible above the existing tree line or vegetation height. The EIS notes that additional visual screening will be provided by the applicant, however it is not clear what is proposed and what amount of screening it will provide.
- Maps, visual representations, site plans or figures, and/or photos of example aboveground facilities should be included in the EIS. These would be incredibly useful for the public and other stakeholders to have a better understand of that the actual facilities proposed will look like.
- Please consider potential impacts from lights or beacons that may be on communication towers and other aboveground facilities.

13) Socioeconomics

- Page 4-168 concludes that "given the study area population (totaling 12,281,054) and the distribution of the construction workforce, the addition of 6,490 people would not be a significant change." Please clarify where this total study area population was derived from. Table 4.9.1-1 provides the 2013 populations for each of the counties in PA affected by the project; the total population for those 10 counties is 1,517,537.
- Please provide estimated workforce totals for Counties that are affected by more than one project facility. For example, construction for CPL North, CPL South, CS 610, and the West Diamond Regulator Station will take place in Columbia County. It is unclear if the impacts from these combined construction/workforce have been considered. It be beneficial to consider workforce impacts by spread.
- Several studies relating to property values and mortgages are referenced in Section 4.9.5. It may be useful to include information about the size of pipelines (pipe diameter) in order to more fully understand how these relate to the proposed project.
- Table 4.9.8-1 and 4.9.8-2 should also include data specific to Pennsylvania.
- No maps relating to EJ were provided.
- It would have been preferable for the minority and low-income assessments to have been conducted using the minority and low-income population percentages of the study area as a whole as basis for evaluation. Comparisons of minority and low income populations for the county is appropriate in some cases, but in others may represent too large an area for

meaningful comparisons to be made. Comparison of the demographics of the study area to state, county and local benchmarks made provide more meaningful and insightful information as to the localization of minority and low-income populations of concern. Additionally, Environmental Justice concerns are local, occurring at specific points in communities, rarely are they impacting vast areas at a given time. We encourage FERC to attempt to focus on places where adverse impacts are more likely to occur and assess these impacts more comprehensively.

- As noted above, in some instances it may be more appropriate and informative to consider minority and low income populations at a more refined level of study. Please consider conducting a more detailed study for areas surrounding CSs and other aboveground facilities perhaps using block group of census tract level data.
- Please clarify the location of the 11 open houses and how open house information was disseminated to environmental justice communities within the project area (construction and operation).
- EPA encourages FERC to conduct meaningful engagement of environmental justice communities. It appears that some scoping meetings were located in counties with EJ locations. The DEIS does not disclose if any accommodations, such as an interpreter or providing literature/project information in other languages, were needed or made for non-English speaking communities.
- The DEIS states that "none of the counties that would be affected by the Project in Pennsylvania have the potential to be in environmental justice community based on race." In the following paragraph, the DEIS states that three counties within the project area have populations larger than the state average, therefore considered an environmental justice community. This discrepancy should be clarified.
- The EJ analysis does not consider construction and displacement impacts on environmental justice communities. The DEIS should analyze if a disproportionate amount of environmental justice communities have construction related displacements, as well as construction truck traffic or water turbidity to areas that are used for subsistence fishing.
- Children's health was not considered.
- EPA sees this project as a great opportunity to implement Health Impact Assessments (HIA). HIAs from the communities surrounding the new electric compressors and the communities surrounding the traditional gas compressors. The results of these assessments would help to define the services or interventions required to help to prevent or mitigate health problems associated to this type of projects if any. Additionally, the HIAs will ensure considerations of environmental justice (EJ - EO12898), children's health (EO – 13045) and human health as called by the NEPA process. We are providing some resources below. Also, you might contact EPA for guidance on this matter. http://www.humanimpact.org/new-to-hia/faq/

    - EPA assumed that the facilities would be equipped with emergency generator(s). EPA wants to make you aware that there are two specific rules for new source engines. One of these rules would apply to a generator for this facility. In order to learn and comply with these rules please visit: http://www.epa.gov/region1/rice/.

- EPA has issued three final rules that together will curb emissions of methane, smog-forming volatile organic compounds (VOCs) and toxic air pollutants such as benzene from new, reconstructed and modified oil and **gas** sources, while providing greater certainty about Clean Air Act permitting requirements for the industry. To comply with these rules please go to: https://www3.epa.gov/airquality/oilandgas/actions.html

- EPA recommends that for new equipment utilize contract specifications requiring advanced pollution controls and clean fuels: http://www.northeastdiesel.org/pdf/NEDC-Construction-Contract-Spec.pdf and http://www.epa.gov/cleandiesel/technologies/index.htm
  Implement diesel controls, cleaner fuel, and cleaner construction practices for on-road and off-road equipment used for transportation, soil movement, or other construction activities, including:

  ✓ Strategies and technologies that reduce unnecessary idling, including auxiliary power units, the use of electric equipment, and strict enforcement of idling limits; and
  ✓ Use of clean diesel through add-on control technologies like diesel particulate filters and diesel oxidation catalysts, repowers, or newer, cleaner equipment.

- EPA recommends the use of low maintenance trees at the project sites (reduces pollutants emissions from maintenance activities) and the construction of Rain Gardens for erosion and runoff mitigation while decreasing impervious surfaces to improve ground water quality. By adopting these low-cost easy to achieve suggestions, extra enhancements will be achieved such as noise reduction and aesthetics improvement.

14) Air

- Background air quality monitoring data for PA and MD from 2013 was presenting using EPA AirData website as the source in Table 4.11.1-1. Please provide a map of the locations selecting showing their spatial relationship to the proposed CSs. County level data may not provide sufficient detail to analyze site level air quality conditions. No data was presented for Virginia, South Carolina and North Carolina, please explain why sources in these states were 'not considered to be significant'.
- Construction emissions of CO2 (not CO2e) are estimated to be 163,535.5 tpy. Does reporting construction emissions in CO2 not CO2e effect the analysis? Should it be reported as CO2e to be consistent with other emissions data?
- Please include operational emissions for CS 605 and 610. No operational emissions were given for CS 605 and 610. These CSs will be electric-driven, and it is stated that minor methane emissions would not have a significant impact on local air quality.
- Emissions data should clearly include estimated emissions related to fugitive emissions, venting, blowdowns, gas-fired emergency shutdowns and gas heaters. The combined CO2e emissions for existing and modifications at CS 517 and 520 are estimated to be

296,841 tons and 224,792 tons, respectively. It is unclear if venting, blowdowns, and other sources are included in these totals.

- Emissions data for all CSs included in the proposed project should be provided, including CSs 605, 610, 517, 520, 190.
- The emissions for CS 517 and 520 are based on the operating condition of 0 °F. Does the temperature of the operating condition effect the emissions estimated? Why was zero degrees F chosen? Was zero selected for all estimations made? It is unclear if estimates made at zero are conservative estimates or if estimates accurately represent anticipated working conditions.
- Please clarify if the emissions reductions and pollution controls, including low NOx combustor to control NOx emissions, being used at CS 190 will also be implemented at other stations. As it appears that the reductions and controls can be effective, in instances they are not proposed, please clarify why.
- Modifications at several stations is proposed, which will include the installation of gas turbines. Please clarify the rationale for not using electric powered turbines at these locations. The use of electric turbines may result in fewer local emissions at compressor stations.
- The DEIS should clearly explain the methodology used for considering operational emissions to local air quality.
- EPA is concerned by the lack of air modeling analysis provided as well as by the apparent lack of responsiveness by the applicant to FERC's requests for this critical data. According to the DEIS several compressor stations have potential to be significant, however appropriate air modeling has not been conducted and included in the DEIS. Not only will this modeling likely be a required component of any future air permits being sought, it would provide essential information for consideration in this EIS. FERC has recommended that the modeling be completed and filed prior to the end of the DEIS comment period, which EPA strongly supports. We recommend that this modeling data be made available for the public and other stakeholders within the NEPA process.
- Six months of air quality monitoring collected near the stations was available for DEIS. Transco has agreed to gather air data for three years post construction. Please clarify what will be done with the data collected during this time and how it will be shared with the public and other stakeholders. Clarify the steps that will be taken should the data show air impacts are occurring, and how impacts will be mitigated, and how future impacts will be prevented.
- Please include a map of selected air monitoring locations. Selected locations were varying distance from the nearest structure, please clarify if the same siting criteria were used for each stations (CS 517, 520, and 190).
- The data presented was collected CS 520 and 517 was collected while stations were not running at full capacity, which appears to underestimate emissions expected for the project. DEIS states "Compressor Stations 517 and 520 were not operating at the full station loads during air quality monitoring. Therefore, the potential exists for higher impacts from existing sources when Compressor Stations 517 and 520 are operating at full load."
- Additionally, it is not clear if CS 517 was fully operational during the monitoring period, as the EIS states that this location won't be finished by July. So it isn't clear what this data informs. Please more clearly explain what the data collected is meant to inform and

how data collected at less than full capacity is useful for the EIS. EPA is unclear that this information is useful within the DEIS as it may obscure the public's understanding of operational emissions.

- Monitoring data provided for CS 520 doesn't include the full dataset for SO2, by excluding data collected during a system failure. The DEIS stats that the failure was corrected and subsequent values were included. Please clarify why data collected during the system failure wasn't this included. The DEIS should consider possibilities of similar system failure to occur in the future and potential impacts.
- The DEIS mentioned: *"Activated carbon filtration would be installed for deodorization at Compressor Station 155. An activated-carbon filter cartridge, housed in carbon-steel filter housing, would be designed to remove mercaptan from the odorized natural gas."* Please clarify and explain this information. Why will mercaptan be removed at this location? Please explain.

15) Noise

- The DEIS should describe the hours the HDD will be used, specifically if construction will be 24 hours until the pipeline is crossed and the estimated days the HDD will be used (example: days or hours). Also, if the HDD fails, how long will this extend the construction? These descriptions could clarify the impacts to NSA's.
- There are several residences north of the Susquehanna River HDD sites that are not considered NSA's (see Figures 4.11.2-7 and 4.11.2-8). The DEIS should consider these as NSA's as they are under ½ miles from the HDD entry/exit site and should be assessed for impacts from noise construction. In some cases, they seem of equal distance to some other NSA's.
- Figures on operational noise should be included in demonstrating the location of NSA's for the new 605 and 610 compressor stations.
- Current noise levels are provided for CS 605, however they are not provided for any of the other proposed CSs. Please provide equivalent information for each of CSs included in the proposed action.
- The DEIS states that "although the noise of a unit blowdown event could be audible at the nearby NSAs, it would not be a substantial noise impact. Moreover, any unit blowdown events would be infrequent and would last for only a short period of time (1- to 5-minute period)." Please clarify or give an example of what a substantial noise impact would be. We also suggest including why blowdown events occur and how often they are expected to occur within certain timeframes (days, month, year, etc).
- The proposed action includes modifying some existing CSs by increasing horsepower. Please clarify if changes in operational noise will be monitored and reported to FERC for any period of time after modifications are made.
- The noise surveys should be made available to the public via appendixes. These appendixes should be referenced in the DEIS.

16) Reliability and Safety

- Page 4-246 states that Transco has committed to several safety measures that exceed requirements. One measure includes hydrostatic testing of the entire pipeline at a higher

level suitable for Class 3 locations. Please clarify if there are different levels of hydrostatic testing requirements based on the Class designation and include this information in the EIS. Will hydrostatic testing of the entire pipeline at a higher level result in different potential environmental impacts? Or are there different water use requirements? While we understand the need to ensure safety, it is not clear if there are alternatives related to these measures that could result in fewer adverse impacts. What level of safety is to be attained?

17) Cumulative impacts

- The mineral facilities/resources included in Appendix I should be included in the CIA.
- Leidy Line system should be included. Crosses Ricketts Glen, and SGL 206. Why are upgrades to this line not viable? Have they been considered? When was this line put in service? Transco's Leidy Southeast Expansion Project33 (discussed briefly in section 4.13.1) was approved by FERC in December 2014 and placed into service on January 5, 2016. At its closest points in Luzerne, Lycoming, and Columbia Counties, facilities associated with the Leidy Southeast Expansion Project are between 0.0 and 8.4 miles from the Atlantic Sunrise Project. The project was built using a 105-foot-wide construction right-of-way with a 50-foot-wide permanent right-of-way retained for operation, although, due to overlap, most of this comprises existing permanent right-of-way associated with existing Transco pipelines.
- What is the status of the restoration associated with the various projects given, as many are stated to be in service? Have additional plantings been necessary, or even additional mitigation. How ere these impacts mitigated? What mitigation was completed? Are they good actors? Do we believe efforts will be successful? Did work have to be stopped, how did those other projects go? Any lessons learned?
- ROW widths for other projects are given, is any estimation of veg, ROW impact provided?
- Please include a map(s) to show the various spatial/geographic boundaries used for the cumulative impact assessment.
- We recommend that the analysis consider potential cumulative impacts to wildlife and FIDS.
- It is unclear what geographic or temporal scope is being used for certain resources, including vegetation and wildlife. We suggest that these be more clearly defined in the EIS.
- It is not clear that past and present actions were included in the cumulative impact analysis for land use or wetlands. The DEIS states "The Atlantic Sunrise Project in combination with other foreseeable future actions listed in the table in appendix P would result in temporary and permanent changes to current land uses."
- The DEIS states regarding cumulative impacts on recreational areas, "At present, we are not aware of recreational areas that would be cumulatively affected by the Atlantic Sunrise Project and other potential actions. As a result, although the Project would impact recreation and special interest areas, we do not anticipate significant cumulative impacts on these areas." Earlier in the EIS it is stated that Atlantic Sunrise will be collocated (or partially collocated) through recreational areas like Ricketts Glen. The lines that the project is being collocated with should be considered as past, present and reasonably

foreseeable actions. We suggest that cumulative disruption to the parks and reduction of resources be considered in the EIS.

- Cumulative impacts to visual resources are presented. This section briefly notes compressor and meter stations but it doesn't consider other CSs from other projects. What CSs are near the proposed CSs associated with Atlantic Sunrise?
- The DEIS concludes that FERC-jurisdictional and non-jurisdictional projects could contribute to cumulative impacts, however these cumulative effects are not expected to be significant. Please clarify this statement address potential cumulative impacts on all resources?
- Please clarify if CS 517 and 520 are being constructed as part of the Leidy Southeast Expansion project, or if the horsepower included as part of Leidy Southeast represent an expansion to a previously existing station. It is not clear that cumulative impacts from CS operation considers other CSs nearby, or valve releases, leaks or blowdowns. Please clarify if the emissions associated with the Leidy Southeast project are accounted for in the EIS.
- The EIS does not appear to include a discussion on potential cumulative impacts on residences, although commercial/residential and mixed development projects were included as past, present and reasonably foreseeable actions. Atlantic Sunrise crosses numerous residential properties and passes within 50 feet of about 90 residential structures, including 68 houses or townhomes and 22 garages or sheds. 73.7 acres of residential land will be affected by construction, of these 20.4 acres would be within the permanent ROW. FERC should consider the cumulative impact on residences and the community.
- Surface water withdraws are discussed on page 4-274, and present withdraw information for the project and for Marcellus Shale compared to state totals, which is contradictory to the cumulative study area for waterbodies and wetlands, which are stated to be at the watershed level. Please revise this data to more accurately compare, or at a minimum include WS scale data. Are any of other withdraws from the same streams proposed to be used by Atlantic Sunrise?
- Although the EIS concludes that some loss of wetland function could occur from cumulative impacts, no discussion of wetland functions and values was included.
- Page 4-275 states that "Although construction of the Atlantic Sunrise Project along with the other actions in the ROI would result in the conversion or reduction in the amount of forested and woody wetlands in the vicinity, the creation of new wetlands and restoration or enhancement of existing wetlands as may be required by the USACE and individual states would appropriately mitigate for these impacts and minimize any cumulative wetland effects." The analysis includes very little consideration of conversion, and does not provide an estimate of what the cumulative impact of conversion is. As previously state in our comments, mitigation should not be relied upon to prevent cumulative impacts. When considering wetlands we recommend looking at resource trends and considering historic wetlands.
- Vegetation and Wildlife—Page 4-275 states "The effect of clearing would be greatest during and immediately following construction and would diminish when the disturbed areas are restored and revegetated and the wildlife that were displaced during construction return." This does not acknowledge that it could take decades for forest to recover, potential change in community, permanent loss of interior forest, possible

introduction of invasive species, etc. Since it is not clear that an active vegetation restoration plan has been developed, it should not be assumed that the area would be revegetated and wildlife would return. Please address the potential for cumulative impacts to interior forest.

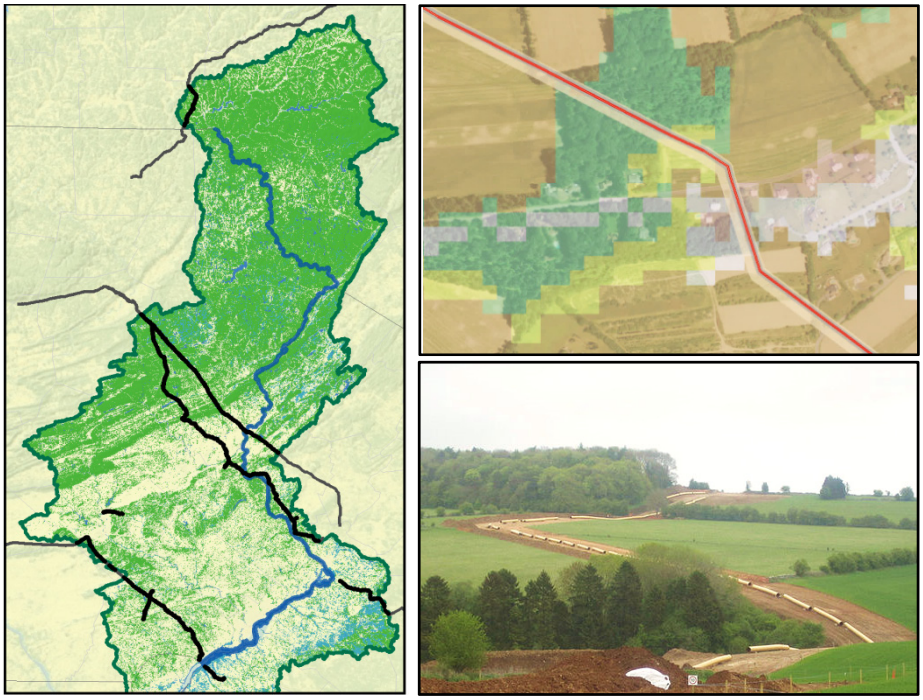
- Page 4-277 states "Transco has reduced the potential for cumulative impacts associated with the Atlantic Sunrise Project by collocating the pipeline and aboveground facilities where possible with existing rights-of-way and existing aboveground facilities. Following construction, Transco would revegetate disturbed areas and monitor these areas to ensure revegetation is successful. Previously forested areas occupying the temporary right-of-way and other temporary workspaces would be allowed to regrow, and vegetation maintenance on the permanent right-of-way would be restricted." Limited detail about the restoration plan has been provided in the EIS. We urge FERC to develop a detailed restoration plan that goes beyond allowing vegetation to regrow.

# EXHIBIT B

# Cumulative Land Cover Impacts of Proposed Transmission Pipelines in the Delaware River Basin

Lars Hanson and Steven Habicht

May 2016



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# Abstract

Transmission pipelines function to transport petroleum products over long distances to connect locations where these products are produced or refined to demand centers. The development of Marcellus shale gas with hydraulic fracturing in Pennsylvania has been accompanied by several proposals for new transmission pipelines. At least eight of these proposed transmission pipeline projects will cross the Delaware River Basin (DRB) to bring natural gas produced from the Marcellus shale play to demand centers on the East Coast, or otherwise connect to the larger petroleum products pipeline network. Each proposed interstate pipeline must undergo a review by the Federal Energy Regulatory Commission (FERC), which includes an environmental impact analysis. The potential environmental impacts of pipeline construction include land cover change, deforestation, sedimentation and erosion, water quality degradation, stream degradation, wetland loss, and air emissions, among others. In this report, we investigate the cumulative land cover change impacts for eight proposed transmission pipelines within the DRB, which total 322 miles in length. Specifically, using geographic information systems (GIS) methods, we investigated total land cover change, loss of forest and wetland area, and stream crossings for the eight proposed projects. We found that during construction, the pipelines' rights-of-way will impact 2,977 acres, including roughly 1,060 acres of forest, and 41 acres of wetlands. The pipelines' permanent rights-of-way will impact 1,328 acres, including roughly 450 acres of forest, and 22 acres of wetlands. In addition, we identified 175 likely stream crossings where a proposed pipeline route will cross a perennial stream.

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# Executive Summary

The primary function of transmission pipelines for petroleum is to provide long distance transport of liquid fuels to where there is demand for them. The planning and construction of pipelines can be a long and complicated process because pipelines and the land needed for their rights-of-way impact property owners, land resources, water resources, air quality, and wildlife along the proposed routes. These impacts may be magnified if multiple pipelines are built concurrently.

The rapid expansion of natural gas production due to the development of the Marcellus shale with hydraulic fracturing has been accompanied by proposals for new transmission pipelines. Although there is a moratorium on natural gas development in the Delaware River Basin (DRB), at least eight proposed transmission pipeline projects will cross the DRB in order to bring natural gas produced in the Marcellus to demand centers on the East Coast, or otherwise connect to the larger petroleum products pipeline network. Each proposed interstate natural gas pipeline must undergo a review by the Federal Energy Regulatory Commission (FERC), which includes an environmental impact analysis. The potential environmental impacts of pipeline construction include land cover change, deforestation, sedimentation and erosion, water quality degradation, stream degradation, wetland loss, and air emissions, among others. The environmental analyses in the FERC approval process document many of these potential impacts, and the proposed measures to mitigate these impacts during construction and operation for each pipeline project. However, the environmental analyses for the individual pipeline projects do not consider the cumulative impact of multiple independent pipeline projects proposed concurrently in the same geographic area – in this case, the DRB.

In this report, we investigated the cumulative land cover change impacts for proposed transmission pipelines within the DRB. Specifically, using geographic information systems (GIS) methods, we investigated total land disturbance, loss of forest and wetland area, and stream crossings for eight proposed projects. This work was funded by the Clean Air Council, which requested that CNA provide an estimate of the land area affected by the eight proposed pipeline projects' rights-of-way (ROW) in the DRB and, especially, an estimate of the total forest area that could be lost as a result of pipeline construction.

Figure ES-1 on the following page shows a map of the proposed pipeline routes overlaid on forest and wetland area within the DRB.

Our results present information that is typical in pipeline environmental analysis, but in new and useful ways. Notably, we present the land disturbance and forest loss broken down by watershed, with totals for the entire DRB. In addition, we compute the new cumulative disturbance area for eight proposed projects (with no double-counting of area where pipelines are adjacent). These cumulative results, presented by watershed, offer a more complete picture of the impact of the pipeline projects in the DRB than the individual, pipeline-specific environmental analyses can offer on their own.

We found that the land disturbance results are very sensitive to the stage of the development process and proximity to other pipelines. For instance, the land disturbance is highest during construction, when a wider ROW is needed for moving equipment. After construction, a smaller permanent ROW is affected, and in some cases, a portion of the permanent ROW may be allowed to return to prior land uses, leaving a smaller permanently cleared area. In addition, pipelines that run adjacent to existing pipelines, and can share a portion of the existing ROW may cause less land disturbance per mile than new, or "greenfield" pipeline projects.

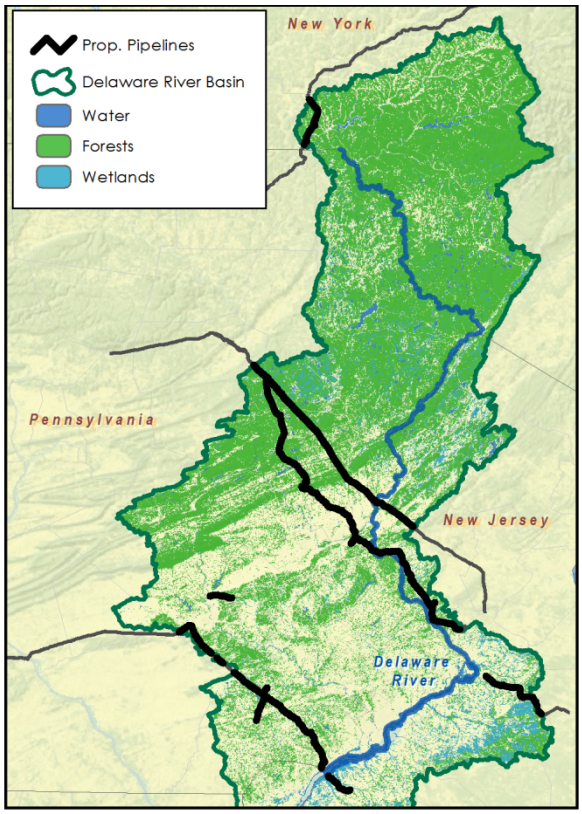


**Figure ES-1. Proposed pipelines and forest and wetland areas in the Delaware River Basin**

Overall, for the Delaware River Basin, we calculated the following impacts for the eight proposed projects:

- Total land disturbance during construction is 2,977 acres, of which roughly 1,050 are forest, and 41 are wetlands.
- Total land disturbance for the permanent right-of-way is 1,328 acres, of which roughly 440 are forest, and 22 are wetlands.
- The proposed pipeline routes will require at least 175 stream crossings, of which 92 potentially could be shared with existing pipelines.

The most significant impacts with respect to area of forest and wetland disturbance, as well as stream crossings, will happen in the central part of the DRB, in the Lehigh and Middle Delaware subbasins. This concentration of impacts is caused by the Diamond East, Leidy SE, and especially the PennEast pipeline project (which accounts for 40–50 percent of the total land disturbance area in the DRB) passing through a similar corridor, which is heavily forested. Analyzing multiple pipeline projects simultaneously allows easier detection of these types of concentrated impacts. The body of the report contains many more tables, figures, and maps that break down results by pipeline, county, and subwatershed in much more detail.

These results offer a clear picture of the potential scale of pipeline development impacts on land cover across the Delaware River Basin, offering stakeholders a significantly different view than they might receive when reviewing individual projects. In the future, similar methodology may be used to investigate impacts in other geographic areas of interest. Or, these results could be used to conduct follow-on analyses of secondary impacts of pipeline infrastructure development in the DRB such as forest fragmentation, or water quality pollutant loadings.

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# Contents

**Introduction** ..... **1**

**Methodology** ..... **4**

Pipelines and Data Sources ..... 4
Right-of-Way Assumptions ..... 8
Construction and Permanent Rights-of-Way ..... 8
Greenfield Construction ..... 9
Adjacent to Existing Rights-of-Way ..... 9
Typical Right-of-Way Widths ..... 10
GIS Methods ..... 12
Estimation of Total Forest Area Impact ..... 15

**Results** ..... **16**

Validation ..... 16
Land Cover Distribution near Pipelines ..... 18
Land Cover Impact in the DRB ..... 21
Impact by Pipeline ..... 22
Impact by County ..... 24
Impact by Watershed ..... 26
Potential Stream Crossings ..... 30
Best Estimate of Impacts ..... 31
Forest Area Impacts ..... 31
Wetland Area Impacts ..... 33

**Discussion** ..... **34**

**Appendix A: County and Watershed Results Tables** ..... **38**

**References** ..... **44**

# List of Figures


Figure 1. Map of proposed pipelines within the Delaware River Basin ..... 7
Figure 2. Typical pipeline rights-of-way illustration ..... 8
Figure 3. Generalized GIS process for identifying land use breakdown within proposed pipeline right-of-way..... 12
Figure 4. GIS methodology illustration for the three area impact calculation methods for both greenfield construction (top), and construction adjacent to existing ROWs (bottom). ..... 14
Figure 5. Land cover disturbance area for typical ROW widths for the 8 proposed pipeline projects..... 19
Figure 6. Disturbance area by land cover type versus theoretical ROW buffer width for the 8 pipelines examined in the DRB ..... 19
Figure 7. As ROW width increases, forest area impacts increase in a linear fashion. ..... 20
Figure 8. As ROW width increases, the increase in wetland impact area is nearly linear ..... 21
Figure 9. Total disturbance areas in the DRB for the permanent and construction ROWs for the proposed pipeline as generated by the three GIS methods (A,B, &C) used in this study ..... 22
Figure 10. Land area impacts of proposed pipeline construction within the Delaware River Basin (DRB), by county ..... 25
Figure 11. New permanent ROW land cover breakdown by watershed (HUC10), with grouping by HUC8 watershed name (labels show total impact area)..... 27
Figure 12. New construction ROW land cover breakdown by watershed (HUC10), with grouping by HUC8 watershed name (labels show total impact area)..... 28
Figure 13. Watershed impacts of pipeline construction – land disturbance and stream crossings (labels show HUC10 numbers)..... 29

# List of Tables


Table 1. Proposed pipeline projects included in this study ..... 5
Table 2. Land cover groupings by 2011 National Land Cover Dataset classifications ..... 6
Table 3. Assumptions for right-of-way widths ..... 10
Table 4. Average width of pipeline ROWs based on reported disturbance area and pipeline length ..... 11
Table 5. Methods for estimating land use area impacts of proposed pipelines ..... 14
Table 6. Validation of new forest disturbance [ac] from pipeline documentation ("Document") versus GIS estimates for the permanent and construction ROWs ..... 17
Table 7. Validation of total new disturbance area [ac] from pipeline documentation ("Document") versus GIS estimates for the permanent and construction ROWs ..... 17
Table 8. Estimated disturbance area [ac] within the DRB by pipeline and land cover type for the new permanent ROW ..... 23
Table 9. Estimated disturbance area [ac] within the DRB by pipeline and land cover type for the new construction ROW. ..... 24
Table 10. Estimated total forest area impact for pipeline ROWs in the DRB by ROW type for the eight proposed pipelines in this study ..... 32
Table 11. Total land disturbance by county for new permanent ROWs[a] ..... 39
Table 12. Total land disturbance by county for construction ROWs[a] ..... 40
Table 13. Pipeline land area impact [acres] by watershed, Permanent ROW ..... 41
Table 14. Pipeline land area impact [acres] by watershed, Construction ROW. . 42
Table 15. Stream crossings by HUC-10 watershed: total, shared (potentially, with existing crossings), and new (=total – shared) ..... 43

# Glossary

| | |
|---|---|
| DRB | Delaware River Basin |
| EIS | Environmental Impact Statement |
| GIS | geographic information systems |
| FERC | Federal Energy Regulatory Commission |
| HDD | horizontal directional drilling |
| NHD | National Hydrography Dataset |
| NLCD | National Land Cover Dataset |
| ROW | Right-of-way |
| USGS | United States Geological Survey |
| | |
| ac | acres |
| ft | feet |
| mi | miles |
| | |
| easement | Legal term to describe the holding of land area to ensure access to pipelines (see "right-of-way"). |
| gathering pipeline | Small diameter pipelines used to transport from wells to the larger gas pipeline network. |
| greenfield | Term to describe construction in a new right-of-way |
| looping | Type of pipeline project in which a new pipeline is added parallel to an existing pipeline, and connected at both ends to form a 'loop' allowing for greater capacity and control of flow. |
| play | A geologic formation containing petroleum (natural gas) resources with potential for development. |
| right-of-way | The land area around a pipeline needed for access to construct the pipeline and protect, and maintain it over time. Typically wider during construction. |
| spoil side | Term to describe the side of the pipeline ROW where the excavated soil ("spoils") will be stored during construction. |
| well pad | The location from which gas wells are drilled from the surface into the shale. Typically, flat, covered with gravel, and two–five acres in size to accommodate equipment needed for well drilling. |
| working side | Term to describe the side of the pipeline ROW where construction equipment travels, and pipeline segments are laid out and assembled. |

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# Introduction

Over the past decade, the rapid expansion of unconventional natural gas development with hydraulic fracturing in the Marcellus Shale has been accompanied by an increase in pipeline construction proposals in Pennsylvania, New Jersey and New York. The process of shale gas development requires many miles of small gathering pipelines to connect well pads where gas is extracted to transmission pipelines that allow the gas to reach customers. In recent years, the operators of these transmission pipelines have proposed both upgrades and extensions to existing pipeline networks and entirely new pipelines. Many of these proposed pipelines cross the Delaware River Basin by virtue of its location between the Marcellus Shale and densely populated areas with demand for natural gas on the East Coast. It is these proposed transmission pipelines that are the focus of this analysis.

Interstate natural gas transmission pipelines (those that involve building infrastructure in more than one state) must be authorized by the Federal Energy Regulatory Commission (FERC).[1] The typical process is for the pipeline proponent to notify FERC of intention to build an interstate transmission pipeline, followed by the pipeline proponent marketing the pipeline to determine if enough contracts can be sold to build it, followed by a much more detailed route and design process. Then the pipeline proponent works in tandem with FERC staff to perform necessary environmental reviews before finalizing the pipeline route, acquiring necessary permits from relevant federal and state agencies, negotiating with land owners, developing construction plans, and building the pipeline [1]. The scope of the FERC environmental review process is broad, covering land use change impacts, water use, stream crossings and wetland impacts, potential impacts to species (fish, wildlife, and vegetation), soils, and air emissions, among others (including socioeconomic and cultural resource impacts) [2].

Pipelines, as linear features, bring a different set of challenges than most land development activities. While the pipeline itself requires a trench no more than a few

[1] This study also investigates a few transmission pipelines transporting other liquid fuels, and intrastate gas pipelines (those that do not cross state lines), which do not require FERC approval, but have very similar construction methods and impacts on land and water resources.

feet wide, the construction process requires a much wider right-of-way (ROW) area. In addition, the linearity of pipeline projects means that they cross numerous property boundaries, municipalities, and watersheds. The impact on any one of these geographic entities is typically limited, but over the entire length of the pipeline, the total land disturbance area can be significant. Furthermore, several pipelines built in the same area can cause larger cumulative impacts than the individual projects.

Pipeline construction can result in a wide range of environmental impacts, some of them interacting and layered. Experts studying the risks of shale gas development term the chain of potential impacts a "Risk Pathway," which describes how an *activity* (pipeline construction) leads to *burdens* (land cover change) that create *intermediate impacts* (e.g., forest fragmentation), leading to *final impacts* or *outcomes* (e.g., ecosystem change) [3-4]. In the case of pipeline construction, among the most well-known burdens and intermediate impacts are stream and wetland crossing impacts, land cover change, forest fragmentation, and habitat loss [5-9]. These impacts can lead to other impacts and outcomes, including ecosystem changes (relative changes in species abundance, impacts on specialist or threatened and endangered species), and hydrologic and water quality impacts resulting from the land disturbance (erosion and sedimentation, flow changes, and stream buffer impacts) [5, 10-12]. The hydrologic and water quality changes may in turn impact aquatic ecosystems in streams and wetlands [3, 5].

The FERC environmental review process does investigate many of these impacts in a series of resource reports and environmental assessments, often in detail, but there are some shortcomings for the projects examined in this report. Notably, the land cover change estimates are often broken down by political boundaries, but not always relevant natural boundaries, especially watersheds. Most importantly, the resource reports rarely investigate the cumulative land cover change impacts of multiple concurrent pipeline proposals on watersheds or sensitive land resources. We note that the environmental analyses prepared for many of these analyses were published prior to updated FERC guidance [2] that clarifies instructions for assessing cumulative impacts.[2] In this analysis, we investigate the combined land cover change of eight proposed pipelines within the boundaries of the Delaware River Basin (DRB).

The Delaware River drains an area of 13,000 square miles, and its watershed (i.e., the DRB) spans portions of Pennsylvania, New Jersey, and Delaware. The river itself, 330

[2] Guidance for the FERC environmental review process was updated in December 2015, after the majority of the analysis for this report was completed. The guidance clarifies cumulative impact as the "the impact on the environment which results from the incremental impact of the action [being studied] when added to other past, present, and reasonably foreseeable future actions…", and further notes that the geographic area to be examined should be specific and relevant to each resource category examined (e.g. land and water, air, cultural resources, etc.).

miles long, forms the border between Pennsylvania and New Jersey, and empties into the Delaware Bay, which separates Delaware and New Jersey. The DRB is the source of drinking water for roughly eight million people living within the basin, and roughly an equal number outside who receive water transferred from the basin [13]. Much of the basin has exceptional water quality in part due to the over five million acres (7,800 square miles) of forest and wetlands. The forests have been estimated to provide roughly $2,000 per acre per year (in 2010 dollars) in ecosystem service benefits such as water treatment, air pollution removal, and carbon sequestration, and the wetlands as much as $13,000 per acre. Another 4,500 square miles is used for agriculture, which is responsible for roughly $3.5 billion per year in revenue from farm products [14]. Land cover changes have the potential to degrade some of these benefits either directly (conversion to other land uses) or indirectly (e.g., pollutant runoff or fragmentation).

This study does not examine loss of these benefits in detail or the ultimate environmental outcomes from pipeline development, but these consequences establish the rationale for investigating the land cover changes. This study aims to provide credible estimates of the area of land cover changes associated with the eight transmission pipeline proposals.

# Methodology

In this study, we use Geographic Information Systems (GIS) methods to generate estimates of land cover change using spatially referenced pipeline route information (existing and proposed) and baseline land cover data. The goal of this methodology is to develop cumulative projections of land cover disturbance impacts for eight proposed pipeline projects that are currently anticipated to cross through the DRB. The primary metric of interest is the affected land area that is newly "disturbed" (i.e. converted from an existing non-pipeline related land use) within the pipeline projects' construction or permanent ROW, exclusive of area already within existing pipelines' ROW.

## Pipelines and Data Sources

Table 1 lists the eight pipeline projects included in this study. The most important data source for this analysis is pipeline route information. The primary source of pipeline route information was commercially available U.S. oil and gas pipeline facilities data purchased from IHS [15], which includes GIS data for both active and proposed pipelines. The IHS data includes route information for all of the pipeline projects except the Southern Reliability Link, and Penn East Pipeline project. The quality of the IHS data for the majority of pipeline routes is rated as "Excellent" (accurate within 50 feet), with the remainder rated as "Very Good" (50–300 feet), or "Good" (301–500 feet). The pipeline route information as purchased was current through the end of 2014.

We verified route information for all pipelines using other data sources. These sources include a GIS geodatabase provided by the Clean Air Council [16], which included preliminary route information for the Southern Reliability Link and Penn East Pipeline project (quality estimated as "Very Good"). In addition, we used maps available in FERC documents and from project proponent reports and websites. We projected digital versions of these maps into ArcGIS 10.2 in order to compare them with the geo-referenced pipeline route features. We also used these maps to update the route information when the route had changed during the course of the project planning. Table 1 includes references to the documents and maps from which we acquired all pipeline information used in this study.

Table 1. Proposed pipeline projects included in this study

| | Pipeline Project | Proponent | Details /Segments | Length in DRB [mi] | Sources* |
|---|---|---|---|---|---|
| **1** | Constitution Pipeline | Williams | | 13.5 | [17-19] |
| **2** | Diamond East Project | Williams | | 56.8 | [15] |
| **3** | Leidy SE Project | Williams | Franklin Loop | 11.2 | [20-21] |
| **4** | Mariner East[a] | Sunoco Logistics | Mariner East 1,<br>Mariner East 2 | 49.9<br>49.8 | [22-23] |
| **5** | Southern Reliability Link[b] | NJ Natural Gas | | 18.2 | [24-25] |
| **6** | PennEast Pipeline | PennEast Pipeline Co. | | 100.9 | [26-29] |
| **7** | TEAM 2014 Expansion Project | Spectra Energy | Bernville Loop | 5.6 | [30] |
| **8** | East Side Expansion Project | Columbia Pipeline Group | NJ Loop 10345,<br>PA Loop 1278 | 7.4<br>8.8 | [31-37] |
| | ***Total*** | | | **322.2** | |

* Sources common to several pipelines: [15-16]; [a] – transports other petroleum products; [b] – Not an interstate pipeline.

For the PennEast project, we used detailed project maps [29] (last updated July 22, 2015) as the primary data source and digitized the pipeline features over the entire project length.

We note that pipeline routes can and do change during project planning, and even construction. We have attempted to include the most recent preferred project routing available from the listed data sources as of September 30, 2015.

In addition to the pipeline route information, we also acquired land cover data. For this study, we used the National Land Cover Dataset (NLCD), 2011 version [38], for the states of New York, New Jersey, and the Commonwealth of Pennsylvania. This data is available as a raster data type, with a spatial resolution of 30 meters. Land cover types are distinguished by numeric codes. For this analysis, we combined some of the land cover types into larger groupings for simplicity. Table 2 shows these groupings. For example, three different forest types are combined into the "Forest" grouping.

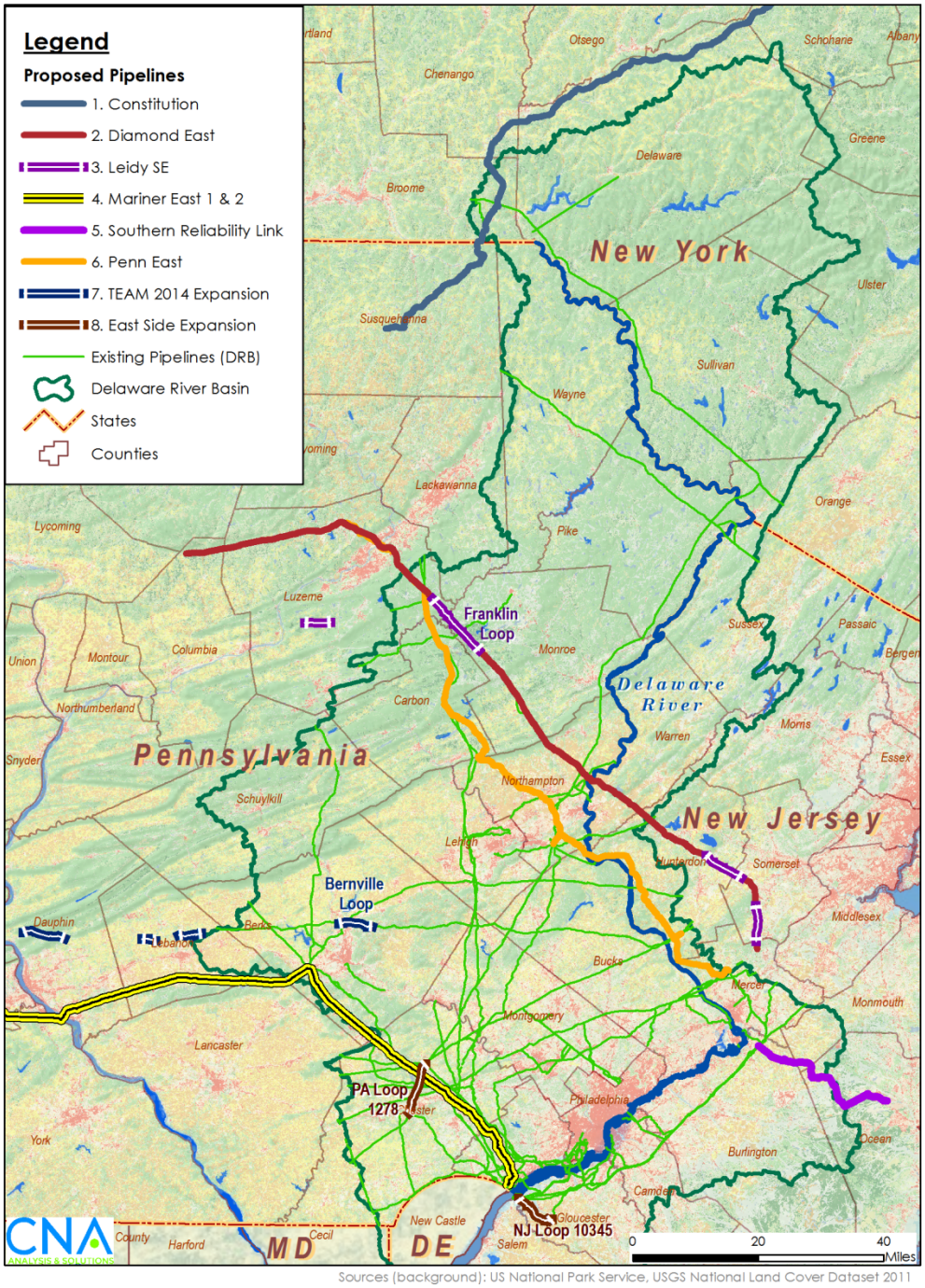
Table 2. Land cover groupings by 2011 National Land Cover Dataset classifications

| Grouping | NLCD Classifications Included |
|---|---|
| **Forest** | 41 – Deciduous Forest; 42 – Evergreen Forest; 43 – Mixed Forest |
| **Wetland** | 90 – Woody Wetlands; 95 – Emergent Herbaceous Wetlands |
| **Agriculture (Ag) – Pasture** | 81 – Pasture/Hay |
| **Ag - Cultivated** | 82 – Cultivated Crops |
| **Grassland/Shrub** | 71 – Grassland Herbaceous; 52- Shrub/Scrub |
| **Open Space** | 21 – Developed Open Space; 31 – Barren Land |
| **Developed** | 22 – Developed Low Intensity; 23- Developed Medium Intensity; 24 – Developed High Intensity |
| **Water** | 11 – Open Water |

Source: [39]

Figure 1 shows an overview map of the study area with the route information for the proposed pipelines overlaid on the NLCD 2011 land cover raster. In addition, the DRB boundary, county boundaries, and existing pipeline routes are shown for reference.

Figure 1. Map of proposed pipelines within the Delaware River Basin




Source: CNA; [15-17, 19, 24-26, 29, 31-32]

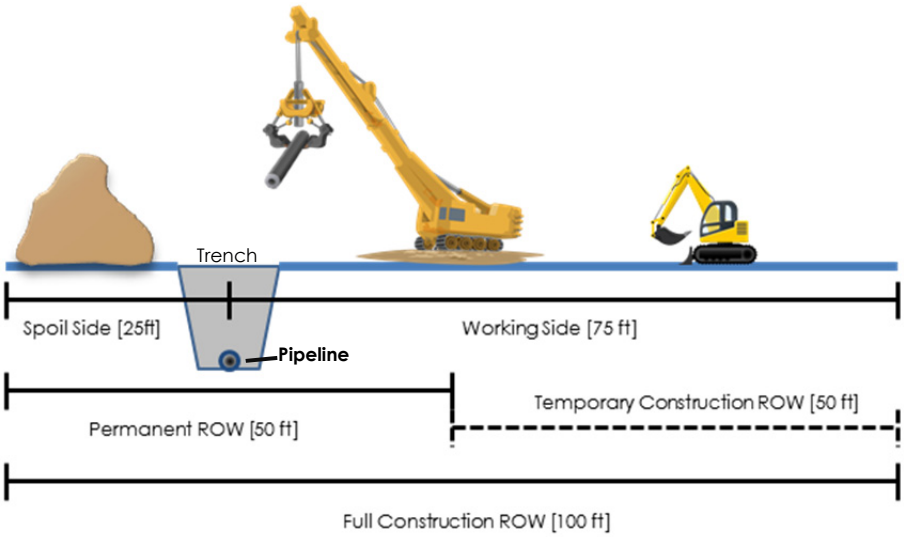
# Right-of-Way Assumptions

## Construction and Permanent Rights-of-Way

This analysis focuses primarily on the land disturbance required for pipeline development, which includes both permanent land use change impacts and additional disturbance during construction. For the purpose of this analysis, we define the permanent land cover change area as the new permanent right-of-way of the pipeline exclusive of existing permanent right-of-way shared by adjacent pipelines. The land cover change area during construction includes the new permanent right-of-way and additional temporary work space associated with construction, but excludes existing permanent right-of-way shared by adjacent pipelines. The FERC filings and other documents released by the project proponents differ in their presentation and description of these areas. In this study, "New Permanent ROW" is new area cleared for the permanent right-of-way, and "Construction ROW" is total area cleared during construction, inclusive of the New Permanent ROW. The temporary workspace may be inferred by subtraction. See Figure 2 for an illustration of typical ROWs for pipeline construction.

This analysis is limited to the direct pipeline ROWs and construction areas, and does not include additional land area needed for pipeline facilities (e.g. launchers, pump stations, etc.), access roads, or temporary equipment storage areas.

Figure 2. Typical pipeline rights-of-way illustration




Source: CNA; Clip art: clker.com, openclipart.org, office.com

## Greenfield Construction

Greenfield construction refers to pipeline construction through areas where no existing pipelines or rights-of-way are present. The entire operation requires new clearing for construction and operation.

When new pipelines are constructed outside of existing ROWs, a new permanent easement is created, and additional land is usually needed for construction. In general, construction ROWs are divided into a spoil side (area for storing soil and materials excavated from, or used for, backfilling the trench) and a larger working side for moving equipment, and aligning and connecting the pipeline itself before lowering into the trench.

The size of the construction area can vary depending on the type of terrain crossed. In wetlands or core forest areas, the construction ROW can be reduced to limit impacts. In urban or suburban areas, construction ROW may need to be reduced to avoid existing buildings, property lines, or utility infrastructure. In agricultural areas, sometimes a larger right-of-way is needed so that agricultural land can be quickly returned to productive use after construction. The additional area is needed to store the agricultural top soil that is removed during construction so that it can be replaced later, when the construction right-of-way returns to agricultural use.

## Adjacent to Existing Rights-of-Way

Pipelines are often routed adjacent to existing pipelines to minimize new clearing and costs of purchasing new easements. Looping projects are nearly always adjacent to the existing pipeline, but new pipelines may also run adjacent to existing pipelines, where possible, to reduce land disturbance impacts and costs. While some additional right-of-way is typically needed, the pipeline itself can often be laid within or very close to the existing permanent easement of another pipeline. That is, the spacing between pipelines can be reduced so that each pipeline does not need its own (typically 50-foot) full permanent right-of-way. When the existing and new pipelines have different owners, a new permanent ROW is generally required even when the routes are adjacent.

In general, it appears that the existing ROW of the adjacent existing pipeline is used as the spoil side of the construction right-of-way for the new pipeline. The wider working side of the construction ROW generally requires new clearing, so as to limit potential damage to existing pipelines due to the movement of heavy equipment.

## Typical Right-of-Way Widths

Our default assumption for the typical ROW width is 50 feet for the permanent easement and 100 feet for the total construction ROW. In this analysis, we analyze both a simplistic symmetric case with equal width on either side of the pipeline, and a more realistic case where the construction ROW is split asymmetrically across the pipeline. The rest of the section documents the assumption when an asymmetric ROW is used.

In greenfield construction, we assume the typical construction ROW is split into a 25-foot spoil side, and a 75-foot working side, with the outer 50 feet being temporary workspace, and 25 feet on either side of the pipeline as permanent easement (see Figure 2). For looping projects or pipelines adjacent to existing pipelines, we assume up to 25 feet of shared right-of-way on the spoil side. Thus, in the case that shared right-of-way is 25 feet, the new disturbance ROW width (all on the working side) is 25 feet for permanent right-of-way and 75 feet for construction ROW. Based on the location of the adjacent pipelines, we varied the amount of shared ROW between 10 and 25 feet. Accordingly, we reduced the spoil side width for construction between 0 and 15 feet, meaning that the new permanent ROW is between 25 and 40 feet in width (instead of 500 feet for greenfield projects). In situations when the proposed project pipeline route diverged from the path of the existing pipelines, we treated it as greenfield construction. Table 3 displays the default ROW widths we used in this study. Several of the pipelines have specific ROW widths specified by land cover type in their project documentation, including the PennEast and Constitution projects.

Table 3. Assumptions for right-of-way widths

| **Pipeline/ Construction method** | **Permanent ROW [ft]** | **Construction ROW [ft]** | | | | |
|---|---|---|---|---|---|---|
| | | Spoil side | Working-General | Working-Ag | Working-Wetland | Working-Forest |
| Greenfield: | | | | | | |
| Default | 50 | 25 | 75 | 100 | 50 | |
| PennEast | 50 | 35 | 65 | 90 | 40 | |
| Constitution | 50 | 30 | 80 | 95 | 45 | 70 |
| Looping: | | | | | | |
| Default | 25-40 | 0 - 15 | 75 | 100 | 50 | |

We used best professional judgment to determine on which side the spoil side and working side will fall, based on the route and location of other pipelines and infrastructure.

In cases where pipeline documentation specified techniques to reduce pipeline impacts, we attempted to replicate these using mile markers and other notes on construction methods as a guide.[3]

To check the validity of these assumptions, we calculated the implied average width for several pipeline segments using length and disturbance area reported in the FERC or project proponent documentation [17, 27, 33, 37]. Table 4 displays the relevant average ROW width for six pipeline segments, which was computed simply by dividing reported disturbance area for various types of ROW by pipeline length.

Table 4. Average width of pipeline ROWs based on reported disturbance area and pipeline length

| | | | **Average ROW Width** [ft] | | | |
|---|---|---|---|---|---|---|
| **Pipeline Project** | **Segment** | **Length** [mi] | New Perm. | Const. Temp. | Const. Total (new) | W/in Existing |
| East Side Expansion[a] | Loop 10345 NJ | 7.41 | 26.5 | 50.2 | 76.8 | ~25 |
| East Side Expansion[a] | Loop 1278 PA | 8.93 | 25.5 | 56.2 | 81.7 | ~25 |
| Leidy SE[a] | Franklin Loop | 11.47 | 26.0 | 30.0 | 55.9 | 45.0 |
| TEAM 2014[a] | Bernville Loop | 5.60 | 24.0 | 75.3 | 99.3 | 63.2 |
| Constitution[b] | Broome County | 16.85 | 45.9 | 57.8 | 103.7 | |
| PennEast[b] | Entire | 110.60 | 58.6 | 71.5 | 130.2 | |

Sources: [17, 27, 33, 37]

a. Looping project, or adjacent to existing pipeline ROW.

b. New "greenfield" construction project.

Based on Table 4, our assumptions for right-of-way width seem reasonable. The average new permanent ROW ("New Perm.") width for the four looping projects is 25.5 feet, and the temporary construction ROW ("Const. Temp.") width is 52.9 feet, for a construction total ROW of 78.4 feet of new clearing. So in general it is valid to assume that looping projects save roughly 25 feet of clearing width by using existing ROW on the spoil side during construction and sharing permanent ROW.

The new construction projects average 52.3 feet for new permanent ROW width, and an additional 64.6 feet for temporary construction ROW. Although the PennEast

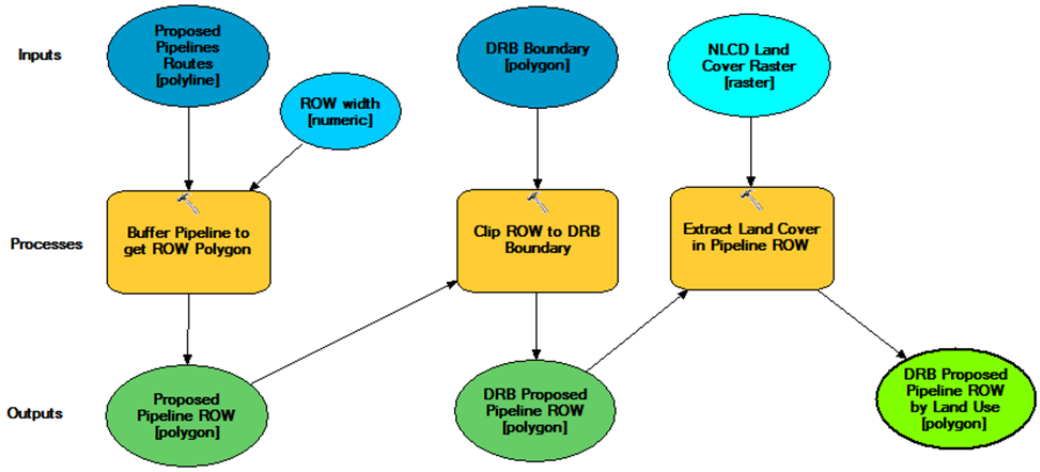
[3] For example, for horizontal directional drilling (HDD), we assumed a permanent ROW of 10 feet (to protect the pipeline) but no construction ROW over the drilled segment. We assumed a 250-by-200-foot drilling pad at the start and end of the HDD sections during construction.

appears to run adjacent to several existing pipelines for portions of its length, the reported areas in the PennEast project documentation [27] (and the calculated average widths) seem to suggest that a full-width permanent easement will be needed along its entire length. This may reflect the fact that PennEast will have a different proponent than the adjacent pipelines, and therefore will need its own easement.

# GIS Methods

The land cover analysis for pipelines involves two major steps: (1) converting pipeline route information (in line format) to right-of-way area (in polygon format), and (2) extracting land use types that fall within the right-of-way polygon. In Figure 3, we illustrate the general GIS methodology used for this analysis, including the inputs, processes, and outputs. The major inputs are the pipeline routes, DRB boundary, the NLCD 2011 raster, and the desired ROW width. GIS data types are shown in brackets. We performed additional post-processing as necessary to analyze the results at the county and watershed level.

Figure 3. Generalized GIS process for identifying land use breakdown within proposed pipeline right-of-way




Source: CNA, created with ESRI ArcGIS 10.2 ModelBuilder.

The actual process is slightly more complicated, and requires more steps to extract values from the NLCD raster over the correct domain and convert to a polygon data type. The process as shown can be used only for a symmetrical buffer about the pipeline, which is suitable for analyzing the permanent right-of-way, but not ideal for analyzing the construction ROW, which is typically asymmetric.

As a result, we used two separate methodologies - asymmetric buffering and symmetric buffering - to estimate the new disturbance caused by pipelines. The asymmetric method cuts the pipelines into segments, and uses two fields of the attribute table to create independent buffers on the left side, and then the right side of the feature. This permits setting the left and right side buffers to different values, allowing for an asymmetric simulated ROW. We adjusted the relevant right or left buffer width for each segment to account for shared rights-of-way with existing pipelines. For example, for an existing pipeline located 25 feet to the topographic left of the proposed pipeline, we would set the left buffer distance to zero instead of the typical 25 feet because there would no 'new' clearing needed.

The symmetric method uses a single entered value (e.g., 25 feet) to buffer a constant distance from the pipeline, which results in a symmetric ROW with a width of twice the entered value. We excluded the rights-of-way for existing pipelines by creating buffers (assuming a 50-foot permanent ROW) around the existing pipelines, and "erased" that area from the proposed pipeline ROW.

We also performed a third analysis based on the symmetric methodology to determine the total land disturbance for full-width ROWs with no exclusions for existing pipelines. We did not erase the existing pipeline ROWs in this case.

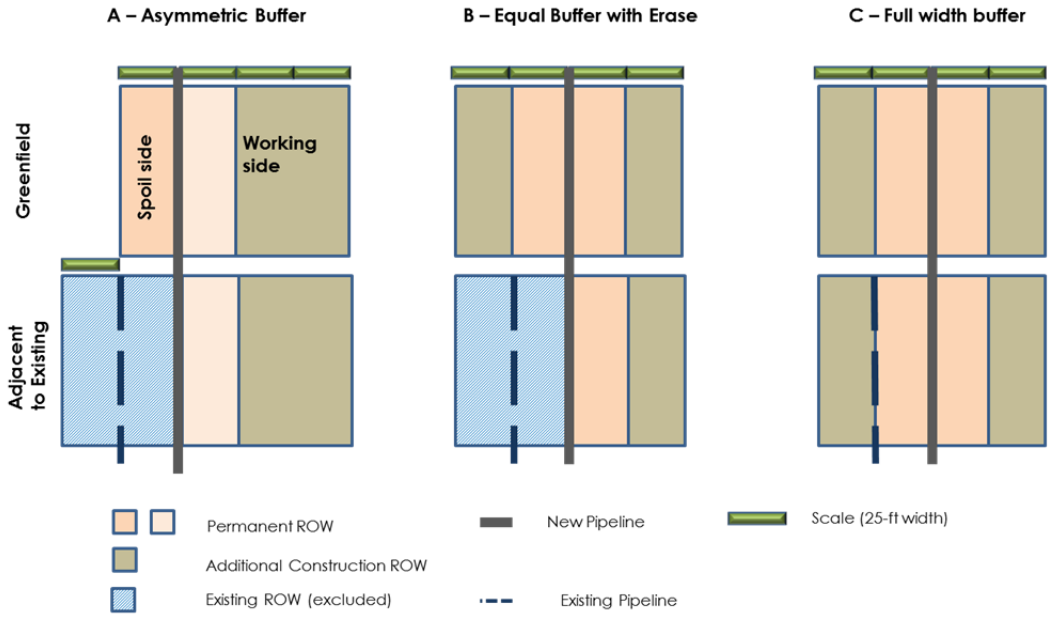
Table 5 describes these three methodologies in more detail. Figure 4 shows an illustration of the differences between the methodologies, including differences in handling cases involving shared ROWs with existing pipeline projects. The figure illustrates how the ROW is computed for both greenfield construction (top), and construction adjacent to existing ROWs (bottom).

In all three cases, we performed the analysis twice; first, we used smaller buffers for the permanent ROW, and then larger buffers for the construction ROW. Table 3 displays the assumed widths for these ROW cases.

Table 5. Methods for estimating land use area impacts of proposed pipelines

| Method | Name | Description |
|---|---|---|
| A | Asymmetric Buffer | Divide all pipelines into segments, and enter a buffer distance for the topographic left and right side of the feature. Adjust buffer width to account for different land use types and existing ROWs. In addition, account for special cases such as HDD and encroachments. |
| B | Equal Buffer with Erase | Buffer the proposed pipeline by a constant width (equating to either permanent or construction ROW), symmetric about the pipeline. In GIS, also buffer all existing pipeline features to account for a 50-ft permanent right-of-way. Use the Erase tool in GIS to remove the existing ROW area from the proposed ROW area. |
| C | Full-width buffer | Buffer the proposed pipeline by a constant width (equating to either permanent or construction ROW), symmetric about the pipeline. |

Figure 4. GIS methodology illustration for the three area impact calculation methods for both greenfield construction (top), and construction adjacent to existing ROWs (bottom).



# Estimation of Total Forest Area Impact

While this study investigates land cover disturbance for the entire range of land cover types in the NLCD, a particular metric of interest is the total direct forest area impact for the entire Delaware River Basin. (This study does not examine indirect effects such as loss of core forest area due to new forest edges.) We first calculate the forest area impact based on the GIS methodology described, but we recognize some limitations posed by using the NLCD raster. Namely, the coarseness of the NLCD and issues with assignment of land cover types could lead to errors for an individual land use type such as forests. Specifically, we have observed that existing pipeline rights-of-way are often classified as forest (instead of grassland or developed/open space), which may slightly over-estimate forest area. To a lesser extent, low-density residential (or agricultural) land with some tree canopy may also be classified as forest. The 30-meter resolution (cell size) of the NLCD may also come into play, as each cell is slightly wider than the typical construction ROW, and the land cover type may not be completely homogenous within the cell.

In order to correct potential errors in forest area, we validate our GIS results against forest area impacts reported in the FERC or pipeline proponent documentation, which should be more accurate due to greater precision of right-of-way limits and possibly more precise land cover data. Through comparison of these two forest area estimates, we generate adjustment factors that can be used to compute a refined estimate of forest area impacts for the whole basin based on the GIS results. The next section, particularly Table 6, explains the validation process for the forest areas, and presents the adjustment factors we use to compute the best estimate of total forest area impact.

# Results

This section presents results of the land cover disturbance analysis. We first present a validation of the methodology. Then we present the total land disturbance area within the DRB for both permanent ROWs and construction ROWs, followed by more granular results by pipeline, by county, and by watershed. Finally, we present our own calculations of the total number of stream and waterbody crossings.

## Validation

We validated our GIS methodology by comparing estimates of new pipeline impact by land use to similar estimates in the FERC documentation. All of the GIS estimates used for validation were generated using the "A – Asymmetric Buffer" methodology (see Table 5). We focused on pipelines with disturbance area broken out by land cover type in the documentation, and with pipeline segments within the DRB. Three pipeline projects had segments entirely within the DRB with detailed land cover impact estimates: the Leidy SE Franklin Loop, the TEAM 2014 Bernville Loop, and the two loops in the East Side expansion project. While these projects all fit these criteria, they are also primarily looping projects. Thus we also included the Broome County section of the Constitution pipeline, which is mostly within the DRB, in order to check the methodology on a primarily greenfield construction project.

For validation, we elected to compare the new area impacted for forest, and for all land cover types. Table 6 displays the validation results for forest area impact, and Table 7 for total area impact (all land cover types). The definitions of land cover class groupings for computation of area impact varied by pipeline project. In some cases, the existing right-of-way area was not separated from the total impact area. Generally, the "Open Space" land cover type included the existing pipeline ROW areas. In these cases, we left out the "Open Space" land cover type (where existing ROW area was included in the documentation) from the total. We have denoted the projects to which this assumption was applied with an asterisk. We analyzed the impacts using all the remaining land cover types.

Generally, our GIS estimates of forest disturbance are about 25 percent high for permanent ROW, and 13 percent high for construction ROW as compared to the pipeline documentation. By contrast, GIS estimates of total disturbance are about 5

percent high for permanent ROW and 3 percent low for construction ROW, which amounts to an overall average error of 1.5 percent high.

Table 6. Validation of new forest disturbance [ac] from pipeline documentation ("Document") versus GIS estimates for the permanent and construction ROWs

| | New Permanent ROW | | | Construction ROW | | |
|---|---|---|---|---|---|---|
| **Pipeline Project** | Document [ac] | GIS [ac] | Error [%] | Document [ac] | GIS [ac] | Error [%} |
| Leidy SE - Franklin | 14.9 | 21.9 | 47.5% | 42.6 | 51.8 | 21.5% |
| TEAM 2014- Bernville | 5.9 | 6.7 | 13.6% | 22.6 | 26.3 | 16.6% |
| East Side - NJ | | | | 10.3 | 3.0 | -70.8% |
| East Side - PA | | | | 21.4 | 25.0 | 16.9% |
| Constitution (Broome County) | 47.5 | 56.6 | 19.1% | 98.5 | 114.3 | 16.0% |
| Median | | | 19.1% | | | 16.6% |
| **Weighted Average** | **68.3** | **85.2** | **24.8%** | **195.5** | **220.5** | **12.8%** |

Table 7. Validation of total new disturbance area [ac] from pipeline documentation ("Document") versus GIS estimates for the permanent and construction ROWs

| | New Permanent ROW | | | Construction ROW | | |
|---|---|---|---|---|---|---|
| **Pipeline Project** | Document [ac] | GIS [ac] | Error [%] | Document [ac] | GIS [ac] | Error [%] |
| Leidy SE - Franklin | 36.1 | 33.9 | -6.0% | 77.7 | 75.6 | -2.7% |
| TEAM 2014 - Bernville * | 16.4 | 18.4 | 12.0% | 69.7 | 61.5 | -11.7% |
| East Side - NJ * | | | | 65.5 | 65.2 | -0.3% |
| East Side - PA * | | | | 89.7 | 82.7 | -19.4% |
| Constitution (Broome County) | 93.4 | 100.9 | 8.0% | 211.1 | 211.7 | 0.3% |
| Median | | | 8.0% | | | -2.7% |
| **Weighted Average** | **145.9** | **153.2** | **5.0%** | **513.6** | **496.8** | **-3.3%** |

* Open Space excluded from calculations because pipeline documentation does not distinguish open space in existing ROWs from new open space impacts.

# Land Cover Distribution near Pipelines

Land cover disturbance area estimates could theoretically be sensitive to small errors or potential changes in pipeline route information. It is common that pipelines may have small shifts in routing all the way through construction. For instance, the PennEast pipeline has a 400-foot right-of-way "study area" to account for some of these potential shifts in the final route [26]. In addition, the GIS pipeline route data on which we based this analysis was of varying spatial accuracy (generally within 50 feet, but occasionally only within 300–500 feet).

Before investigating the new disturbance areas within the pipeline ROWs only, we investigated the sensitivity of the land cover impact area to uncertainty in pipeline route. To do so, we computed the land cover characteristics of the larger areas in successively wider 'corridors' around proposed pipeline routes. Here we assume a symmetric buffer and we don't exclude existing ROW, so the calculation method is method C (see Table 5).

We examined the land cover distribution as a function of distance from the proposed route by progressively increasing the buffer width from the pipeline. If the distribution does not change as the buffer distance increases, we can be reasonably confident that the errors associated with route uncertainty are relatively small. If the relative proportions of a given land use change as the buffer distance (i.e. ROW width) increases, then pipeline siting may be effectively avoiding (or targeting) certain types of land uses. Plotting the areas of disturbance versus pipeline ROW width also gives an idea of the general makeup of the land cover in the neighborhood of pipelines.

We first investigated the area very close to the pipeline at several ROW widths, including 10 feet (minimum in areas such as wetlands), 30 feet (typical cleared ROW width in the permanent easement), 50 feet (typical permanent easement), and 100 feet (typical construction easement).

Figure 5 displays these results, which do not exclude existing ROW, and so is not solely new disturbance area. Figure 6 displays the results for larger buffer distances (up to a width of 400 feet) on a continuous stacked area plot. For each land cover type, the increase is nearly linear.

Figure 5. Land cover disturbance area for typical ROW widths for the 8 proposed pipeline projects

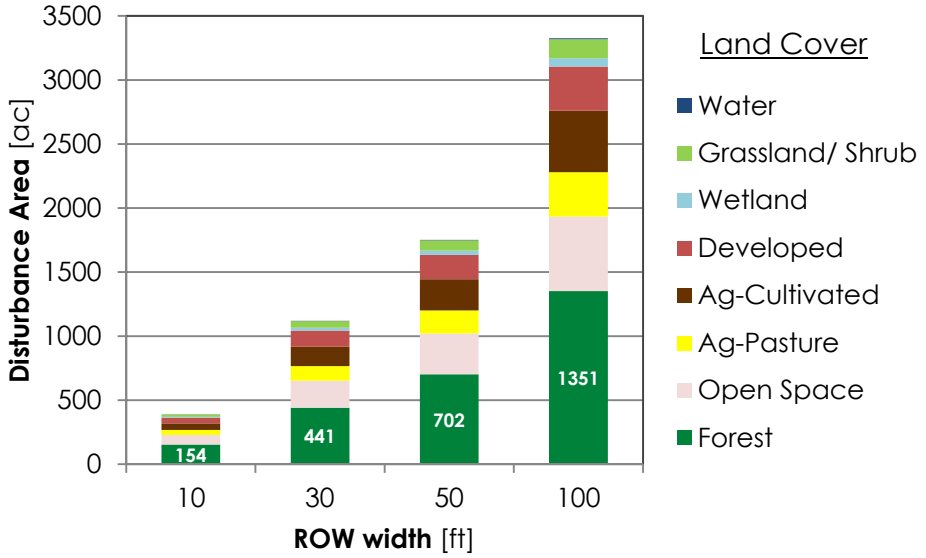
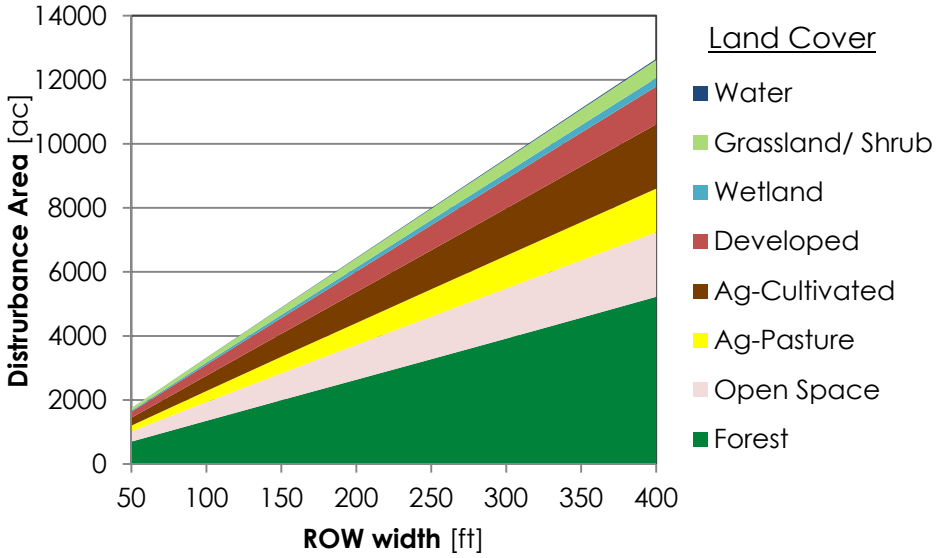
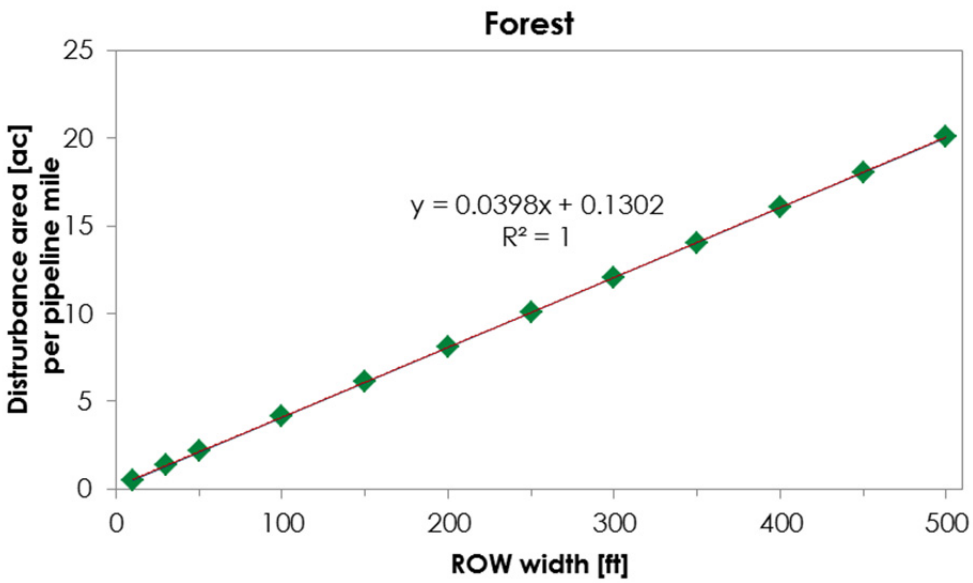



Figure 6. Disturbance area by land cover type versus theoretical ROW buffer width for the 8 pipelines examined in the DRB



We can check these results to see whether the increase in area versus increase in ROW width for particular land use types is truly linear. First we analyze forest impacts. Figure 7 shows the amount of forest area affected versus pipeline ROW width. In this case, the forest area is normalized to the pipeline length, so the vertical axis shows impacted acreage per mile of pipeline. The figure demonstrates that the trend is very much linear. By fitting a trendline to the data, we generate a useful equation that gives the expected forest area impacted per mile for each additional foot of pipeline ROW width. In this case, the slope of the trendline indicates that, on average, each mile of new pipeline in the DRB will affect 0.04 acres of forest for each foot of ROW width. So a 50-foot ROW will affect roughly two acres of forest per mile.

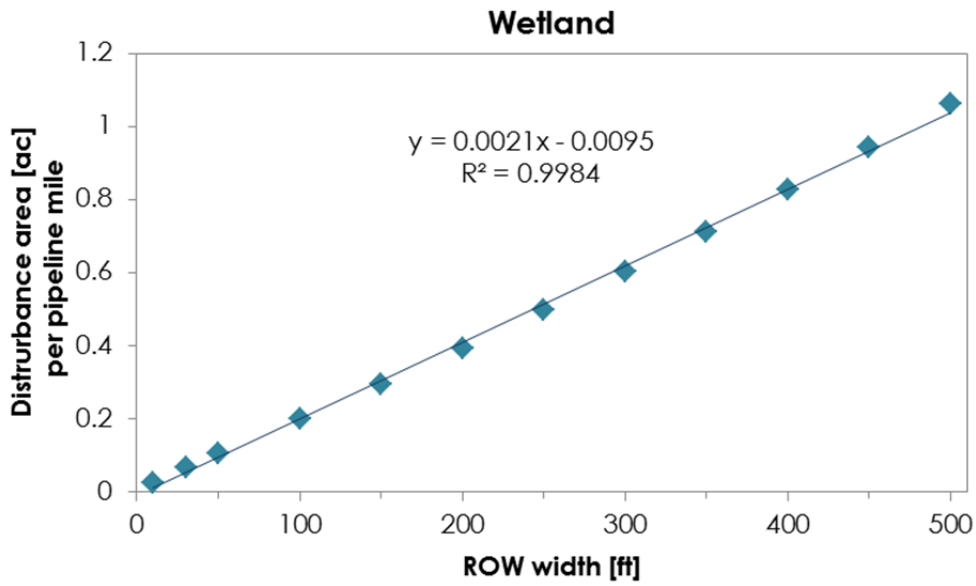
Figure 7. As ROW width increases, forest area impacts increase in a linear fashion.




Many of the other land cover types show a similar pattern. For wetlands, the trend is nearly linear (see Figure 8). Based on this analysis, the slope of the trendline indicates that, on average, each mile of new pipeline in the DRB will affect 0.002 acres of wetland for each foot of ROW width. So, a 50-foot ROW will affect roughly 0.1 acres of wetland per mile on average.

The equations presented here can provide a useful means for generating an initial estimate of the potential impact from pipeline development in the DRB if no information is known about the specific route. Though we add the caveat that the relationships are based on the eight pipeline projects we examined. A more localized analysis would then be needed to generate more refined estimates of the impacts for a specific pipeline project once the route is known.

Figure 8. As ROW width increases, the increase in wetland impact area is nearly linear

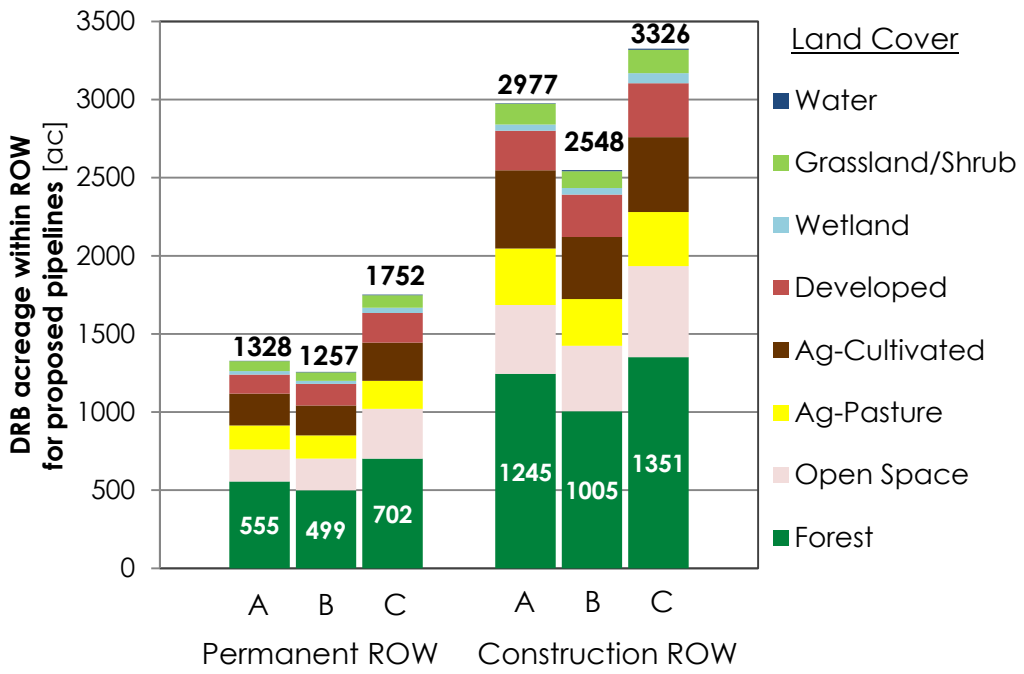



# Land Cover Impact in the DRB

Figure 9 displays the total new disturbance area in the DRB associated with ROW construction for the eight proposed pipelines projects. The results for the new permanent ROW are shown on the left, and the construction ROW on the right, each computed via three separate methodologies (refer to Table 5). Labels on the graph display the forest area impacted and total area impacted for each methodology.

Method A is the best estimate using asymmetric buffers, and excluding existing ROW. Method B is the symmetric buffer method excluding existing ROW. Method C is the symmetric buffer method with no exclusions. The forest impact area and total area in acres are labeled on the chart. We note that the computations for Methods A and B are very similar for the permanent ROW, but are different for the construction ROW. This is likely due to the fact that the asymmetric buffer used for Method A would create less overlap with existing ROW than the symmetric buffer method used in Method B. Method C does not exclude any existing ROW, and is unsurprisingly the highest estimate.

Figure 9. Total disturbance areas in the DRB for the permanent and construction ROWs for the proposed pipeline as generated by the three GIS methods (A,B, &C) used in this study




# Impact by Pipeline

The total new disturbance area can be separated by pipeline only to a limited extent because some of the new pipelines share a ROW for part of their length: For instance, the Diamond East and Leidy SE projects (see Figure 1), which also have the same pipeline proponent. Or the Mariner East and East Side Expansion projects, which intersect each other.

Table 8 displays the estimated disturbance area by pipeline, broken down by land cover type for the new permanent ROW. Table 9 shows the same for the construction ROW. In both cases, the areas shown are the areas only within the DRB. The area calculations reflect the Method A methodology (see Table 5) applied for each pipeline. The total area disturbed by land cover type is shown at the bottom as the sum of the individual pipeline results. This total includes double-counting of some area where the proposed pipeline ROWs cross or are parallel. Hence, we also present the totals for all pipelines computed where all proposed pipeline ROWs are merged

to avoid double-counting. We observe from the Method A total results (computed with the same methods as the sum of individual pipeline results) that the double-counted area is roughly 18 acres (1346 minus 1328). Results for Methods B and C (see Table 5) are shown for comparison.

Table 8. Estimated disturbance area [ac] within the DRB by pipeline and land cover type for the new permanent ROW

| Pipeline | Forest | Wetland | Grassland/Shrub | Ag - Pasture | Ag- Cultivated | Open Land | Developed | Water | Total |
|---|---|---|---|---|---|---|---|---|---|
| Constitution Pipeline | 40.7 | 0.9 | 1.3 | 29.0 | 4.9 | 3.8 | 0.1 | 0.0 | **80.8** |
| Diamond East Project | 96.7 | 6.3 | 3.7 | 9.2 | 23.7 | 26.6 | 3.9 | 0.6 | **170.7** |
| Leidy SE Project | 21.9 | 3.7 | 3.3 | 0.3 | 0.1 | 4.0 | 0.1 | 0.4 | **33.9** |
| Mariner East 1&2 | 75.5 | 1.4 | 16.6 | 28.2 | 25.3 | 76.1 | 51.7 | 0.0 | **274.9** |
| NJ Natural Gas Project | 7.1 | 1.4 | 1.8 | 4.3 | 11.3 | 48.1 | 36.0 | 0.0 | **110.0** |
| PennEast Pipeline | 311.2 | 6.6 | 36.7 | 72.8 | 132.3 | 33.8 | 14.1 | 0.4 | **607.9** |
| TEAM 2014 Expansion Proj. | 6.7 | 0.1 | 0.4 | 2.5 | 2.5 | 2.7 | 3.3 | 0.1 | **18.4** |
| East Side Expansion Project | 8.6 | 2.5 | 2.0 | 6.8 | 4.2 | 12.0 | 12.9 | 0.0 | **49.0** |
| *NJ Loop 10345* | *0.9* | *1.9* | *0.4* | *2.1* | *1.2* | *4.9* | *9.0* | *0.0* | **20.6** |
| *PA Loop 1278* | *7.7* | *0.6* | *1.6* | *4.7* | *3.0* | *7.1* | *3.8* | *0.0* | **28.5** |
| TOTALS - by method | | | | | | | | | |
| Sum of Pipeline Results [a] | 568 | 23 | 66 | 153 | 204 | 207 | 122 | 1.5 | **1346** |
| A - Asymmetric buffer | 555 | 22 | 64 | 153 | 204 | 205 | 122 | 1.4 | **1328** |
| B - Symmetric buffer | 499 | 20.2 | 56.4 | 149 | 192 | 200 | 137 | 3.2 | **1257** |
| C - Full symmetric buffer | 702 | 34.3 | 79.8 | 180 | 244 | 319 | 189 | 4.1 | **1752** |

[a.] "Sum of Pipeline Results" includes some double counting of areas, notably for Mariner East 1 and 2, and Leidy SE, Diamond East, and PennEast.

NOTE: Pipeline results generated using Method A. Totals shown for other methodologies by comparison. Totals may not sum exactly due to rounding.

Table 9. Estimated disturbance area [ac] within the DRB by pipeline and land cover type for the new construction ROW.

| Pipeline | Forest | Wetland | Grassland/Shrub | Ag - Pasture | Ag- Cultivated | Open Land | Developed | Water | Total |
|---|---|---|---|---|---|---|---|---|---|
| Constitution Pipeline | 80.8 | 1.5 | 2.4 | 65.0 | 11.1 | 8.1 | 0.4 | 0.0 | **169.3** |
| Diamond East Project | 295.7 | 15.1 | 8.0 | 28.8 | 71.5 | 74.4 | 11.7 | 2.2 | **507.4** |
| Leidy SE Project | 51.8 | 6.1 | 5.4 | 0.9 | 0.3 | 10.0 | 0.3 | 0.8 | **75.6** |
| Mariner East 1&2 | 172.0 | 3.9 | 39.6 | 64.7 | 64.2 | 160.2 | 100.9 | 0.1 | **605.7** |
| Southern Reliability Link | 16.2 | 2.7 | 3.5 | 11.4 | 29.8 | 83.2 | 68.0 | 0.0 | **214.7** |
| PennEast Pipeline | 633.3 | 11.1 | 71.3 | 164.3 | 305.8 | 70.7 | 27.9 | 0.7 | **1285.1** |
| TEAM 2014 Expansion Project | 19.7 | 0.3 | 0.8 | 6.4 | 7.3 | 6.9 | 7.4 | 0.1 | **48.9** |
| East Side Expansion Project | 24.8 | 4.3 | 5.2 | 20.1 | 11.5 | 34.2 | 36.5 | 0.0 | **136.6** |
| *NJ Loop 10345* | *2.5* | *3.1* | *1.3* | *6.8* | *3.8* | *13.8* | *24.8* | *0.0* | **56.2** |
| *PA Loop 1278* | *22.3* | *1.2* | *3.8* | *13.3* | *7.7* | *20.4* | *11.8* | *0.0* | **80.5** |
| TOTALS - by method | | | | | | | | | |
| Sum of Pipeline Results[a] | 1294 | 45 | 136 | 362 | 501 | 448 | 253 | 3.9 | **3043** |
| A - Asymmetric buffer | 1245 | 41 | 133 | 361 | 501 | 440 | 253 | 3.3 | **2977** |
| B - Symmetric buffer | 1005 | 42 | 112 | 299 | 398 | 414 | 272 | 6.6 | **2548** |
| C - Full width symmetric buffer | 1351 | 65 | 149 | 344 | 479 | 582 | 344 | 8.1 | **3324** |

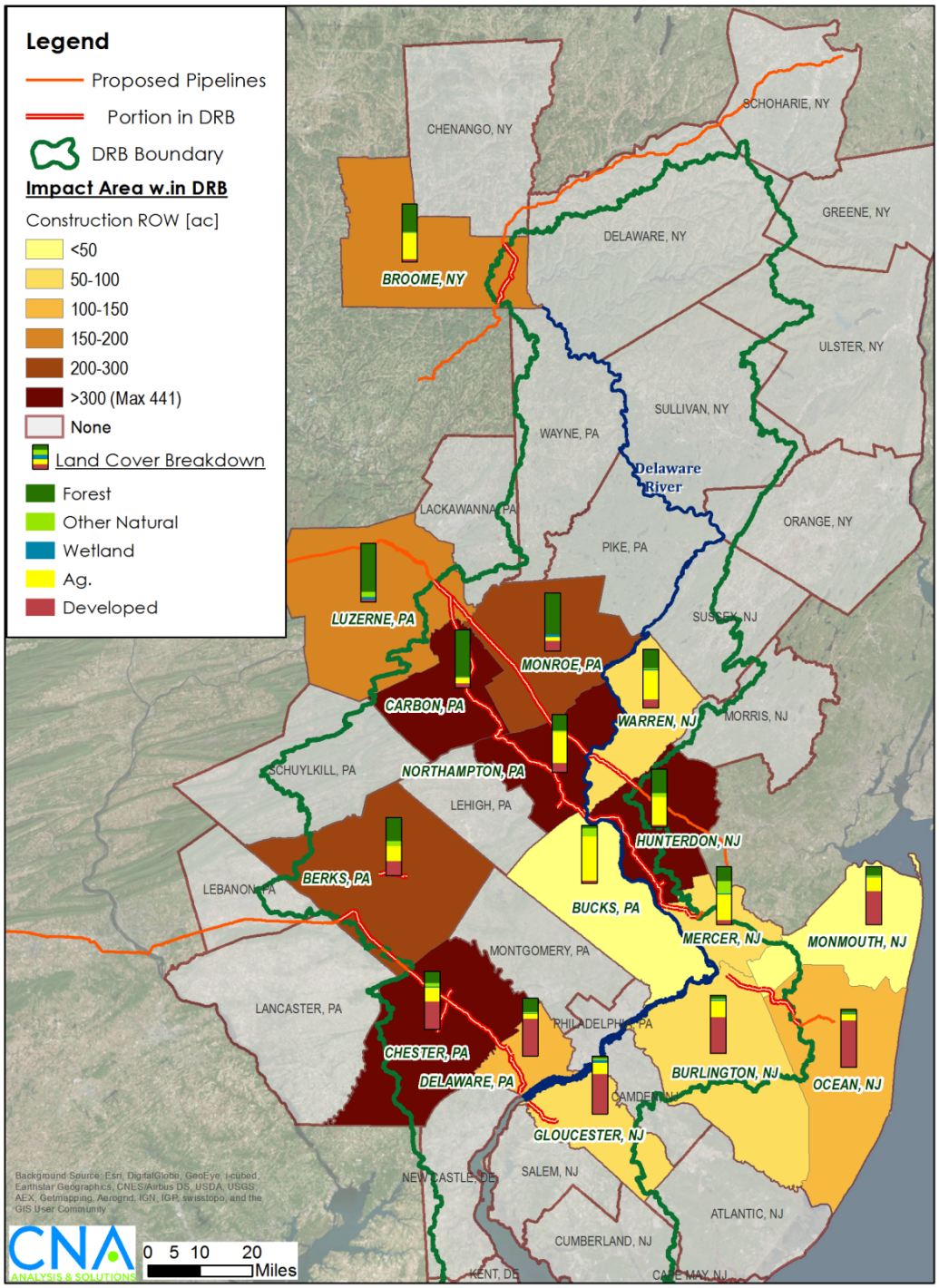
[a.] "Sum of Pipeline Results" includes some double counting of areas, notably for Mariner East 1 and 2, and Leidy SE, Diamond East, and Penn East.

NOTE: Pipeline results generated using Method A. Totals shown for other methodologies by comparison. Totals may not sum exactly due to rounding.

# Impact by County

We computed the total area impact by county by intersecting the Method A total impact area in the DRB with county boundaries. Figure 10 maps the construction ROW impact by county. Shading shows the total area impacted by construction ROW within the DRB portion of each county. Stacked bars on the map show the breakdown of the impacted area by land cover type. See Appendix A for the results by county in tabular format. (Table 11 displays the county-level area impact for the new permanent ROW, and Table 12 does so for the construction ROW.)

Figure 10. Land area impacts of proposed pipeline construction within the Delaware River Basin (DRB), by county



In Figure 9, it appears the impacts will be most concentrated in the central portion of the DRB. Carbon, Monroe, and Hunterdon counties all have in excess of 200 acres of land disturbance, while Northampton has the highest of any county, with 441. These counties also have the largest percentage of the impact affecting forests. For instance, over 75 percent of the total impact area in Luzerne and Carbon counties will be in forests.

The lower portion of the watershed also has a concentration of impacts. Chester and Berks Counties each have over 200 acres affected during construction. The land cover types impacted are distributed more across agriculture, developed land, and forests than in the middle portion of the basin.

Broome is the only county with impacts in the upper basin. The area of impact is roughly evenly divided between forest and agriculture.

Overall, the breakdown of land cover types affected by pipeline development follow the general land cover patterns of the DRB as a whole: predominantly forest in the Upper and Western portions of the basin, more agriculture in the middle and Eastern portions, and finally, much more developed land in the lower portion of the basin.

# Impact by Watershed

In addition to analyzing the results by county, we also investigated the results by using hydrographic boundaries. We totaled the results by Hydrologic Unit Code–10 digit (HUC10) watershed using data from the USGS Watershed Boundary Dataset [40]. In Figure 11, we display the results for new permanent ROW area by HUC10 watershed as a stacked bar chart. Figure 12 shows similar results for the new construction ROW. On the left, the HUC10s are grouped by the larger HUC8 watershed subdivision, with the HUC8 names labeled. (Figure 13 shows the spatial location of both the HUC10 and HUC8 boundaries.) The bold number labels on the graph indicate total area impacted in acres. The breakdown of the area by land cover type is shown in a table format in Appendix A (see Table 13 and Table 14).

Figure 13 shows the total new construction ROW area impact on a map instead. (Shading denotes total new construction ROW area [ac] by HUC10 for the proposed pipeline projects.) It is clear from the map that the most area will be affected through the middle portion of the DRB, especially in the Lehigh and Middle Delaware HUC8 watersheds, and to a lesser extent the Schuylkill, Brandywine-Christina, and Lower Delaware watersheds. These areas, especially the Lehigh subbasin, also have the majority of the forest disturbance.

Figure 11. New permanent ROW land cover breakdown by watershed (HUC10), with grouping by HUC8 watershed name (labels show total impact area)

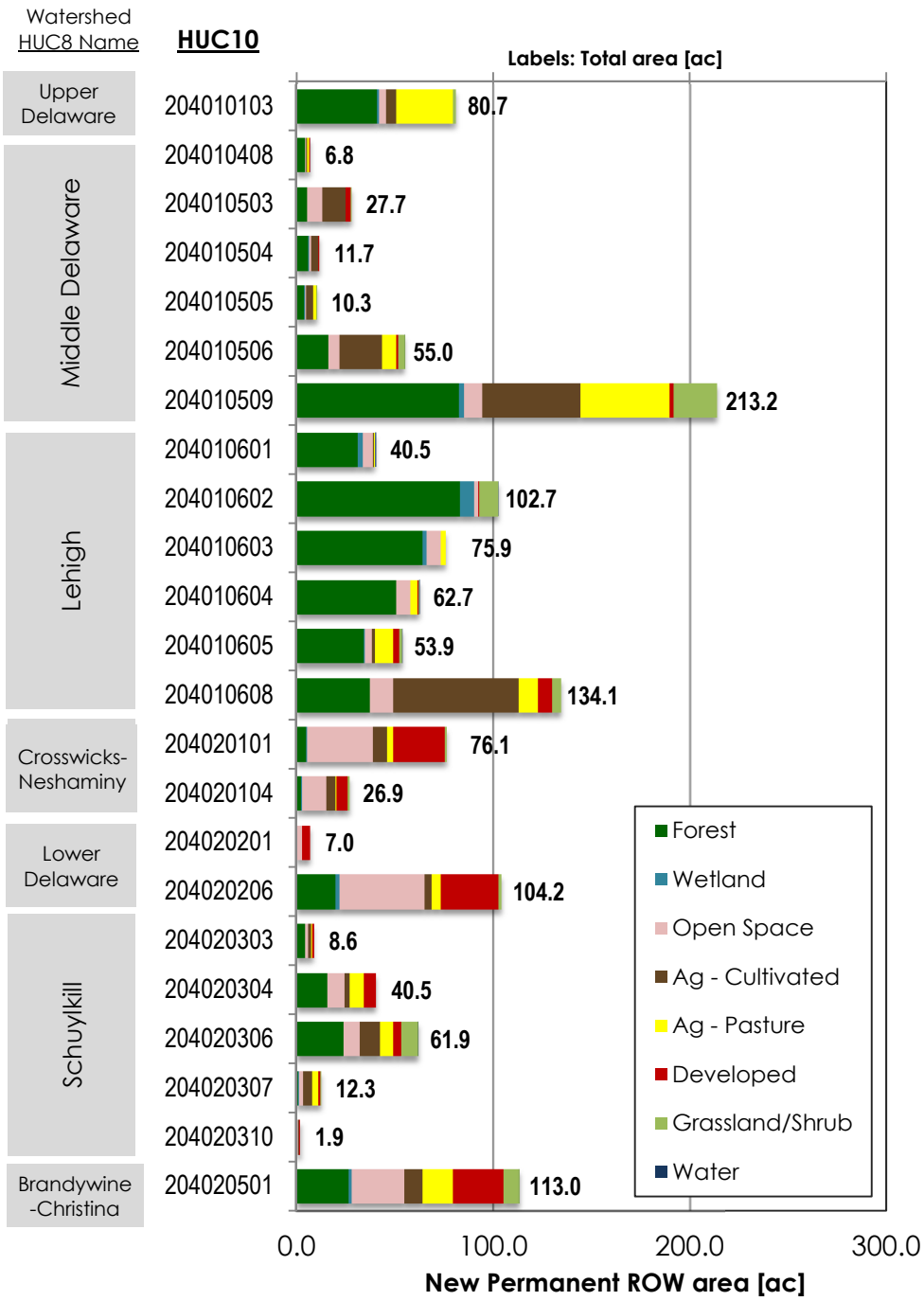


Figure 12. New construction ROW land cover breakdown by watershed (HUC10), with grouping by HUC8 watershed name (labels show total impact area)

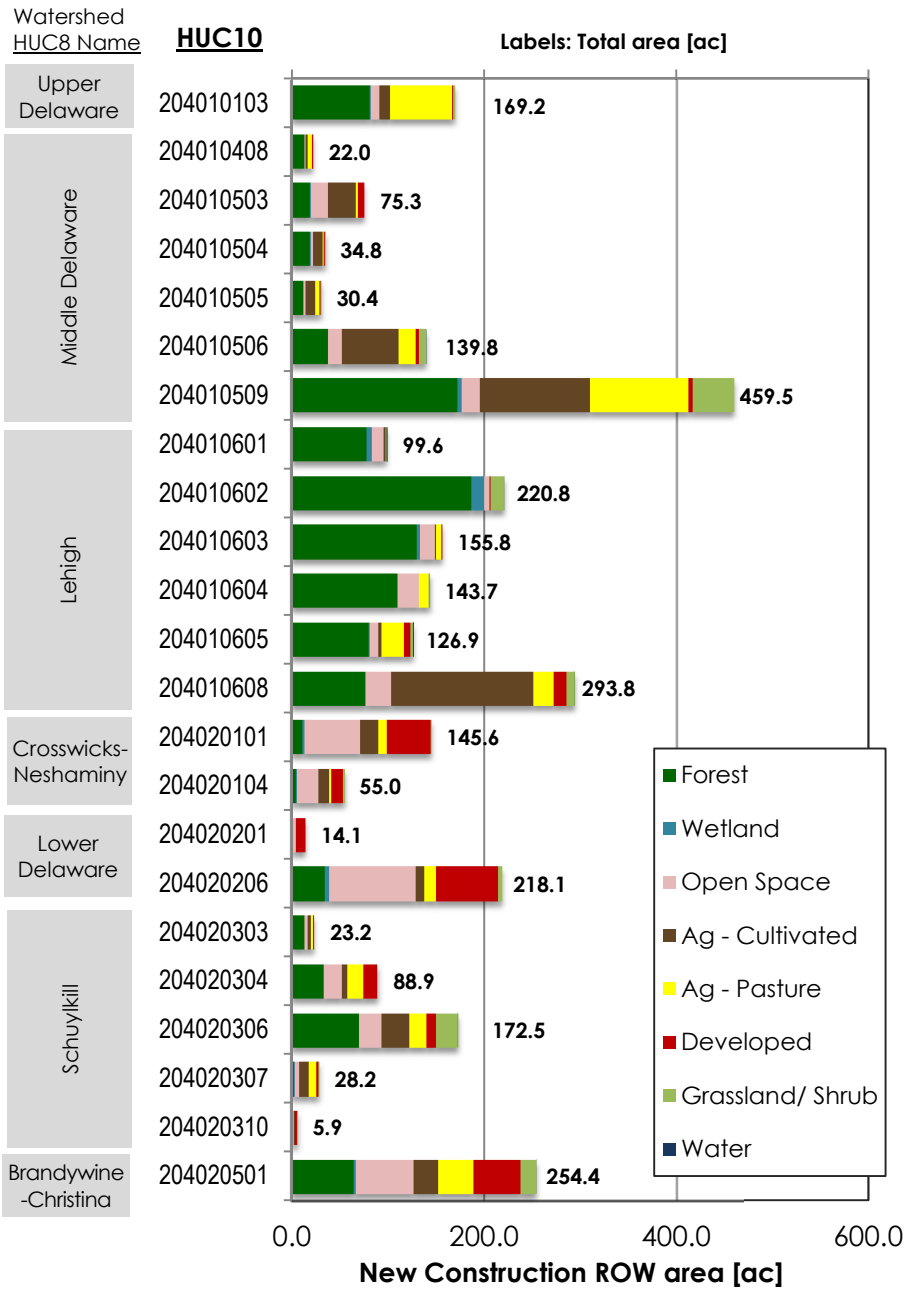
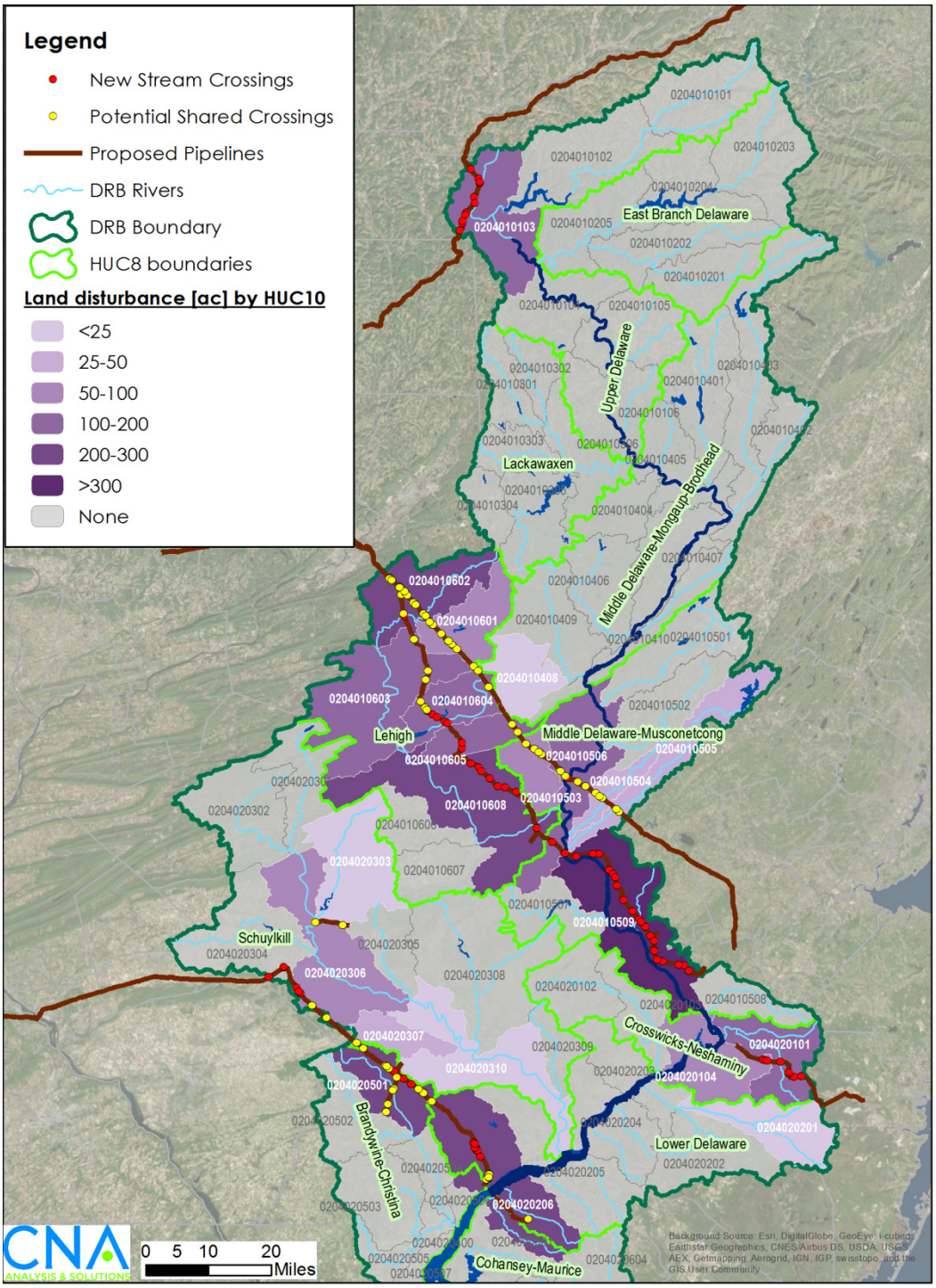


Figure 13. Watershed impacts of pipeline construction – land disturbance and stream crossings (labels show HUC10 numbers)



# Potential Stream Crossings

Stream crossings are a particular area of concern for pipeline development, as land in close proximity to waterways is at high risk for erosion, nutrient export, and potential pollutant export. In addition, any sediment or pollutants that enter the stream will be carried downstream in the waterway.

While the final EIS documents approved by FERC for pipeline projects contain listings of the proposed stream crossings, it is difficult to determine the total number of stream crossings for all eight projects for several reasons. Not all of the pipelines have final EIS documents, and the location of stream crossings is not in a consistent format across the different documents. In some cases, it is difficult to assess whether certain streams are within the Delaware River Basin. For these reasons, we assessed stream crossings using a consistent methodology for all of the proposed pipelines.

We computed the number of stream intersections[4] in GIS using the pipeline route information and the National Hydrography Dataset Plus Version 2 (NHDPlus v2) stream flowlines. The NHDPlus v2 dataset is fairly high resolution (stream segments drain less than one square mile on average in the Delaware River basin), but does not include most intermittent streams or ephemeral streams in the Eastern US.

We also accounted for the possibility that existing stream crossings could be used where proposed pipelines are parallel to existing pipelines. We assumed that when an existing pipeline intersected the stream within 250 feet[5] of the proposed pipeline's crossing, a shared crossing would be used.

Figure 13 shows these intersection points that indicate stream crossings. The yellow points indicate crossings that have some potential to share an existing crossing. The red points indicate "new" crossings that are not adjacent to existing pipeline crossings of streams. Table 15 (in Appendix A) tabulates the intersections by HUC10.

In total, we found 175 potential new crossings, of which 92 have the potential to be "shared" crossings with existing pipelines.

[4] We used the ArcGIS Intersect tool with the pipeline routes and NHDPlus flowlines as inputs (both are polyline datatype), which results in a point file with a point marking each location a stream and a proposed pipeline intersect.

[5] We generated a second set of intersection points using existing pipeline routes and NHDPlus flowlines. Then we computed the number of proposed intersection points falling within 250 feet of these intersections. We chose 250 feet as a generous buffer that can identify potential shared crossings even when the stream line is nearly parallel to the pipeline ROWs.

This total counts only intersections with streams in the NHDPlus database, and likely dramatically undercounts the total number of stream crossings due to many intermittent and ephemeral streams not included in the database. We note that the environmental assessment documents issued by FERC and the pipeline proponents usually provide a more complete accounting of potential stream crossings, most likely gathered from local field and site analysis. As an example, a permit application to Delaware River Basin Commission for the Mariner East project found over 180 potential stream crossings, the great majority of which are intermittent or ephemeral [23]. Without the ability to do field investigation, or access to much more complete stream data for the entire basin, we were limited to identifying crossings of the predominantly perennial streams in the NHDPlus database.

# Best Estimate of Impacts

## Forest Area Impacts

The metrics presented in this report present an estimate of the land cover impacts of pipeline construction. The estimates for individual land cover type impacts depend heavily on the accuracy of the pipeline routes, and the accuracy of the NLCD data used. As mentioned previously, we observed that existing pipeline rights-of-way were often classified as forest in the NLCD, which may slightly overestimate forest impact area. To a lesser extent, pipeline routes running through or adjacent to low-density residential (or agricultural) land with some tree canopy may also be classified as forest.

In order to partially account for these potential discrepancies, we used our validation data (refer to Table 6) to develop adjustment factors for forest area impact. We report three key metrics in Table 10, computed in three ways: First, the GIS results for both the construction and permanent ROW areas, computed via the asymmetric method (A). The third metric is the permanently cleared forest area that would be within the permanent ROW, commonly estimated to be 30 feet wide (see, for example, [19]). This metric identifies the forest impact over the longer term, assuming some of the permanent ROW (outside 30 feet) is allowed to regrow, while still leaving the center of the ROW cleared.[6] Since our results show forest area impact scales linearly with ROW width (see Figure 6 and Figure 7), we calculate this

[6] This metric is almost certainly a low estimate of potential impact since many pipeline operators may elect to keep the entire permanent ROW clear. This also does not take into account looping projects where one side of the permanent ROW may be shared with an existing pipeline, and therefore would not be suitable for allowing forest regrowth.

permanently cleared area by multiplying permanent ROW impact area by the ratio of widths (30/50), or 0.6.

The second and third data columns in Table 10 are computed using two adjustment factors computed from the validation data. The specific adjustment factor uses values specific to the construction and permanent ROWs. The permanent ROW specific adjustment factor used is 0.752, and the construction ROW specific factor is 0.872. The general adjustment factor uses an average, constant adjustment applied to both ROW types.[7] The resulting general adjustment factor used is 0.832, or a 16.8 percent reduction in forest area from GIS results. In all cases, the permanently cleared area estimate is computed by multiplying the permanent ROW estimate by 0.6.

Table 10. Estimated total forest area impact for pipeline ROWs in the DRB by ROW type for the eight proposed pipelines in this study

| | **DRB Forest Area Impact** [ac] | | | | |
|---|---|---|---|---|---|
| **ROW Type (width)** | GIS Results | Adjusted (Specific) | Adjusted (General) | **Adj. Factor** (Specific) | **Adj. Factor** (General) |
| Construction (~100 ft) | 1,245 | 1,036 | 1,086 | 0.872 | 0.832 |
| Permanent (~50 ft) | 555 | 462 | 418 | 0.752 | 0.832 |
| Permanently cleared (~30ft) | 333 | 277 | 251 | 0.6[a] | 0.6[a] |

[a.] Adjusted by multiplying by Permanent ROW Forest Impact Area

So, in total, we estimate that within the DRB, the eight pipeline projects in this study will impact:

- Approximately 1,040–1,090 acres of forest within construction ROW during construction
- Approximately 420–460 acres of forest that will fall within the proposed pipelines' new permanent ROWs
- Approximately 250–280 acres of forest that will be permanently lost in the cleared area of the pipeline ROWs, if all pipeline projects keep only 30 feet of width in the permanent ROW cleared.

[7] Since we had an unequal number of pipeline validations for the construction and permanent ROW, we computed the general adjustment factor by weighted average of the construction and permanent factors, with the nominal ROW width as the weight. That is, the construction ROW factor had twice the weight as the permanent factor.

We note that these estimates do not include all potential forest impacts for the pipelines' construction. Typically, pipeline construction requires additional area for pipeline facilities (compressors, pumps, valves, terminals), temporary workspace for equipment storage and staging, as well as access roads to bring equipment and materials to the working ROW. A spatial analysis of the location of these facilities and their associated impacts was beyond the scope of this study. However, based on pipeline documentation, the potential additional area associated with these facilities ranges from about 17 percent of total area impact for greenfield projects (e.g., Constitution [19]) to over 30 percent for looping projects (Leidy SE Franklin Loop [20], East Side Expansion [37]). Relative to the pipeline ROW area only (not the total impact area), these percentages are 20 percent for greenfield projects, and 45 percent for looping projects.

## Wetland Area Impacts

For wetland impacts, developing reasonable adjustment factors is impractical because of the small areas involved for any individual pipeline. We report the results for our GIS analysis (Method A), which did take into account narrower ROWs when passing through wetland areas. In total, we estimate that within the DRB, the eight pipeline projects in this study will impact:

- 41 acres of wetlands within the construction ROW
- 22 acres of wetlands within the new permanent ROW.

# Discussion

This analysis computed the cumulative impacts of eight proposed natural gas transmission pipelines on existing land cover in the Delaware River Basin (DRB). The length of the new pipelines will total 322 miles within the DRB, a length roughly equivalent to the Delaware River itself. We found that the total area of new land disturbance is 2,977 acres (4.7 square miles) during construction and 1,328 acres (2.1 square miles) in the permanent right-of-way (ROW). These impacts only account for the ROWs directly, and not total impacts for associated activities such as road buildings, or equipment storage. Forests account for over one-third of the land area impacted (roughly 40 percent before adjustment). The basin-wide totals don't present the whole story, however. Our analysis showed that results vary significantly by pipeline, construction method, and watershed location.

We found that the cumulative area of impact was far greater than for any individual pipeline project, but several of the projects do have disproportionate impacts compared to the others. In part, this depends on the pipeline route and construction methods. Unsurprisingly, our results indicate that greenfield pipeline projects result in more land disturbance and forest loss per mile than looping projects or those that parallel an existing ROW. Combined, the PennEast, Constitution, and NJ Natural Gas Southern Reliability Link projects, which are all predominantly greenfield projects, account for well over half of the total potential disturbance area. The PennEast pipeline project has the largest potential impact within the DRB. The Mariner East 1 and 2, and Diamond East projects would affect a large amount of acreage due to their length, but less than they otherwise would, as the majority of their length is adjacent to existing pipeline ROWs. This reduction in affected acreage is more evident in the permanent ROW results than the construction ROW results, possibly because the wider working side of the pipeline usually can't be shared with existing ROWs, and requires new clearing.

The pipeline results also indicate a few key portions of the watershed with disproportionate impacts. The PennEast, Diamond East, and Leidy SE projects cross through the middle portion of the basin, especially the Lehigh, and Middle Delaware subbasins in Carbon, Northampton, Hunterdon, Luzerne, Monroe, Mercer, and Warren counties. These projects in particular pass through heavily forested areas, and account for the largest impacts on forests in the basin. The Mariner East, East Side Expansion, and Southern Reliability Link projects substantially affect the Brandywine-Christina, Lower Delaware, and Crosswicks-Neshaminy subbasins in the

lower portion of the watershed, where the land cover tends to be more agricultural or developed. Finally, the Constitution Pipeline is the only pipeline of the eight affecting the Upper portion of the watershed as it passes through Broome County, NY. The land cover along its route is split between agriculture and forest. Of course, additional pipeline proposals could change the distribution of impacts in the future.

This analysis also demonstrated how geospatial analysis can be used to determine a rough estimate of land disturbance area based only on pipeline route information. There is often a considerable delay between the initial route proposal for a pipeline and the environmental analysis or environmental impact statement that includes a full accounting of the land cover impacts using detailed ROW information. The pipeline proponent and FERC will have access to the most authoritative information on the project, and are in the best position to assess potential impacts with a high degree of certainty. The higher-resolution data for both the pipeline ROW and potentially, existing land cover (plus, likely field surveying) allow a higher degree of certainty than we could achieve in this analysis. Nonetheless, our methodology in this report demonstrates that a fairly accurate initial estimate of impacts can be generated using only proposed and existing pipeline route information and the National Land Cover Dataset (NLCD). We validated our results, and found that the error in total disturbance area was less than 5 percent compared to the FERC environmental analysis documents. The specification of forest area impacted requires an adjustment factor to account for uncertainty and coarse resolution in the NLCD.

We also determined that small errors in the pipeline route are not likely to be extremely consequential with respect to land cover breakdown. Changes in overall length due to altered routes will of course affect acreage of impact, but small perturbations or uncertainty in the proposed route may not greatly affect results. The overall breakdown of land cover disturbance is nearly constant as theoretical ROW width expands, even far beyond the construction ROW. This leads to some potentially useful rules of thumb for pipeline construction. For instance, a 50-foot ROW will affect, on average, four acres of forest per mile in the DRB (based on the routes of these eight pipelines).

There are several ways this analysis could be expanded in the future. First, the analysis method could be applied to other geographic areas such as the Susquehanna River Basin or the entire State of Pennsylvania. At present, this analysis considers only land cover changes due to development of the pipeline ROWs, and potential stream crossings, but no secondary impacts on land or water resources. The results from this study could feed into secondary impact analyses. For instance, the permanent pipeline ROWs could be used with existing land cover data to estimate secondary forest impacts such as fragmentation and loss of core forest as a result of the new forest edges along the ROWs. Or the total disturbance area and existing land

cover distribution could be used as inputs in a water quality model to estimate potential changes in sediment loading to streams.

It is worth noting that in Pennsylvania, pipelines are a special topic of concern because of the rapid increase in shale gas development since 2007. Some estimate that 30,000 miles of additional pipelines may be constructed in Pennsylvania in the next 30 years [41]. The majority of those will likely be the smaller gathering lines to move gas from production wells to the existing distribution network, but new transmission lines will also be needed to handle the increased production. In 2015, Pennsylvania Governor Tom Wolf appointed a pipeline task force, managed by the PA Department of Environment Protection, to study pipeline impacts in Pennsylvania and come up with a list of recommendations [42]. Similar to the motivations of this study, the task force found that the pipeline approval and permitting review process may not always account for long term, cumulative impacts: "Chosen routes do not necessarily avoid sensitive lands, habitats, and natural features. . . . Impacts to natural and cultural resources, landowners, and communities along them not always avoided, minimized or mitigated. . . . Individual decisions can accumulate into a much broader and longer impact on the citizens and the lands of a community, county or watershed" [42].

The Pipeline Task Force's report included 12 top recommendations, and 184 overall recommendations for improving the pipeline infrastructure development process in Pennsylvania [43]. These recommendations may affect the permit and approval process in the future, and thus, pipeline routing and construction methods. (Note that no policy changes have been adopted, and these state level recommendations likely will not directly affect the FERC process.) Accordingly, the methodology used in this study would have to be adapted to account for potential changes where possible. Some of the most relevant recommendations relate to better information sharing about pipeline routes, planning routes to avoid or mitigate environmental impacts, and construction methods and offsets to reduce net environmental impacts. The recommendation for earlier information sharing about proposed pipeline routes (including GIS data) would make assessing impacts with a methodology like the one used in this study easier. Other recommendations might affect ROW routes or widths. For instance, the recommendation to "Reduce Forest Fragmentation in Pipeline Development" could discourage routes from going through core forest areas. The recommendation to "Minimize Impacts to Riparian Areas at Stream Crossings" could result in changing assumptions about ROW width near stream crossings. Finally, several recommendations include policies for either mitigation banking or net loss limits for certain land cover types such as wetlands, forests in headwater watersheds, riparian buffers [43]. These types of policies would require more clarification in order to be modeled, and the methodology would have to account for the policies' impact through adjustment factors or additional assumptions (e.g., assume forest area loss is replaced within the same watershed).

In summary, the next several years and decades will witness much more pipeline development in Pennsylvania and the Delaware River Basin. The pipeline projects will result in some impacts to land resources, water resources, cultural resources, ecosystems, and air quality, among others, even after accounting for project-specific mitigation measures. Analyzing several projects at once can give a clearer picture of potential cumulative impacts, but it requires timely and accurate geospatial information on proposed pipeline routes. It appears likely that Pennsylvania will consider recommendations to change the pipeline infrastructure development process to further mitigate or avoid impacts, especially for particularly sensitive resources. These changes may complicate future analyses such as this one, but may ultimately result in lessened impacts over the landscape of development.

Analyzing the cumulative impacts of concurrent pipeline projects is likely to be an ongoing need in Pennsylvania, for FERC interstate transmission pipeline proposals, and wherever pipeline infrastructure is being expanded. Pipelines are necessary to move liquid fuels across the country; they are an efficient means of transport, but their development does have short-term and long-term impacts on the landscape over which they are built. Policymakers at various levels may find analyses such as that presented in this study useful for comprehending how new pipeline proposals add to the cumulative impacts in geographic areas of interest. They may then determine whether mitigation measures may be appropriate, based on cumulative landscape impacts rather than solely on project-specific impacts.

# Appendix A: County and Watershed Results Tables

Table 11 displays the county-level area impact for the new permanent ROW, and Table 12 does so for the construction ROW.

Table 13 shows the impact area for the permanent ROW, broken down by land cover type and HUC10 watershed. Table 14 shows the impact area for the construction ROW, broken down by land cover type and HUC10 watershed.

Table 15 shows the number of stream crossings in each HUC10 watershed. These crossings reflect points of intersection between proposed pipeline routes and NHDPlus v2 stream flowlines within the DRB. We used existing pipeline routes to identify where existing crossings are located. In situations where a proposed pipeline's crossing is within 250 feet of an existing crossing, there may be the potential for a shared crossing, which could reduce the impact of the stream crossing. It is certainly possible these potential shared crossings may require a new crossing. Nonetheless, we have identified the total number of crossings, potential "shared" crossings, and the remaining crossings—which, by default, will be "new" crossings. Many of the new crossings that occur are associated with greenfield construction, and the potential shared crossing locations are typical for looping projects.

Table 11. Total land disturbance by county for new permanent ROWs[a]

| County | Forest | Wetland | Grassland/Shrub | Ag - Pasture | Ag- Cultivated | Open Land | Developed | Water | Total |
|---|---|---|---|---|---|---|---|---|---|
| Burlington, NJ | 2.8 | 0.6 | 0.8 | 2.4 | 6.3 | 18.6 | 10.4 | 0.0 | **41.9** |
| Gloucester, NJ | 0.9 | 1.9 | 0.4 | 2.1 | 1.2 | 4.9 | 9.0 | 0.0 | **20.6** |
| Hunterdon, NJ | 76.0 | 1.2 | 10.8 | 39.2 | 40.5 | 7.5 | 0.7 | 0.0 | **175.9** |
| Mercer, NJ | 10.5 | 1.4 | 11.6 | 8.4 | 9.9 | 2.5 | 1.2 | 0.0 | **45.5** |
| Monmouth, NJ | 2.0 | 0.1 | 0.4 | 1.6 | 2.4 | 7.6 | 1.9 | 0.0 | **15.9** |
| Ocean, NJ | 2.4 | 0.8 | 0.5 | 0.4 | 2.6 | 21.9 | 23.6 | 0.0 | **52.2** |
| Warren, NJ | 9.3 | 0.4 | 0.5 | 1.1 | 14.0 | 3.8 | 0.5 | 0.1 | **29.6** |
| Broome, NY | 40.7 | 0.9 | 1.3 | 29.0 | 4.9 | 3.8 | 0.1 | 0.0 | **80.8** |
| Berks, PA | 43.9 | 0.3 | 8.4 | 14.6 | 14.3 | 18.1 | 11.3 | 0.1 | **111.0** |
| Bucks, PA | 0.6 | 0.0 | 1.5 | 0.9 | 6.5 | 0.4 | 0.3 | 0.0 | **10.3** |
| Carbon, PA | 137.7 | 1.7 | 2.0 | 13.0 | 1.2 | 9.8 | 3.6 | 0.4 | **169.5** |
| Chester, PA | 27.7 | 1.4 | 8.7 | 18.6 | 14.0 | 41.5 | 35.5 | 0.0 | **147.5** |
| Delaware, PA | 18.4 | 0.4 | 1.4 | 2.2 | 2.5 | 26.5 | 12.0 | 0.0 | **63.4** |
| Luzerne, PA | 65.8 | 4.9 | 9.7 | 0.0 | 0.0 | 2.2 | 0.5 | 0.0 | **83.1** |
| Monroe, PA | 63.5 | 5.3 | 0.2 | 4.2 | 1.4 | 14.1 | 0.6 | 0.8 | **90.1** |
| Northampton, PA | 53.4 | 0.5 | 5.8 | 15.3 | 82.6 | 22.1 | 10.5 | 0.0 | **190.3** |
| TOTALS - by State | | | | | | | | | |
| *Subtotal - NJ* | *104* | *6* | *25* | *55* | *77* | *67* | *47* | *0* | ***382*** |
| *Subtotal - NY* | *41* | *0.9* | *1.3* | *29* | *5* | *4* | *0* | *0.0* | ***81*** |
| *Subtotal - PA* | *411* | *15* | *38* | *69* | *123* | *135* | *74* | *1* | ***865*** |
| TOTAL - DRB | **555** | **22** | **64** | **153** | **204** | **205** | **122** | **1** | **1328** |

[a.] Land disturbance estimate computed by Method A (see table 5). Totals may not sum exactly due to rounding.

Table 12. Total land disturbance by county for construction ROWs[a]

| County | Forest | Wetland | Grassland/Shrub | Ag - Pasture | Ag- Cultivated | Open Land | Developed | Water | Total |
|---|---|---|---|---|---|---|---|---|---|
| Burlington, NJ | 5.4 | 1.2 | 1.6 | 6.9 | 16.3 | 31.2 | 19.4 | 0.0 | **81.9** |
| Gloucester, NJ | 2.5 | 2.9 | 1.3 | 6.8 | 3.8 | 13.8 | 24.8 | 0.0 | **55.9** |
| Hunterdon, NJ | 157.9 | 2.2 | 24.1 | 88.9 | 92.0 | 15.3 | 1.6 | 0.0 | **382.1** |
| Mercer, NJ | 24.2 | 2.4 | 20.5 | 19.2 | 24.0 | 4.8 | 2.9 | 0.0 | **97.9** |
| Monmouth, NJ | 4.7 | 0.3 | 0.7 | 3.3 | 4.1 | 14.2 | 3.7 | 0.0 | **30.9** |
| Ocean, NJ | 6.1 | 1.2 | 1.2 | 1.2 | 9.4 | 37.8 | 44.9 | 0.0 | **101.9** |
| Warren, NJ | 29.1 | 1.0 | 1.7 | 2.9 | 41.6 | 10.8 | 1.8 | 0.3 | **89.2** |
| Broome, NY | 80.8 | 1.0 | 2.4 | 65.0 | 11.1 | 8.1 | 0.4 | 0.0 | **168.8** |
| Berks, PA | 115.6 | 0.9 | 22.6 | 35.3 | 38.1 | 45.2 | 26.8 | 0.1 | **284.6** |
| Bucks, PA | 1.2 | 0.0 | 3.2 | 2.2 | 15.4 | 0.7 | 0.4 | 0.0 | **23.0** |
| Carbon, PA | 276.5 | 2.5 | 4.0 | 31.6 | 2.9 | 20.3 | 7.5 | 0.5 | **345.7** |
| Chester, PA | 67.2 | 3.4 | 19.0 | 44.2 | 35.3 | 86.1 | 67.4 | 0.1 | **322.6** |
| Delaware, PA | 31.3 | 1.1 | 2.7 | 4.9 | 5.8 | 56.0 | 25.8 | 0.0 | **127.7** |
| Luzerne, PA | 150.4 | 9.8 | 14.3 | 0.0 | 0.0 | 5.1 | 1.1 | 0.0 | **180.7** |
| Monroe, PA | 170.9 | 9.1 | 0.5 | 13.3 | 4.0 | 40.6 | 1.9 | 2.1 | **242.5** |
| Northampton, PA | 121.5 | 1.9 | 12.7 | 35.3 | 197.4 | 49.9 | 22.1 | 0.2 | **441.0** |
| TOTALS - by State | | | | | | | | | |
| *Subtotal - NJ* | *230* | *11* | *51* | *129* | *191* | *128* | *99* | *0* | ***840*** |
| *Subtotal - NY* | *81* | *1.0* | *2.4* | *65* | *11* | *8* | *0.4* | *0.0* | ***169*** |
| *Subtotal - PA* | *935* | *29* | *79* | *167* | *299* | *304* | *153* | *3.0* | ***1968*** |
| **TOTAL - DRB** | **1245** | **41** | **133** | **361** | **501** | **440** | **253** | **3** | **2977** |

[a.] Land disturbance estimate computed by Method A (see table 5). Totals may not sum exactly due to rounding.

Table 13. Pipeline land area impact [acres] by watershed, Permanent ROW

| Watershed (HUC) | Forest | Wetland | Grassland/Shrub | Ag - Pasture | Ag- Cultivated | Open Land | Developed | Water | Grand Total |
|---|---|---|---|---|---|---|---|---|---|
| Upper Delaware | 40.7 | 0.9 | 3.8 | 4.9 | 29.0 | 0.1 | 1.3 | 0.0 | **80.7** |
| 204010103 | *40.7* | *0.9* | *3.8* | *4.9* | *29.0* | *0.1* | *1.3* | | ***80.7*** |
| Middle Delaware | 117.4 | 3.5 | 24.9 | 90.0 | 56.3 | 6.4 | 26.0 | 0.1 | **324.6** |
| 204010408 | *4.2* | | *0.4* | *0.5* | *1.3* | *0.4* | | *0.0* | ***6.8*** |
| 204010503 | *5.1* | *0.4* | *7.6* | *11.5* | *0.4* | *2.6* | *0.1* | | ***27.7*** |
| 204010504 | *6.0* | *0.3* | *1.2* | *3.2* | *0.5* | *0.2* | *0.3* | | ***11.7*** |
| 204010505 | *3.8* | *0.3* | *0.8* | *3.4* | *1.5* | *0.3* | *0.2* | | ***10.3*** |
| 204010506 | *15.9* | *0.2* | *5.6* | *21.6* | *7.2* | *1.2* | *3.3* | *0.1* | ***55.0*** |
| 204010509 | *82.4* | *2.4* | *9.3* | *49.9* | *45.4* | *1.9* | *22.0* | | ***213.2*** |
| Lehigh | 299.4 | 12.1 | 37.6 | 66.0 | 25.8 | 11.5 | 16.2 | 1.1 | **469.7** |
| 204010601 | *30.9* | *2.8* | *5.0* | *0.7* | *0.5* | | | *0.5* | ***40.5*** |
| 204010602 | *82.9* | *7.0* | *2.4* | | | *0.5* | *9.7* | *0.1* | ***102.7*** |
| 204010603 | *63.9* | *1.8* | *7.3* | *0.2* | *2.4* | *0.3* | | | ***75.9*** |
| 204010604 | *50.6* | | *7.1* | *0.0* | *3.8* | *0.3* | *0.6* | *0.3* | ***62.7*** |
| 204010605 | *34.0* | *0.4* | *3.9* | *1.1* | *9.2* | *3.3* | *1.6* | *0.2* | ***53.9*** |
| 204010608 | *36.9* | *0.1* | *11.9* | *63.9* | *9.8* | *7.1* | *4.2* | | ***134.1*** |
| Crosswicks-Neshaminy | 7.1 | 1.4 | 45.5 | 11.3 | 4.3 | 31.7 | 1.7 | 0.0 | **103.0** |
| 204020101 | *4.6* | *0.9* | *33.3* | *6.9* | *3.6* | *26.0* | *0.9* | | ***76.1*** |
| 204020104 | *2.4* | *0.5* | *12.2* | *4.4* | *0.8* | *5.7* | *0.8* | | ***26.9*** |
| Lower Delaware | 19.5 | 2.3 | 45.8 | 3.7 | 4.5 | 33.4 | 2.0 | 0.0 | **111.2** |
| 204020201 | *0.1* | | *2.6* | | | *4.3* | *0.0* | | ***7.0*** |
| 204020206 | *19.4* | *2.3* | *43.2* | *3.7* | *4.5* | *29.1* | *1.9* | | ***104.2*** |
| Schuylkill | 44.9 | 0.5 | 13.7 | 19.4 | 17.2 | 20.4 | 9.1 | 0.1 | **125.2** |
| 204020303 | *4.5* | | *1.5* | *1.2* | *0.6* | *0.8* | *0.0* | | ***8.6*** |
| 204020304 | *15.7* | | | *7.1* | *2.5* | *8.7* | *6.5* | | ***40.5*** |
| 204020306 | *69.2* | *0.9* | *25.6* | *16.7* | *30.1* | *24.7* | *5.2* | *0.1* | ***172.5*** |
| 204020307 | *0.9* | *0.2* | *2.2* | *4.5* | *2.9* | *1.3* | *0.3* | | ***12.3*** |
| 204020310 | *0.1* | | *0.6* | *0.3* | | *0.6* | *0.4* | | ***1.9*** |
| Brandywine-Christina | 26.5 | 1.2 | 26.9 | 9.3 | 15.6 | 25.6 | 7.9 | 0.0 | **113.0** |
| 204020501 | *26.5* | *1.2* | *26.9* | *9.3* | *15.6* | *25.6* | *7.9* | *0.0* | ***113.0*** |
| TOTAL - DRB | **555** | **22** | **198** | **205** | **153** | **129** | **64** | **1** | **1327** |

Table 14. Pipeline land area impact [acres] by watershed, Construction ROW.

| Watershed (HUC) | Forest | Wetland | Grassland/Shrub | Ag - Pasture | Ag- Cultivated | Open Land | Developed | Water | Grand Total |
|---|---|---|---|---|---|---|---|---|---|
| Upper Delaware | 80.7 | 1.5 | 8.1 | 11.1 | 65.0 | 0.4 | 2.4 | 0.0 | **169.2** |
| 204010103 | *80.7* | *1.5* | *8.1* | *11.1* | *65.0* | *0.4* | *2.4* | | ***169.2*** |
| Middle Delaware | 271.6 | 7.0 | 56.4 | 223.9 | 133.0 | 16.1 | 53.6 | 0.3 | **761.8** |
| 204010408 | *13.3* | | *1.1* | *1.5* | *5.3* | *0.9* | *0.0* | *0.0* | ***22.0*** |
| 204010503 | *18.8* | *1.3* | *17.2* | *29.5* | *1.5* | *6.5* | *0.4* | | ***75.3*** |
| 204010504 | *18.7* | *0.6* | *2.9* | *9.7* | *1.3* | *0.7* | *1.0* | *0.0* | ***34.8*** |
| 204010505 | *11.5* | *0.8* | *2.3* | *9.7* | *4.6* | *0.9* | *0.7* | | ***30.4*** |
| 204010506 | *37.3* | *0.2* | *14.1* | *58.8* | *18.4* | *2.6* | *8.2* | *0.3* | ***139.8*** |
| 204010509 | *172.0* | *4.1* | *18.8* | *114.7* | *101.9* | *4.5* | *43.4* | | ***459.5*** |
| Lehigh | 660.0 | 22.3 | 91.3 | 153.4 | 60.1 | 23.3 | 27.4 | 2.8 | **1040.6** |
| 204010601 | *77.8* | *5.0* | *12.4* | *1.8* | *1.3* | | *0.0* | *1.3* | ***99.6*** |
| 204010602 | *186.6* | *13.2* | *5.5* | | | *1.1* | *14.3* | *0.1* | ***220.8*** |
| 204010603 | *130.1* | *2.8* | *16.0* | *0.4* | *5.6* | *1.0* | *0.0* | | ***155.8*** |
| 204010604 | *109.9* | | *21.4* | *0.2* | *10.0* | *0.6* | *1.3* | *0.3* | ***143.7*** |
| 204010605 | *79.7* | *0.7* | *9.7* | *2.9* | *22.7* | *7.0* | *3.2* | *0.9* | ***126.9*** |
| 204010608 | *76.0* | *0.6* | *26.3* | *148.1* | *20.5* | *13.6* | *8.6* | *0.2* | ***293.8*** |
| Crosswicks-Neshaminy | 15.7 | 2.7 | 79.6 | 29.8 | 11.4 | 58.4 | 3.1 | 0.0 | **200.6** |
| 204020101 | *11.1* | *1.5* | *57.9* | *18.7* | *8.9* | *45.8* | *1.6* | | ***145.6*** |
| 204020104 | *4.5* | *1.2* | *21.6* | *11.1* | *2.5* | *12.6* | *1.6* | | ***55.0*** |
| Lower Delaware | 34.9 | 4.2 | 93.1 | 9.7 | 11.8 | 73.7 | 4.8 | 0.0 | **232.2** |
| 204020201 | *0.5* | | *3.6* | | | *9.6* | *0.4* | | ***14.1*** |
| 204020206 | *34.3* | *4.2* | *89.4* | *9.7* | *11.8* | *64.1* | *4.5* | | ***218.1*** |
| Schuylkill | 118.4 | 1.6 | 35.5 | 46.4 | 44.6 | 50.4 | 21.6 | 0.1 | **318.6** |
| 204020303 | *13.3* | | *3.2* | *3.6* | *1.4* | *1.6* | *0.0* | | ***23.2*** |
| 204020304 | *33.1* | | *0.0* | *15.9* | *5.6* | *19.2* | *15.1* | | ***88.9*** |
| 204020306 | *69.2* | *0.9* | *25.6* | *16.7* | *30.1* | *24.7* | *5.2* | *0.1* | ***172.5*** |
| 204020307 | *2.4* | *0.7* | *4.6* | *9.7* | *7.4* | *3.0* | *0.4* | | ***28.2*** |
| 204020310 | *0.4* | | *2.1* | *0.6* | | *1.9* | *1.0* | | ***5.9*** |
| Brandywine-Christina | 63.9 | 2.7 | 59.8 | 25.0 | 36.7 | 49.0 | 17.2 | 0.1 | **254.4** |
| 204020501 | *63.9* | *2.7* | *59.8* | *25.0* | *36.7* | *49.0* | *17.2* | *0.1* | ***254.4*** |
| TOTAL - DRB | **1245** | **41** | **424** | **499** | **363** | **271** | **130** | **3** | **2977** |

Table 15. Stream crossings by HUC-10 watershed: total, shared (potentially, with existing crossings), and new (=total – shared)

| Watershed (HUC10 #) | Total | Shared | New |
|---|---|---|---|
| Upper Delaware | 11 | 0 | 11 |
| 204010103 | *11* | | *11* |
| Middle Delaware | 39 | 15 | 24 |
| 204010408[a] | | | *0* |
| 204010503 | *6* | *6* | *0* |
| 204010504 | *3* | *3* | *0* |
| 204010505 | *3* | *3* | *0* |
| 204010506 | *6* | *3* | *3* |
| 204010509 | *21* | *0* | *21* |
| Lehigh | 58 | 42 | 16 |
| 204010601 | *13* | *13* | *0* |
| 204010602 | *20* | *19* | *1* |
| 204010603 | *4* | *4* | *0* |
| 204010604 | *9* | *4* | *5* |
| 204010605 | *4* | *2* | *2* |
| 204010608 | *8* | | *8* |
| Crosswicks-Neshaminy | 8 | 0 | 8 |
| 204020101 | *5* | | *5* |
| 204020104 | *3* | | *3* |
| Lower Delaware | 15 | 7 | 8 |
| 204020201 | *0* | | *0* |
| 204020206 | *15* | *7* | *8* |
| Schuylkill | 18 | 8 | 10 |
| 204020303 | *2* | | *2* |
| 204020304 | *2* | | *2* |
| 204020306 | *12* | *6* | *6* |
| 204020307 | *2* | *2* | *0* |
| 204020310 | | | *0* |
| Brandywine-Christina | 26 | 20 | 6 |
| 204020501 | *26* | *20* | *6* |
| TOTAL - DRB | **175** | **92** | **83** |

[a.] HUC10 numerical codes shown grouped by HUC8 name. This HUC10 is in the Middle Delaware-Mongaup-Brodhead HUC8. The remaining HUC10s in this grouping are in the Middle Delaware-Musconetcong HUC8.

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# EXHIBIT C

# Natural Gas Pipelines

*Excerpt from Report 2 of the Pennsylvania Energy Impacts Assessment*

December 16, 2011

Authors: Nels Johnson, Tamara Gagnolet, Rachel Ralls, and Jessica Stevens

The Nature Conservancy – Pennsylvania Chapter

*The Nature Conservancy gratefully acknowledges generous financial support for this assessment from the Heinz Endowments, the R.K. Mellon Foundation, and the William Penn Foundation.*

## Natural Gas Pipelines

An extensive web of pipelines is needed to collect gas from well sites and transport it to storage areas and major markets. Even before Marcellus shale natural gas development started, Pennsylvania had over 8,600 miles of large diameter interstate and intrastate gas pipelines (8th highest in U.S.), due to the Commonwealth's long history of oil and gas production, its existing gas storage sites in depleted gas reservoirs, and its location between gas production areas and major northeastern markets (USDOE, 2011). Current and future Marcellus gas development will dramatically increase the miles of large diameter gas pipelines in the state. The two most important reasons for the pipeline expansion are the large number Marcellus well sites that are likely to be developed over the next two decades and the transport lines needed to get growing volumes of shale gas – from various formations – delivered to different parts of the country (INGAA, 2011). Although pipelines are buried, their construction, monitoring, and maintenance require clearing and maintaining open rights-of-way. While their widths vary, pipeline rights-of-way often create a significant and permanent fragmenting feature through natural habitats. Extensive soil disturbance during construction can also increase the risk of erosion and sedimentation if controls are not carefully designed and implemented. This assessment looks closely at pipeline development associated with Marcellus gas development in Bradford County, Pennsylvania, to better understand the potential scale and scope of statewide habitat impacts.

### What Is Natural Gas Transmission?

The vast majority of natural gas gets to markets through pipelines, though some related products—including propane and butane—are transported in pressurized tanks via rail and trucks. Natural gas transportation infrastructure consists of **gathering lines** which take the gas from each well to a **transport line** which takes the gas either to another transport line (sometimes called "mid-stream" lines) or directly to markets (often referred to as "interstate" lines). This report does not address service lines that take gas from storage areas or transport lines directly to commercial, industrial, and residential consumers. In the Marcellus region, gathering lines may range from 6 to 24 inches in diameter and may clear rights-of-way (ROW) of 30 to 150 feet wide. These are much larger than gathering lines used in shallow gas fields, which generally range from 2 to 6 inches in diameter. Transport lines vary in size, generally ranging from 24 to 36 inches in diameter, and have right-of-way widths of up to 200 feet, depending on the size and number of lines. At various points along the pipeline, including at line junctions, compressor stations pressurize the natural gas to ensure a continuous and regulated flow. This report assesses the spatial footprint and scenarios for future expansion of gathering lines. Gathering lines are likely to comprise by far the greatest extent of new large diameter pipeline constructed in Pennsylvania during the next 20 years.

Gathering pipeline construction in Bradford County, PA © Nels Johnson /TNC

## Current and Projected Natural Gas Pipeline Development

An estimated 8,600 miles of large diameter natural gas pipeline already crossed Pennsylvania before Marcellus development began (USDOE, 2008). This number is changing rapidly as pipelines are installed to move large volumes of Marcellus natural gas to markets. Unfortunately, there is no statewide source of data on new pipelines, including the expanding web of Marcellus gathering pipelines. Given the fast pace of Marcellus development and lack of a centralized regulatory framework for gathering pipelines, we recognize the many challenges associated with maintaining an accurate and updated pipeline dataset.

The Bradford County Office of Community Planning and Grants is tackling that challenge and maintains one of the best available datasets representing built and proposed gas pipelines. As of November 2011, Bradford County has Pennsylvania's highest number of permitted (almost 2,000) and drilled (781) Marcellus gas wells (DEP, 2011a) and has over 500 miles of built and proposed gas pipelines (Bradford County, 2011) (see Figure 1). Given the dearth of statewide datasets, we used gas pipeline data from Bradford County as a case study to develop statewide projections of gathering gas pipeline development.

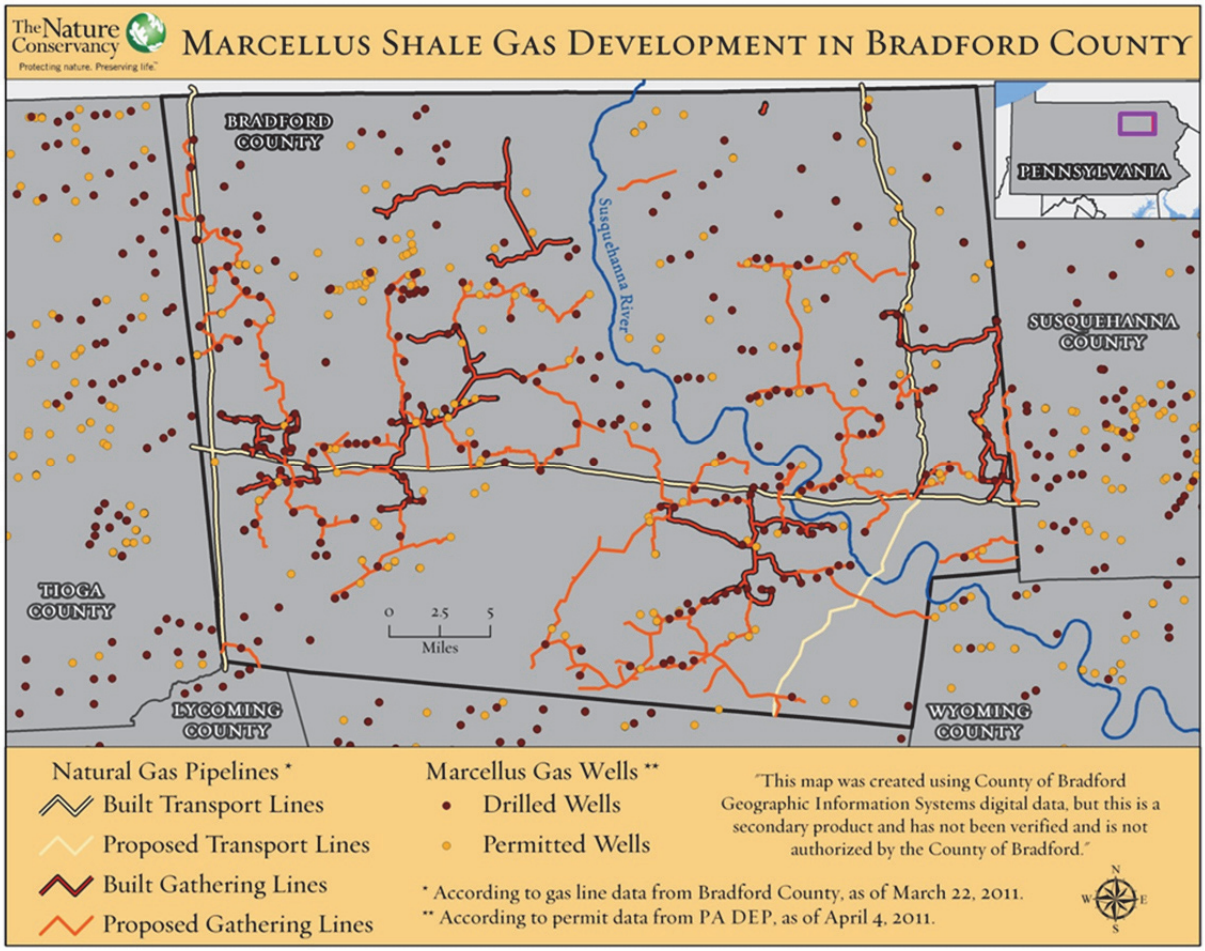


Figure 1. Marcellus gas development in Bradford County, PA, including wells and pipelines. Data sources are the Pennsylvania Department of Environmental Protection and Bradford County Geographic Information Systems.

Using Bradford County data, we estimated the average gathering pipeline length for each well pad by counting all well pads within one-half mile of an existing or proposed gathering pipeline (263 well pads) and dividing them by the total distance of existing and proposed gathering pipelines (434 miles). Well pads further than one-half mile were considered unlikely to be connected to existing and proposed pipelines and would likely connect through future proposed pipelines. The result is an average of 1.65 miles of gathering pipeline for each Marcellus well pad. Although the entire network of wells and gathering pipelines will take years to complete, the density of development in Bradford County is one of the highest in Pennsylvania. The ratio of pipelines to pads may be higher in other counties where gas development is more dispersed.

Based on an average of 1.65 miles of gathering pipeline per pad, we used Marcellus pad projections from Report 1 to estimate the length of new gathering pipelines that could be expected under each of

the development scenarios. Six thousand Marcellus pads are projected under the low development scenario, resulting in the construction of approximately **10,000 miles** (6,000 pads x 1.65 miles/pad) of new gathering pipeline by 2030 in Pennsylvania alone. The medium development scenario projects ten thousand new Marcellus pads, resulting in **16,500 miles** (10,000 pads x 1.65 miles/pad) of new gathering pipeline by 2030. Finally, under the high development scenario, fifteen thousand new pads are projected, which would mean approximately **25,000 miles** (15,000 pads x 1.65 miles/ pad) of new gathering pipeline would need to be added. Even the low scenario would more than double the miles of large diameter natural gas pipeline in Pennsylvania while the high scenario would nearly quadruple the mileage (see total projections of existing and new gathering pipelines in Figure 2, below).

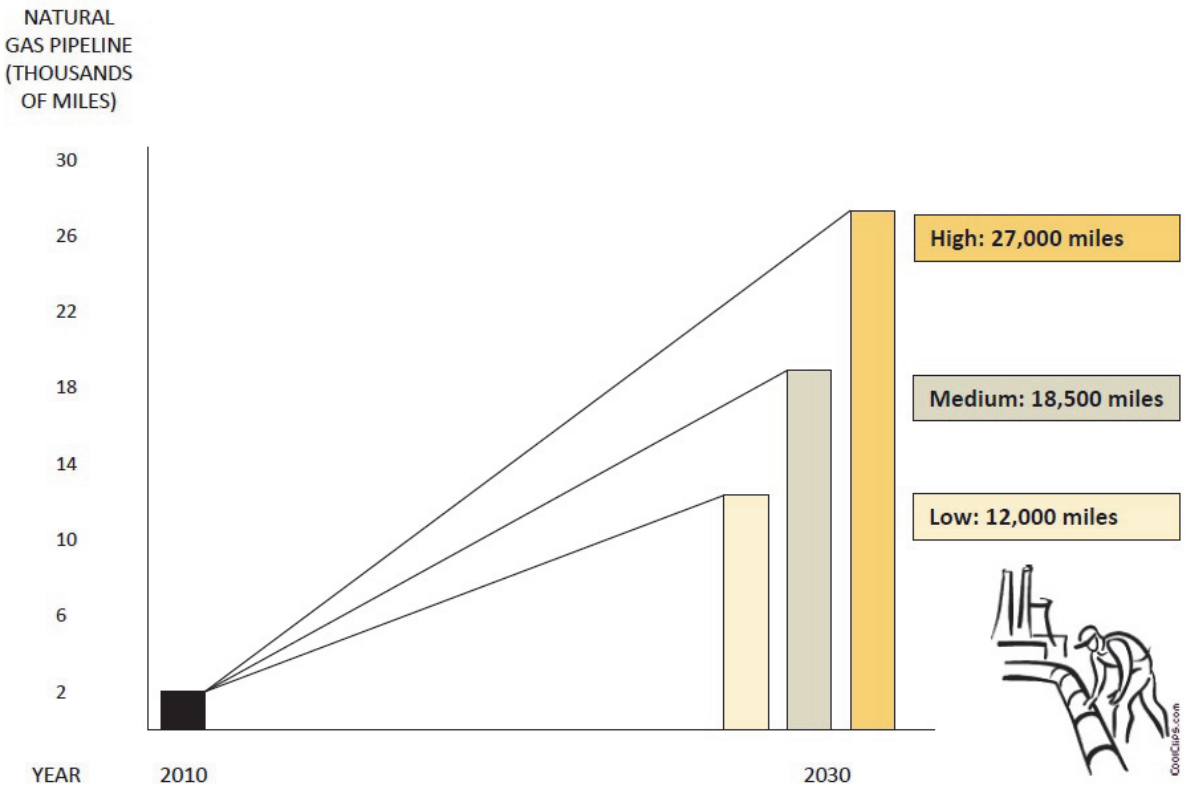


Figure 2. Projections for total miles of natural gas gathering pipelines under low, medium, and high development scenarios. As of the end of 2010, total gathering pipeline length was approximately 2,000 miles, based on the number of well pads at the time.

We assessed all existing gathering pipelines in Bradford County that were visible in 2010 aerial imagery (from the USDA National Agriculture Imagery Program; see Figure 3 below) and noted the following attributes: (a) the width of the cleared right-of- way, and (b) the land cover type through which the right-of-way passed (forested, agricultural, or existing cleared). We found that cleared rights-of-way were usually 100 feet wide but ranged between 30 to 150 feet. About one third of the mileage for built pipelines was in forest areas, with a somewhat higher portion (44%) for proposed pipelines. About one third of that length was in forest interior areas that were previously at least 300 feet from the edge of

the forest patch. In counties with more extensive forest cover and larger forest patches, we can anticipate a higher percentage of gas pipeline mileage will be cutting through forest interior areas.

Given that Bradford County is less forested than Pennsylvania's Marcellus region as a whole, we anticipate that the statewide percentage of pipelines built in forest areas will be higher. A conservative estimate would be that 50 percent of all future pipelines will be built in forest areas, or approximately 5,000 miles in the low Marcellus development scenario, 8,250 miles in the medium scenario, and 12,500 miles in the high scenario. Each mile of a 100-foot right-of-way directly disturbs 528,000 square feet or approximately 12 acres and creates an additional 72 acres of new forest edges.

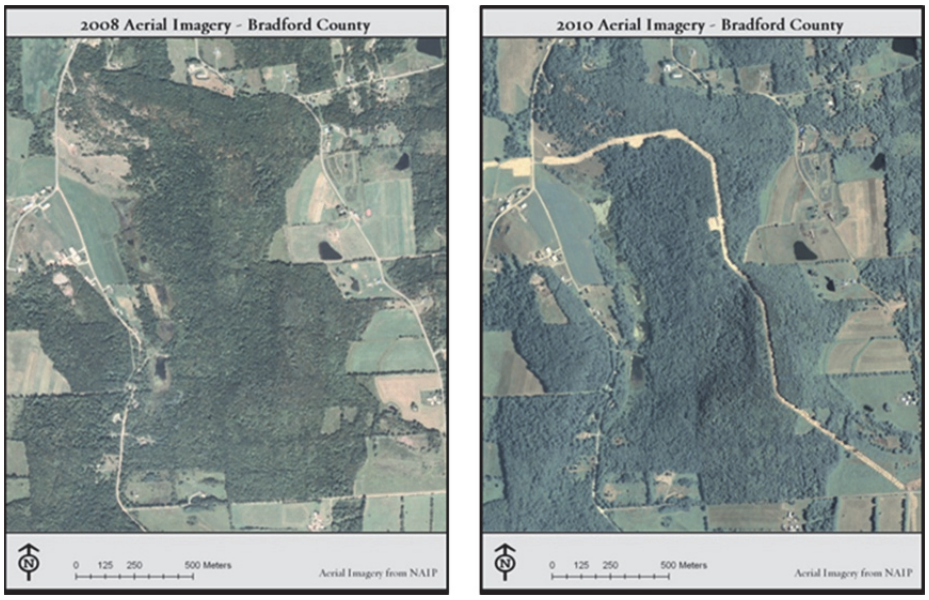


Figure 3. A right-of-way cleared for a gathering natural gas pipeline in Bradford County, PA. (Aerial imagery from USDA National Agriculture Imagery Program)

Therefore, we project that statewide forest area cleared from future pipeline development could be approximately 60,000 acres in the low scenario, 100,000 acres in the medium scenario, and 150,000 acres in the high scenario over the next two decades. In addition to these direct impacts, new gathering pipelines will create between 360,000 and 900,000 acres of new forest edges that deprive interior forest species, such as black-throated blue warblers, salamanders, and many woodland flowers, of the shade, humidity, and tree canopy protection that only deep forest environments can provide. We were unable to find any comprehensive plans for new transport lines in Pennsylvania. In general, however, we believe that the length of new gathering lines will dwarf mileage of new transport lines, perhaps by an order of magnitude.

Finally, compressor stations are an important part of natural gas transmission infrastructure. According to Bradford County data from March 2011, there are currently 14 built or proposed compressor stations in the county. Based on an aerial imagery assessment, these sites occupy an average area of slightly over 5 acres each (see Figure 4). Projecting how many compressor stations will be built in Pennsylvania is

difficult at this point in time, but the number is likely to be in the hundreds. Impacts from air emissions and noise pollution at compressor stations are likely to be more significant than land-use impacts.

Figure 4. Natural gas compressor station in Bradford County, PA. (Aerial imagery from USDA National Agriculture Imagery Program, 2010)

## Conservation Impacts of Natural Gas Pipelines

Natural gas pipelines can impact the environment in several ways. This includes natural habitat loss and fragmentation, changes in species movement, sedimentation, and air emissions.

Rights-of-way for Marcellus gathering lines are generally cleared up to a width of 100 feet, but may be up to 150 or 200 feet if transport lines share the same corridor. After construction is completed, some portion of the right-of-way may be allowed to re-vegetate to trees and shrubs. At least 50 feet of the right-of-way, centered on the pipeline, is generally kept open, though vegetated with grass to minimize erosion and to facilitate monitoring, maintenance and repairs of the pipeline. This area represents a long-term loss of the cleared habitat. Even where forest remains, pipeline corridors can fragment large patches of forest into smaller ones (see Box 1, below). The new open corridor inhibits the movement of some species, such as forest interior nesting birds, which are reluctant to cross openings where they are more exposed to predators (Bennett, 2003). Pipelines, however, can also facilitate the movement of other species, both native and invasive (Transportation Research Board, 2004).

The large amount of soil disturbance involved in laying pipelines also poses erosion and sedimentation risks, particularly in steeper areas, near water bodies, and during heavy rain events. Heavy rains during two tropical storms in August and September 2011 caused extensive failures to erosion and sediment controls on pipelines under construction in north central Pennsylvania (Tanfani & McCoy, 2011). Stream and wetland crossings may create erosion and sedimentation problems, as well, especially with an "open cut" process, and there is a risk of stream bed collapse with "bore crossing" techniques if poorly designed or executed. The "open cut" process uses a trench dug across the stream channel with water temporarily diverted around the trench, while the "bore crossing" technique uses a drill or hydraulic ram to create a bore for the pipeline under the stream. Stream crossings require a permit from the PA Department of Environmental Protection with specific requirements to minimize erosion and sedimentation during and following construction.

**Box 1. Large Forest Patches**

Large contiguous forest patches are especially valuable because they sustain wide-ranging forest species, such as northern goshawk, and provide more habitat for "forest interior" species. Habitat fragmentation deprives "interior" forest species—such as black-throated blue warblers, salamanders, and many woodland flowers—of the shade, humidity, and tree canopy protection that only deep forest environments can provide. Large forest patches are also more resistant to the spread of invasive species, suffer less tree damage from wind and ice storms, and provide more ecosystem services—from carbon storage to water filtration—than small patches.

Air emissions from pipelines and compressor stations are another concern, and may include methane, ethane, benzene, tolulene, xylene, carbon monoxide, ozone and other pollutants (DEP, 2011b). High emission levels for some of these pollutants have been detected in the Barnett Shale region of Texas near pipelines and compressor stations and have exceeded human health standards at times (Armedariz, 2009). Short-term monitoring in north central Pennsylvania has detected some of the same pollutants but at lower levels not likely to trigger public health concerns, according to the Pennsylvania Department of Environmental Protection (DEP, 2011b). Air emissions – especially low level ozone – can also affect forest health. The focus of this assessment, however, is on habitat impacts from natural gas pipelines.

The Pennsylvania Marcellus Shale Advisory Commission (MSAC, 2011) recommended that pipeline impacts be reduced by identifying changes needed to:

- Share pipeline capacity and reduce surface disturbance and related environmental impacts;
- Encourage expansion of existing pipeline capacity and co-location of new capacity with other rights-of-way;
- Improve coordination and consistency of infrastructure planning and siting decisions by state, county and local governments, and;

- Provide authority and resources for government agencies to ensure ecological and natural resource information is used to review siting of pipelines in order to avoid or minimize habitat impacts.

## Key Findings

Key findings from the Pennsylvania Energy Impacts Assessment for natural gas pipelines include:

- Pennsylvania's existing network of large diameter natural gas pipelines (including transport and gathering pipelines) will at least double, and possibly even quadruple, over the next two decades. This expansion will be largely due to a five- to twelve-fold increase in gathering pipeline mileage associated with Marcellus development.

- A low expansion scenario indicates 10,000 miles of new pipelines could be built (based on 6,000 new well pads), a medium scenario projects 16,500 miles (10,000 new well pads), and a high scenario shows up to 25,000 miles (15,000 well pads). Each new well pad on average requires 1.65 miles of gathering pipeline (based on data from Bradford County);

- Between 120,000 and 300,000 acres will be affected by natural gas pipeline construction, an area larger than the cumulative area affected by all other Marcellus gas infrastructure (e.g., well pads, roads, water containment, and staging/storage areas). Approximately half of this area is likely to be in forest areas.

- The expanding pipeline network could eliminate habitat conditions needed by "interior" forest species on between 360,000 and 900,000 acres as new forest edges are created by pipeline right-of-ways. This is substantially greater than the combined forest interior impacts from all other energy types examined in the *Pennsylvania Energy Impacts Assessment*.

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# EXHIBIT D

# Natural Gas Pipeline FAQs

## Answers to Your Natural Gas Pipeline Questions.

The following are answers to questions that residents along Spectra Energy natural gas pipelines have asked in the U.S. and Canada. Select a category below to view residents' frequently asked questions.

Pipeline Maintenance and Ope

**How often do you check the pressure on your pipelines?**

Spectra Energy constantly checks the pressure at thousands of points along our pipeline system. When pressures approach maximum acceptable levels, operators in the gas control center are alerted by electronic pressure transmitters so that appropriate action may be taken. Personnel conduct maintenance on the remote transmitters of pressure information all along the pipeline system at a predetermined frequency (or sooner if there appears to be a malfunction).

**How can you pump natural gas for hundreds of miles?**

As natural gas flows through a pipeline, the pipeline pressure will decrease due to friction and elevation differences. To maintain pipeline flow and pressure, a pipeline company must install compressors along the pipeline to mechanically re-pressure the natural gas so it may continue to flow to the end user. Compressor stations are typically installed at intervals of 30 to 70 miles (approximately 48 to 112 kms) along the pipeline.

With proper diligent maintenance and constantly improving operation and maintenance technology, pipelines made of steel can sustain their usefulness for an indefinite period. There are many pipelines in the U.S. and Canada that have operated safely for many decades and should be able to continue operating safely for the foreseeable future.

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**The pipeline on our property goes through wetlands. Are they deep enough to prevent rusting, corrosion and other threats? How do you know for sure?**

The top of natural gas pipelines are at least 30 inches (76 cm) below the ground's surface when installed. The pipe has a coating which protects the steel from corrosion. In addition, cathodic protection systems are installed at various locations to prevent corrosion on the pipeline by a applying small amount of direct current. This direct current is maintained at a very low level that will not harm people or animals in the vicinity of the pipeline.

To verify our pipelines are not corroding, we routinely inspect our pipelines using In-Line Inspection (ILI) Tools, or "smart pigs", that are able to identify pipeline defects such as corrosion, metal loss, dents, gouges, etc. that could affect the integrity of the pipeline. When any pipeline defect is discovered, that segment of pipe containing the defect is repaired or replaced.

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**When does your company run 'smart pigs' through the pipelines? What are the results?**

In the U.S., the pipeline company routinely runs smart pigs at a predetermined interval in compliance with U.S. DOT regulations. The smart pigs are able to discover pipeline defects such as corrosion, metal loss, dents, gouges, etc. that could affect the integrity of the pipeline. When pipeline defects that could affect the integrity of the pipeline are discovered, that segment of pipe containing the pipeline defect is repaired or replaced.

Spectra Energy was involved in the development of in-line inspection technology in the 1960s and was one of the first pipeline operator to employ it. We have tens of thousands of miles of experience in running the tool and analyzing the results.

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**Does gas transported have rotten egg smell?**

Some natural gas pipelines have an odorant added known as mercaptan which has a smell resembling that of rotten eggs. Local distribution companies typically add this odorant so their customers can detect the presence of natural gas in the air.

Spectra Energy is an interstate natural gas transmission pipeline company in the U.S. and not a local distribution company. Thus many of our pipelines are not odorized.

If a leak were to occur in a pipeline that does not have mercaptan, a person might still detect a faint smell of hydrocarbons (propane and butane are other examples of hydrocarbons), not rotten eggs, even though natural gas is considered odorless.

**Does daily blasting within one mile of your pipeline over several years create a safety issue?**

Distance from a pipeline, soil type, blast intensity, and blast frequency all must be considered to determine if the blasting will create a safety concern for a pipeline. If you know of any planned blasting or any blasting has occurred in the vicinity of one our pipelines, please contact Spectra Energy toll free at 888-293-7867 (tel:+18882937867) so we may conduct the technical evaluation of the blasting's impact on the pipeline.

**Do you advise those who reside along the pipeline when you will take the pipeline out of service (blow gas into the air)?**

Spectra Energy's practice is to advise nearby residents before we conduct a scheduled activity that might result in extended noise or other type of disturbance. Regrettably, and at times unavoidably, the company is unable to notify everyone of such an event. On rare occasions, there may be unscheduled gas releases where prior notification to residents is not feasible.

**ABOUT SPECTRA ENERGY AND SPECTRA ENERGY PARTNERS**

Spectra Energy Corp (NYSE: SE), a FORTUNE 500 company, is one of North America's leading pipeline and midstream companies.

Spectra Energy Partners, LP (NYSE: SEP) is a Houston-based master limited partnership, formed by Spectra Energy Corp.

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# EXHIBIT E

# Water Quality Impacts from PennEast's Preferred Alternative Route

## Princeton Hydro's Report on DEIS dated September 2016

## I. Introduction

To comply with the requirements of the National Environmental Policy Act, the draft environmental impact statement (DEIS) for the PennEast Pipeline must provide an assessment of the potential adverse water quality effects related to the construction and operation of the project.[1] FERC was required to review the water quality impacts from the applicant's preferred alternative, as well as the no-action alternative, and any other reasonable alternatives to the project. The DEIS states that, "FERC staff concludes that approval of the Project would result in some adverse environmental impacts; however, most of these impacts would be reduced to less-than-significant levels with the implementation of PennEast's proposed mitigation and the additional recommendations in the draft EIS." Upon review, it appears that the DEIS contains no analysis of water quality impacts of the no-action alternative. In fact, FERC dismisses – without any analysis – the no-action alternative as having no environmental advantages.

The only analysis of water quality impacts ascertainable in this DEIS stems from FERC's consideration of the applicant's preferred alternative. That analysis suggests that significant impact avoidance can be accomplished not by avoiding the impacts, but by relying upon mitigation to reduce them. This same idea presents a common theme throughout the DEIS, as does the frequent reference to the PennEast's Erosion and Sediment Control Plan (E&SCP), to mitigate impacts rather than avoid or minimize impacts. This approach to impact mitigation is not, however, consistent with either the Clean Water Act or New Jersey's Freshwater Wetlands Protection Act. Those regulatory schemes deploy mitigation as the last option, and one which is typically only considered after an applicant performs a thorough, fact-based analysis that illustrates that all impact avoidance and minimization measures have been exhausted.

The DEIS, however, relies on a dramatically different approach. The DEIS simply suggests potential adverse impacts and then relies on speculative and unspecified mitigation to circumvent designating those adverse impacts as "significant."[2] PennEast's selection of its preferred alternative -- a route through a part of New Jersey that arguably possesses some of the state's most sensitive natural resources -- can only be a product of failure to prepare an

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[1] This report reviews only the DEIS's failure to analyze water quality and wetlands impacts for the applicant's preferred alternative. It does not address data contained elsewhere in the record regarding the applicant's failure to supply data with respect to other suites of environmental impacts.

[2] As discussed more fully below, there are not enough data in the record to even determine environmental baseline, much less assess what the impacts will be. A full accounting of the nature and scope of adverse impacts is a necessary precursor to any assessment of how to avoid, minimize, or mitigate those impacts.

appropriately documented environmental baseline from which to assess impacts from the preferred alternative.

The DEIS specifically states that, "*[b]ased on our analysis, we conclude that the Project is not expected to significantly impact groundwater, surface water, or wetland quality or quantity during construction or operation with implementation of PennEast's proposed mitigation measures as well as our recommendations.*" However, this conclusion is not scientifically credible. The data contained in this administrative record do not support FERC's finding that this major construction project, the implementation of which involves: (1) crossing 43 of New Jersey's antidegradation streams; (2) "temporary impacts" to 30 acres of wetlands; (3) permanent impacts to about 35 acres of wetlands (including areas that are habitat for endangered and threatened species); and (4) 452 acres (both PA and NJ) of permanent forest loss, can realistically occur without any significant adverse impact.

FERC's "mitigation first" approach to impact analysis contravenes the regulatory approach set forth by the Clean Water Act and New Jersey's Freshwater Protection Act. As such, the DEIS could not be used as an impact assessment for permits required under either of those laws. Moreover, the DEIS's findings that any adverse environmental impacts will be reduced to less than significant levels rely on nothing more than unsupported conclusions, couched in scientific terms, but which lack any actual data points or references to validate them. As such, they should be considered with a high degree of skepticism, and accorded no deference. The empty rhetoric of the DEIS is especially troubling when considering the impacts to highly sensitive habitats and landscape features adjacent to antidegradation streams such as those associated with, steep slopes, mature forest, complex wetland systems and endangered species habitat. All of these landscape features are integral to the maintenance of the existing quality of New Jersey's Category-1 antidegradation streams. Inevitable adverse impacts to these features from PennEast's preferred alternative must be carefully considered and evaluated in order to protect the aesthetics and quality of these important surface waters. FERC has not undertaken this analysis to date.

FERC's unsupported conclusions are entitled to no scientific weight as they comprise nothing more than superficial hypothesizing regarding potential impacts, combined with natural gas pipeline's proven inability to successfully mitigate for the values and services provided by sensitive natural habitats. These critical environmental areas, such as wetlands, forests, and antidegradation streams are specifically protected under substantive environmental laws. Instead of taking NEPA's requisite hard look at adverse impacts from the PennEast preferred alternative, here, FERC is hardly looking at data regarding impacts. This allows FERC to conclude that such impacts will not be significant, and thus allows PennEast to gamble with New Jersey and Pennsylvania's sensitive natural resources.

The following sections provide an alternative view of how this major construction project will directly impact streams and water quality. In addition, a review of the effectiveness

of compensatory mitigation will be provided below. Finally, a review of the Clean Water Act and Freshwater Wetlands Protection Act requirements that PennEast must meet in order to construct its preferred alternative is presented, to demonstrate that the project, as designed, cannot be permitted under those regulatory schemes.

## II. Adverse Impacts Associated with the PennEast Pipeline and Efficacy of Compensatory mitigation

The DEIS states, "[p]ipeline construction activities that could potentially affect surface waters include clearing and grading of streambanks, in-stream trenching, blasting , trench dewatering , inadvertent returns of HDD operations, and potential spills or leak of hazardous materials." The DEIS then indicates that effects on surface waters may include: (1) modification of aquatic habitat; (2) increased runoff and the rate of in-stream loading; (3) turbidity; (4) decreased dissolved oxygen concentrations; (5) releases of chemical and nutrient pollutants from sediment and thermal effects. All of these impacts would conflict with the protection of Category 1 waters.[3] However, after reciting these potential impacts, the DEIS summarily concludes that, "no long term effects on aquatic resources are anticipated as a result of construction and operation of the project."

FERC's finding is premised on the idea that mitigation can be relied upon to reduce impacts to surface waters, without first obtaining site specific data or assessing severity of potential impacts from the preferred alternative. Although, mitigation could potentially reduce adverse impacts, there is no evidence that it would reduce them to "less than significant." The DEIS contains no data supporting the efficacy of PennEast's vaguely proposed mitigation measures. Due to the absence of any references or scientific papers based on research, or even other pipeline project examples to support the conclusion that mitigation can realistically reduce project impacts to less than significant levels, the DEIS can only be viewed as an apology for the project. This report contains data and analyses showing that such impacts cannot be mitigated. The record contains additional scientific data and analysis confirming that attempts to mitigate for such impacts have historically been unsuccessful.

## III. Watershed Impacts

In order to understand the impacts associated with the PennEast Project, one has to review the PennEast Pipeline plans for the applicant's preferred alternative in conjunction with the DEIS. When reviewing the DEIS with the project plans simultaneously, it is apparent that much of the route will have critical environmental features producing synergistic effects that

[3] The significance of these areas under New Jersey law is set out in Part V, below.

will complicate mitigation. This will increase the likelihood of long-term adverse impacts on sensitive natural resources.[4]

One illustrative example arose during review of PennEast Pipeline alignment sheet Sta.4620+00 to Sta. 4646+40 at milepost 87.5. This document illustrates the clearing of riparian vegetation along the Nishisakawick Creek, a Category 1 antidegradation steam, in a swath 190' wide on steep (approximately 40%) slopes, with encroachment into the inner 150 foot of the riparian zone on the north side of the stream as well as encroachment into the riparian zone of a downgradient tributary. The depicted removal of the extant steeply-sloping forest will likely result in increased erosion and sedimentation, increased stormwater runoff and thus impacts to State water quality. Although PennEast provides many similar examples of its poor route alignment decisions, here, the DEIS indicates the following: "PennEast would implement its E&SCP, a Post-Construction Stormwater Management Plan, and an SPCC Plan throughout the Project that would further minimize risks from spills or leaks, erosion and sedimentation, and stormwater runoff from construction areas with exposed soils. We have reviewed these plans and find them acceptable."

Since FERC did not provide its data or analysis, such a review of site-specific impact is presented herein. In order to better understand the impacts of the proposed construction activities on the Nishisakawick Creek, Princeton Hydro analyzed the project area (identified by Princeton Hydro as Area 3) for total suspended solids loading, potential soil loss from erosion, and stormwater runoff volume in the existing and proposed conditions (Attachment 1). Based on Princeton Hydro's calculations, the potential soil loss from erosion was evaluated using the Revised Universal Soil Loss Equation (RUSLE) and shown to increase from 7.19 (tons/ac/yr) in the existing condition to 26.81(tons/ac/yr) with implementation of applicant's preferred alternative. This equals an increase of 287% resulting from project implementation.

| **Table 1** | **Approximate Runoff Volume Increase per Storm Event** | | | |
|---|---|---|---|---|
| **Analysis Area** | **2 YEAR** Volume(Gallon) | **10 YEAR** Volume(Gallon) | **50 YEAR** Volume(Gallon) | **100 YEAR** Volume(Gallon) |
| **1** | 29,327 | 36,821 | 43,012 | 44,967 |
| **2** | 38,776 | 48,552 | 56,372 | 58,979 |
| **3** | 142,397 | 183,780 | 216,691 | 228,747 |
| *taken from Princeton Hydro report entitled, Watershed Impact Assessment, PennEast Pipeline Project, September 12, 2016. See Attachment 1 | | | | |

[4] Upon review of those special areas, it becomes apparent that the route would have to be redesigned to avoid them under the Clean Water Act, both Section 401 and New Jersey's implementation of Section 404's regulatory scheme. See Part V, below.

Compounding this significant impact, due to the modification in the vegetated cover, an increase in stormwater runoff will also occur. Princeton Hydro calculated stormwater runoff and found an increase by 142,397 gallons during the 2-year storm (Table 1).

An important but relevant aside is that long–tailed salamander was recently identified in the same segment of the Nishisakawick Creek that we studied, Area 3. As previously stated the proposed PennEast Pipeline project will substantially modify the existing habitat of this segment of the Little Nishisakawick Creek as a result of the elimination of the forested component of their habitat. Due to the conservative habitat requirements of long tailed salamander, the extant population of this listed species cannot be replaced or relocated through current mitigation measures and the project will adversely modify a present habitat and jeopardize the continued existence of this local population. As such there is no way to compensate for the substantial impacts that the pipeline will have on this species and its habitat outside of avoidance.

While the increase in stormwater runoff compounds the above-described soil loss impacts, the synergistic adverse effects from those impacts would be even further exacerbated by soil compaction. Disturbance associated with the installation of the pipeline has been shown to modify soil structure as a result of compaction. Olson and Doherty (2011) found that soils within pipeline corridors had higher bulk density, lower depth to refusal and lower soil moisture. PennEast's E&SCP will not be able to adequately address the changes in erosion potential and stormwater runoff volume to avoid impacts to the Nishisakawick Creek. Moreover, the plan also does little to illustrate that the protection of riparian zone was seriously contemplated during the pipeline route alignment. It is difficult to understand how FERC allowed the placement of a pipeline in a highly sensitive landscape such as this one to proceed this far in the application process, much less be seriously championed in a DEIS.

The two other sites Princeton Hydro analyzed, one along the Harihokake and the other along a tributary to the Harihokake, both show even greater potential for soil loss through erosion (Table 2) (Attachment 1). In addition, based on the calculations of stormwater runoff both of the Harihokake sites show significant increases in stormwater runoff volume. As

**Table 2 Erosion Potential**

| Analysis Area | Existing Soil Loss (tons/ac/yr) | Proposed Soil Loss (tons/ac/yr) | Percent Change (%) |
|---|---|---|---|
| 1 | 8.55 | 32.63 | 282 |
| 2 | 7.31 | 32.14 | 340 |
| 3 | 7.19 | 26.81 | 273 |

indicated previously indicated this increase in stormwater runoff may actually be underestimated due to the potential for soil compaction on a highly disturbed construction site.

The proposed pipeline alignment crosses at least 43 antidegradation streams many of which are bordered by steep slopes, many excess of 50%. The extent of impact is what is most disconcerting as it relates to long term stability and the potential impact to nearby surface waters. For example, where the pipeline crosses a tributary to the Harihokake Creek at milepost 85.8 PennEast proposes clearing a 150 foot wide swath of the riparian buffer, much of which is on relatively steep slopes in the inner 150' of the riparian buffer. Another example of encroachment into steeply a sloping riparian zone can be seen at milepost 83.2 where the pipeline is proposed to cross a tributary to the Harihokake Creek. The riparian zone adjacent to this crossing of a Category 1 stream possesses forested slopes in excess of 60% and a swath of riparian zone 125 feet wide is proposed for clearing. A similar pattern can be observed at milepost 88.4 where the pipeline crosses the Little Nishisakawick Creek. This section of the creek is also bordered by extremely steep sloping forested riparian zones of which 125 foot swaths of forest are proposed to be removed. In this area a field delineated headwater stream will be directly impacted by the pipeline as this stream is indicated to begin in the proposed ROW. As indicated by the three examples selected for analysis impacts to steeply sloping riparian zones will result in a large increase in stormwater runoff and substantially increase the impacted area's potential for erosion. Due to the steeply sloping landscape of Hunterdon County it is unrealistic to believe that PennEast's E&SCP can adequately protect the Category 1 waters proposed to be crossed by the pipeline.

Additionally, based on the calculations of stormwater runoff, both of the Harihokake sites show significant increases in stormwater runoff volume. As indicated previously, this increase in stormwater runoff may actually be underestimated due to the potential for soil compaction on a highly disturbed construction site.

With regard to mitigation, the DEIS indicates that extensive areas, 723 acres (PA and NJ), of soil along the proposed pipeline route have poor revegetation potential and approximately 31% of the soils have shallow bedrock. In the area along the Nishisakawick described above and designated as Area 3, the soils proximate to the stream are mapped by NRCS as Klinesville very channery silt loam, a soil in which bedrock is at a depth of 15 inches. These soils are droughty and considered to be a severe erosion hazard. Based on these soils' characteristics the revegetation of these droughty, erosion-prone soils will be difficult, if not impossible, for the reestablishment of native woodlands.

Representatives of the New Jersey Conservation Foundation (NJCF) inspected a section of the Tennessee Gas Pipeline ROW On August 18th to assess the status of forest mitigation (Attachment 2). The three sections of pipeline inspected indicate that the erosion and sediment control measures employed by Tennessee Gas, which are near identical to those proposed by PennEast, still resulted in soil loss. In fact, all three of the sites showed signs of severe erosion. The steep slopes are currently mostly highly mineral soil with no organic matter. Moreover, ATWS areas along the pipeline are currently dominated by Japanese stiltgrass (*Eulalia viminea*). According to the NJCF report, "*[t]his alien invasion in the altered soil*

*will ensure that a native understory can never be recovered in the tree plantings in the temporary work area which was incorrectly deemed to have temporary, restorable impacts*."

Based on Tetra Tech's post construction monitoring report, year three, prepared for the Tennessee Gas Pipeline Company L.L.C., New Jersey Highlands Region, dated December 2014 the presence of invasive species were identified as a problem. Tetra Tech (2014) stated that the presence of invasive species was especially problematic in the wetland restoration sites. Unsurprisingly, only 32% were considered to be successfully restored at the end of three years. Of the 44 wetlands restored, 30 failed to meet success criteria. These projects were designed to satisfy the same regulatory standards that NJDEP currently requires, that PennEast asserts it will follow – and upon which FERC based its finding of no significant adverse impacts to wetlands or water quality.

In addition, Princeton Hydro inspected several restoration sites along Transco's Stanton Loop. Portions of these sites were dominated by invasive species such as common reed

*Figure 1 Common reed along stream within pipeline ROW*

*Figure 2 Common reed growing out of tree tube*

(*Phragmites australis*) (Figure 1) and reed canary grass (*Phalaris arundinaceae*). Although it is unclear whether these species were present in the pipeline prior to the more recent project, it nonetheless illustrates the current and well documented problem regarding our inability to

control invasive species at compensatory mitigation sites (Figure 2). In addition, several areas possessed stunted vegetation and a considerable amount of rock at the soil surface (Figure 3). Problems such as those observed at the Transco mitigation site are sadly not uncommon as compensatory mitigation remains an inexact science.

*Figure 3 Cobbles at the ground surface in are of sparse vegetation within ROW*

Although the FWPA allows mitigation to occur when an applicant has adequately satisfied all of the conditions of the FWPA permit program. The regulatory conditions required for an Individual Wetland Permit, such as that required by PennEast, are onerous because the primary intent of the FWPA is to avoid impacts to sensitive areas such as endangered and threatened species habitat and antidegradation waters. Moreover, the mitigation of sensitive, rare or complex habitats such as those associated with mature forest, endangered, threatened and rear species habitat, steep slopes and antidegradation waters may be easy to state, as FERC does frequently throughout the DEIS, but more often than not it is impossible to successfully mitigate unique or ecologically complex habitats. In general the ultimate goal of compensatory wetland mitigation is to replace as fully as possible the functions and public benefits of lost wetlands. This level of analysis is particularly relevant when assessing impacts associated with pipelines: permit approvals for FERC pipeline projects routinely depend on mitigation rather than avoidance of impacts. This use of mitigation to support permitting has placed many of New Jersey's unique and highly sensitive natural habitats along the PennEast pipeline in serious jeopardy. The key to protecting these sensitive, irreplaceable resources resides in the proper implementation of the 404(b)(1) guidelines as mitigation has its limitations. The Chicago District of the US Army Corps of Engineers (USACE) "has identified that mitigation cannot mitigate impacts to all sites. The USACE considers that "the functions and values of high quality areas may be considered to be un-mitigatable under the 404(b)(1) Guidelines" and that "impacts to these areas will not typically be permitted" (Chicago District, US Army Corps of Engineers (October 2009).

It is due to the ecological value that New Jersey's regulations seek to avoid these sensitive natural resource. It is also why the regulatory threshold for adverse impacts to these sensitive resources is set very low; for example the regulatory threshold for Category 1 antidegradation waters "is protection from measurable change". With regard to endangered and threatened species the FWPA at 7:7A-7.2 that an individual freshwater wetlands or open water fill permit only if the regulated activity: "*Will not destroy, jeopardize or adversely modify a present or documented habitat for threatened or endangered species; and shall not jeopardize*

*the continued existence of a local population of a threatened or endangered species, as defined at N.J.A.C. 7:7A-1.4*". The following sections will document examples relative to the types of watershed and stream impacts that would likely occur if the PennEast were to be approved.

## IV. *Stream Impacts*

The DEIS states that no long term impacts on surface waters are anticipated as a result of construction and operation of the Project. It also asserts that PennEast's implementation of its E&SCP and FERC Plan and Procedures would minimize the extent and duration of Project-related disturbances to aquatic resources. It posits that PennEast could also implement its E&SCP to further reduce the potential for impacts related to accidental leaks, increased erosion, as well as sedimentation and stormwater runoff. Finally, FERC concludes that the implementation of these measures would minimize impacts on aquatic resources.

As stated above, the implementation of the E&SCP and FERC plans and procedures may able to reduce impacts to sensitive aquatic resources, but the project will still result in a significant change in the landscape adjacent to at least 43 Category 1 antidegradation streams. Simply put, the changes in cover are sufficient to increase stormwater runoff volumes as well as nutrient loading resulting from higher erosion potential of adjacent lands. The widespread impacts to riparian buffers will also trigger environmental changes to the streams in the form of light and temperature alteration.

In order to evaluate such expected pipeline-related impacts, Princeton Hydro conducted two stream assessments to evaluate for biological, physical or chemical changes to the lotic system in relation to habitat modifications resulting from gas transmission pipelines (Attachment 3). Specifically, we document features related to periphyton community composition, periphyton productivity, benthic macroinvertebrate assemblage, water quality and morphometric characteristics. The two streams assessed for this study were the Big Flat Brook in Sussex County, New Jersey, and the Rock Brook located in Somerset County, New Jersey.

Morphometric data at both sites pointed towards narrowing of the streams at the transmission easements with lesser distance between wetted and bankfull width at the time of sampling. Such conditions may be associated with increased stream velocity at these reaches. Peterson (1993) found a greater number and depth of pools in utility corridors than in adjacent areas, and attributed this to the greater density of streambank vegetation, which caused the stream to scour substrate instead of eroding stream banks. This ecological response to the removal of riparian forest was more recently illustrated by research conducted in 16 streams in eastern North America by the Stroud Water Research Institute (Sweeney, et al., 2004). That study showed that riparian deforestation causes channel narrowing, which both reduces the total amount of stream habitat and ecosystem per unit channel length and compromises in-stream processing of pollutants. It also found that wider forested reaches had more

macroinvertebrates, more total ecosystem processing of organic matter, and increased nitrogen uptake per unit channel length.

The impacts associated with this increase in runoff will likely be greater on steeper sloped lands that have been recently disturbed as they will be more difficult to stabilize. Moreover, the presence of compacted soils in the corridor has reduced capacity for recharge and will thus further increase runoff. All of these construction-related issues will result in an increase in the mobilization and transport of pollutants and an increased opportunity for overall soil erosion. These localized changes to the environment related to pipeline construction may all result in impacts to the biologic integrity of the stream.

In scientific literature, aquatic macroinvertebrates are often utilized as indicators of stream health because they provide longer-term insight into the biotic integrity of the stream being studied. Macroinvertebrates are bottom-dwelling organisms, including crustaceans, worms, and aquatic insects, which together serve as the trophic link between primary producers and higher-level consumers such as fish. Macroinvertebrates are extremely important in stream health. They exhibit varying tolerances to a myriad of stressors, including changes in water temperature, dissolved oxygen content, epifaunal substrate type, organic carbon inputs and hydrology. As such, macroinvertebrate community composition are appropriately utilized as the basis for calculating numerous ecological metrics, all of which can provide crucial insight into stream health and variations amongst sites within a stream. These are the types of data that PennEast must use to assess adverse environmental impacts for every stream crossed and impacted by its proposed pipeline construction.[5] Instead, PennEast submitted no data to document or assess site crossing impacts.

Here, Princeton Hydro's macroinvertebrate survey provides important data documenting the distinct shift in community composition between the pipeline-impacted area, and both upstream and downstream samples. The percent EPT, which is a metric of the percentage of pollution-intolerant Ephemeroptera, Plecoptera and Trichopteran organisms, is commonly utilized in rapid bioassessments of stream health because these organisms are sensitive to changes in water quality, habitat alteration or cumulative impacts of anthropogenic stressors.[6] For Rock Brook in Somerset County, the percent EPT showed variation amongst sampled sites. B1 (upstream) exhibited the highest percent EPT at 46.61% while B3 was 31.61%. The lowest value, 17.92%, was observed at B2, the pipeline crossing. Chironomids, which are universally regarded as tolerant of impaired conditions, were the dominant grouping at B2 where they comprised 64.58% of the total community at this site. These metrics point to

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[5] As set out in Part V below, the 404(b)(1) guidelines require impact assessments to be based on evidence.

[6] New Jersey regulations preclude projects that would cause any measurable change to antidegradation waters.

a larger community of pollution tolerant organisms at the pipeline crossing and are indicative of an impaired stream reach relative to B1 and B3.

The study of the Big Flay Brook in Sussex County, NJ indicated that the dominant taxa at the three sites at Big Flat Brook were the *Dubiraphia* sp. which accounted for 12.94% of C1 and 34.06% of C2 while *Promoresia tardella* was dominant at C3 accounting for 29.50% of the community. Species richness was highest at C1 with a measure of 55, declined at the pipeline crossing site, C2, to 37 and then increased downstream at C3 to 43. Of particular interested in this study is the ratio of pollution intolerant organisms, such as the Ephemeroptera, Plecoptera and Trichoptera versus more pollution tolerant species such as those organisms in the Chironomidae and Oligochaeta orders. EPT percentage was similar at C1 and C3 with measures of 21.18% and 25% respectively. Interestingly, EPT percentage was markedly lower at C2 with a value of 4.37%. The decrease in pollution intolerant organisms could be related to degradation at this site due to anthropogenic disturbance related to water quality, hydrology, carbon inputs or other factors. The conversion of this area from a reach with a forested riparian zone to an open system dominated by forbs and graminoids could impact localized erosion, sediment deposition and carbon inputs to this section thereby possibly causing a change to poorer-quality macroinvertebrate indicator organisms.

Based on the shift in community composition observed in the two study areas it appears that the impacts of pipeline crossings to Category 1 would conflict with New Jersey's water quality standards. As indicated previously, Category 1 waters are to be protected "*from measurable changes in water quality based on exceptional ecological significance, exceptional recreational significance, exceptional water supply significance or exceptional fisheries resource(s) to protect their aesthetic value (color, clarity, scenic setting) and ecological integrity (habitat, water quality and biological functions)*." The shift in the macroinverebrate community from one dominated by pollutant intolerant species to one dominated more pollutant tolerant species in the pipeline ROW indicates a change in environment conditions of sufficient magnitude to result in a shift in community composition. The decrease in pollutant sensitive species in the pipeline crossing area is also indicated by the results of the EPT analysis. The EPT analysis indicates that EPT is lowest in the pipeline cut and higher both upstream and downsteam at both sites. EPT is a widely used metric to identify those organisms that are sensitive to changes in water quality, habitat alteration or cumulative impacts of anthropogenic stressors.

## V. Compliance with New Jersey's Regulatory Requirements

New Jersey is one of two states that have assumed delegated authority to implement Section 404 of the Clean Water Act. There is an MOU between EPA and the NJDEP that explains New Jersey requirements for assuming responsibility for this section of the Clean Water Act. This MOU explicitly states in Section IV. Program Maintenance, A. Duty to Maintain Program

compatibility that the "*State Program will be conducted in conformance with applicable regulations and definitions found in 40 C.F.R. Parts 230 and 23.* New Jersey's regulations can therefore be more restrictive than federal Clean Water Act standards, but not less. The Freshwater Wetlands Protection Act, New Jersey's implementation of federal Section 404 authority, clearly states that it shall not consider mitigation when it is evaluating whether an individual permit application for a project. PennEast apparently did not submit data or an application to NJDEP for a wetlands permit or water quality certificate, and FERC does not have such data as would be necessary to conduct its environmental assessment. When NJDEP applies its own regulations, the PennEast preferred alternative that FERC has set forth in the DEIS cannot meet those requirements.

Previous pipeline companies have employed the same approach, choosing to request that FERC certificate a pipeline corridor that fails to satisfy the Clean Water Act requirements. After review of FERC's PennEast DEIS, it is readily apparent that this document does not contemplate or assess compliance with the Clean Water Act standards. Because FERC's NEPA process does little to incorporate New Jersey's Clean Water Act regulations or any assessment of impacts under those standards into the DEIS, the document concludes that the PennEast preferred alternative will have "*no long term effects on aquatic resources.*"

Directly due to the sensitivity of the natural features in this part of New Jersey, every municipality has passed resolutions against this ill-conceived pipeline route. NJDEP has not reviewed data or analysis that could yield a Clean Water Act determination, either respect to wetlands or water quality. It will ultimately be PennEast's responsibility to fully satisfy the requirements of the relevant portions of the Clean Water Act, including section 40 CFR 230 and the requirements of the 404(b)(1) guidelines, before NJDEP can issue a Section 401 Water Quality Certificate, wetlands permits, or flood hazard area permits.[7]

The Freshwater wetlands Protection Act (FWPA) specifically protects against the degradation of ground or surface waters. It mandates compliance with 40 CFR 230.10(c), at N.J.A.C. 7:7A-7.2(b)9. This section of the Freshwater Wetlands Protection Act states that a proposed regulated activity "*Will not cause or contribute to a significant degradation, as defined at 40CFR 230.10(c), of ground or surface waters."* To date, PennEast has submitted no data showing compliance with this provision. Princeton Hydro and other experts have now submitted data showing that the applicant's preferred route cannot comply with this regulatory standard.

Importantly, 40 CFR 230.10(c) states the following:

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[7] Moreover the letter from the US Army Corps of Engineers to Kimberly D. Bose, Secretary of FERC dated January 28, 2015 clearly indicates that PennEast must satisfy the requirements of the 404(b)(1) Guidelines as implemented by the U.S. Army Corps of Engineers on the PA portion of the route, and the NJDEP on the NJ portion of the route.

*(c) Except as provided under section 404(b)(2), no discharge of dredged or fill material shall be permitted which will cause or contribute to significant degradation of the waters of the United States.* ***Findings of significant degradation related to the proposed discharge shall be based upon appropriate factual determinations, evaluations, and tests*** *required by subparts B and G, after consideration of subparts C through F, with special emphasis on the persistence and permanence of the effects outlined in those subparts.* (emphasis added). This provision mandates compliance with other key sections of the 404(b)(1), which an applicant must be able to address in order to illustrate compliance. This regulatory requirement also specifically indicates that regulatory compliance must be evaluated not based on applicant's rhetoric, but on site-specific factual determinations. The DEIS lacks in references to scientific literature or any other existing resources to support its findings. FERC must address all the actual data submitted herewith, and other experts' submissions into the administrative record, and base its finding on those data. Since there is no countervailing evidence provided by the applicant to support its claims of no significant adverse impacts, FERC must provide analysis of the extant data and demonstrate factual support for its findings.

Under N.J.A.C. 7:7A-7.2(b)5, in order for the NJDEP to issue an individual freshwater wetland permit or open water fill permit the project "*[w]ill not cause or contribute to a violation of any applicable State water quality standard.*" The enacting legislation discussing New Jersey's water quality standards is found at N.J.S.A. 7:9B-1.5a(2), states the general policy behind the implementing regulations:

> *Water is vital to life and comprises an invaluable natural resource which is not to be abused by any segment of the State's population or economy. It is the policy of the State to restore, maintain and enhance the chemical, physical and biological integrity of its waters, to protect the public health, to safeguard the aquatic biota, protect scenic and ecological values, and to enhance the domestic, municipal, recreational, industrial, agricultural and other reasonable uses of the State's waters.*

This policy is also implemented through the Surface Water Quality Standards, found at N.J.A.C. 7:9B, which: (1) establishes the designated uses and antidegradation categories of the State's surface waters; (2) classifies surface waters based on those uses; and (3) specifies the water quality criteria and other policies and provisions necessary to attain those designated uses. Under N.J.A.C. 7:9B:

> "*Category one waters" means those waters designated in the tables in N.J.A.C. 7:9B-1.15(c) through (i), for purposes of implementing the antidegradation policies set forth at N.J.A.C. 7:9B-1.5(d), for protection from measurable changes in water quality based on exceptional ecological significance, exceptional recreational significance, exceptional water supply significance or exceptional fisheries resource(s) to protect their aesthetic value (color, clarity, scenic setting) and ecological integrity (habitat, water quality and biological functions*).

PennEast bears the burden of showing no measurable change to category one (C1) waters. It has submitted no data demonstrating adherence to this standard for FERC to consider. Princeton Hydro's analysis of data from pipeline construction impacted streams demonstrates measurable change despite the implementation of best management practices and deployment of approved mitigation measures. Those data are submitted herein.

The definition of a C1 waterway relies on the term *"protection"* in its very language. Moreover, it also explicitly demands the protection of aesthetic values,[8] including scenic setting as well as ecological elements of the stream's habitat water quality and biological functions. These are exceedingly high standards. Because PennEast has chosen to defer applying to NJDEP for its required wetlands or water quality certification until after FERC's Section 7 Certificate review, FERC is now in the position of conducting a NEPA assessment of environmental impacts from pipeline construction prior to having applicant's water quality or wetlands impact data from the preferred alternative.

Princeton Hydro has now submitted data directly related to water quality and wetlands impacts from the preferred alternative route. Those data show that impacts to antidegradation streams from this alternative are far from trivial, because this major pipeline project proposes to cross, at least in its preferred alternative, 43 C1 antidegradation streams. There is, however, likely to be even greater impact to antidegradation streams because PennEast has not completed its surveys and it therefore is likely that unmapped zero and first order headwater streams will be identified when it eventually collects these data. Practicable alternatives such as HDD, Direct Pipe or other measures must thoroughly assessed in order reduce or eliminate water quality related impacts. Compliance with these regulations is not only essential for an applicant to obtain a FWPA and Flood Hazard Area Control Act (FHA) permit but also to obtain a 401 Water Quality Act certification.[9] The DEIS contains no evidence or findings that this has been done. PennEast cannot satisfy applicable water quality regulations in the absence of such analysis, which will likely reveal that the pipeline route cannot receive 401 water quality certificate from the State of New Jersey. If PennEast cannot avoid direct impacts to streams due to the underlying geology or topography then PennEast must consider alternate routes before simply defaulting to the preferred option for crossing streams, trenching.

New Jersey's Flood Hazard Area regulations also have requirements that relate directly to New Jersey's water quality standards and the protection of antidegradation streams.[10] New

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[8] The preferred alternative's impacts to antidegradation streams could not meet New Jersey's regulatory standards for those streams just based on the project's impacts to aesthetic values and scenic setting alone.

[9] Compliance with these regulations is not only essential for an applicant to obtain a FWPA and Flood Hazard Area Control Act (FHA) permit but also to obtain a Clean Water Act 401 water quality certificate from the State of New Jersey.

[10] The Third Circuit recently acknowledged that these regulation were conditions that must be met prior to the State's grant of a 401 Water Quality Certification. (*Delaware Riverkeeper Network v. New Jersey Department of Environmental Protection*, — F.3d —-, No. 15-2122, 2016 WL 4174045 (3d Cir. Aug. 8, 2016).

Jersey's protection of antidegradation streams has, for example, been integrated into the above-mentioned regulations through the establishment of riparian zones in the Flood Hazard Control Act. The Flood Hazard Control Act requires a buffer or riparian zone of 300 feet on both sides of all C-1 streams as well as all upstream tributaries situated in the same HUC 14 watershed. The FHA defines a riparian zone as "*the land and vegetation within and adjacent to a regulated water. Riparian zones exist along both sides of every regulated water and include the regulated water itself*."

Yet the DEIS fails to document or analyze the importance of these C1 stream protective buffers. And no additional scientific work or analysis has been added to this DEIS. PennEast still proposes to disturb areas by removing wide swaths of riparian zone on steep slopes in order to achieve its preferred alternative route. Due to the excessive proposed impacts to riparian zones, which include removing mature forest, PennEast will be required to obtain an Individual Flood Hazard Permit and Hardship Exception. An individual FHA permit is required because the project will have excessive riparian zone impacts, and the quantity of those impacts will have significant adverse impacts on sensitive areas regulated to preserve the state's water quality.

Recent changes to the flood hazard rules prompted an Administrative Order (AO 2016-06) providing guidance on how the FHA revisions must be implemented to ensure that riparian zones are afforded the same level of protection granted to Special Water Resource Protection Areas regulated under New Jersey's Stormwater Rules. The AO states that the collective purpose of compliance with the FHA rules is to "*protect the water quality functions of riparian zones associated with Category One waters.*" The AO also includes the finding that NJDEP must make in order to issue a permit under the FHA. NJDEP must determine that:

> (1) [t]here is no practicable alternative that would have less adverse impact on the regulated area;
>
> (2) the regulated activity would result in minimal feasible alteration of or impairment to the riparian or aquatic ecosystem;
>
> (3) the regulated activity complies with the applicable water quality standard; and
>
> (4) that the regulated activity is in the "public interest."

When considering permit applications under the FHA or the FWPA, NJDEP must make findings that the project is in the "public interest." Yet this inquiry employs different substantive standards, analyses and findings from FERC's public and convenience necessity inquiry. Applying these regulations, the applicant's preferred alternative, as set out in FERC's DEIS, could not meet the above-listed requirements. New Jersey's applicable regulations and standards would

appear difficult if not make it impossible for PennEast to adhere to a preferred alternative that proposes to cross at least 43 antidegradation streams, temporarily impact 30 acres of wetlands, permanently impact to about 35 acres of wetlands (including areas that are habitat for endangered and threatened species), 452 acres (both PA and NJ) of permanent forest loss and an unidentified area of very steep slopes bordering Category 1 streams can realistically occur without any significant adverse impact. As indicated above, C1 waters are, by definition, protected from measurable change. C1 waters' aesthetic values, including scenic setting as well as ecological elements of the streams habitat water quality and biological function, are all explicitly protected.

However, besides providing a general description of the regulatory requirements that the project must eventually meet, the DEIS conveniently sidesteps any actual attempt to investigate environmental values essential for producing an environmental inventory that could be used as a baseline for FERC to assess project impacts. Thus, the DEIS fails to contain data necessary to allow FERC to make NEPA findings as to impacts. Moreover, the DEIS does not provide any discussion regarding compliance with New Jersey's water quality standards. As set out above, that analysis forms the foundation of New Jersey's Section 401 water quality review. Instead, the DEIS reiterates the mantra that, "PennEast would implement its E&SCP and FERC Plan and Procedures to minimize the extent and duration of Project –related disturbances to aquatic resources." The DEIS uses this mantra to dispose of any further analysis of the wide range of impacts that pipeline construction would generate, including:

1. Modification of aquatic habitat
2. Increased runoff and the rate of in-stream sediment loading; turbidity
3. Decreased dissolve oxygen
4. Releases of chemical and nutrient pollutants from sediments; thermal effects
5. Modification of riparian areas
6. Introduction of chemical contaminants such as fuel and lubricants
7. Changes in bottom contours that could alter stream dynamics and increase downstream erosion or deposition.
8. In-stream disturbance during construction could lower dissolved oxygen concentrations that could cause a temporary displacement of motile organisms, such as fish, and may kill non-motile organisms.
9. The clearing of streambanks would reduce vegetation and expose soil to erosional forces.
10. The use of heavy equipment of construction could cause soil compaction of near surface soils, an effect that could result in increased runoff into surface waters which could result in increased turbidity levels and increased sedimentation rates.
11. Disturbances to stream channels could also increase the likelihood of scour.
12. Blasting could occur along the pipeline and within waterbodies and has the potential to kill aquatic organisms

13. Chemical by-products from blasting could also be released and could potentially contaminate the water
14. Greater light penetration could lead to increased temperatures in the water column during warmer months

All of All the potential impacts listed above are summarily disposed of by referring to PennEast's implementation of its E&SCP. Due to the absence of any scientific data regulatory standards which to assess, quantify or even objectively identify adverse impacts it was relatively easy for FERC to dismiss the severity of the impacts that will occur if the PennEast Pipeline were to be approved by simply, yet unrealistically indicating that the impacts will be mitigated. The standards for ultimately identifying impacts reside in New Jersey's Clean Water Act regulations and the. FERC's failure to require PennEast to assess potential for its preferred alternative to comply with those standards simply passes FERC's NEPA obligations on to other agencies. An EIS should draw data and analyses into the reviewing agency charged with assessing the significance of those impacts -- here, FERC -- instead of shunting those analyses out to other agencies, to show compliance with New Jersey's regulation at this time is misleading, especially for after FERC has made baseless conclusions regarding such impacts. This major construction project would significantly alter the landscape of Hunterdon County and Mercer County.

After consideration of the data and analysis contained herein, given the lack of any other data supporting this preferred alternative, FERC's reasoned consideration of the record should result in the rerouting of the PennEast Pipeline to avoid C1 stream corridors. PennEast's request to FERC to certificate a corridor that cannot meet Clean Water Act standards should be viewed as premature and based on the mistaken premise that mitigation can resolve all adverse impacts. These data also show that FERC's initial DEIS reliance on mitigation cannot justify this alternative from either an ecological or regulatory perspective.

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# Attachment 1

## Watershed Impact Assessment

# Watershed Impact Assessment

# PennEast Pipeline Project

## September 12, 2016

## Executive Summary

Princeton Hydro completed a watershed assessment of portions of the proposed PennEast pipeline corridor in order to quantify the impacts of the proposed work on three steeply sloping segments of three Category-1 stream corridors within Hunterdon County, New Jersey (Figure 1). The impacted areas of the three pipeline segments were analyzed for total suspended solids loading, potential soil loss from erosion, and stormwater runoff volume in the existing and proposed conditions. A summary of the potential impacts is listed below.

- Total suspended solid (TSS) loads within stormwater runoff will increase on average 190%. This increase will thereby increase the TSS load of receiving waters and thus increase stream turbidity after storm events. This calculation only considers land cover as a factor and does not take into effect the potential erodibility of the soils, the steepness of the slopes, and the increased volume of stormwater runoff leaving each of the pipeline impact areas.
- Potential soil loss from erosion was evaluated using the Revised Universal Soil Loss Equation (RUSLE) which considers soil erodibility, topographic slope and land cover. The results show that, on average, potential soil loss increased almost 300% when land cover is altered. This indicates that TSS loading will likely increase more than 190% (as noted in the previous bullet) when soil erodibility and topographic slope are taken into consideration.
- In addition, the amount of stormwater runoff generated in the impacted project areas will increase. In general, due to the change in vegetation from forest to meadow less water will infiltrate into surface soils and more stormwater runoff will be generated. See table 1 below for specific increases in stormwater runoff volume for various storm events for each of the pipeline impact areas. An increase in stormwater runoff will ultimately increase stream flow, with potential flood impacts, and carry more pollutants, including solids and non-point source pollutants such as phosphorus.

| **Table 1** | **Approximate Runoff Volume Increase per Storm Event** | | | |
|---|---|---|---|---|
| **Analysis Area** | **2 YEAR** Volume(Gallon) | **10 YEAR** Volume(Gallon) | **50 YEAR** Volume(Gallon) | **100 YEAR** Volume(Gallon) |
| **1** | 29,327 | 36,821 | 43,012 | 44,967 |
| **2** | 38,776 | 48,552 | 56,372 | 58,979 |
| **3** | 142,397 | 183,780 | 216,691 | 228,747 |

Overall, the increase in suspended solids, stormwater runoff volume and increased potential for soil erosion will have a negative synergistic impact on the physical and ecological function of the stream. Refer to the attached map entitled "Stream Corridor Impact Analysis" for a comparison of the existing and proposed parameters along with mapping of the analysis areas.

## Analysis Areas

Analysis areas were determined based on PennEast work plans (7(c) Filing Documents, Appendix C, Part 4, Drawing Numbers 000-03-01-172, 000-03-01-174, and 000-03-01-176) which were georeferenced by Princeton Hydro. The proposed permanent right-of-way and staging areas, hereinafter collectively termed disturbance area, were digitized using the georeferenced work plans (Figure 2).

| Table 2 | |
|---|---|
| **Analysis Area** | **Total Area (Acres)** |
| **1** | 1.29 |
| **2** | 1.86 |
| **3** | 6.03 |

The analysis areas were delineated by bounding the disturbance areas to either a 300-foot riparian zone at each stream crossing or to the upper extent of a steep slope bordering the stream corridor. Only areas of natural land cover, i.e., forest and wetland were included in the analysis areas; cropland was removed from analysis areas since, in this context, no significant changes in runoff or soil loss related to agricultural land cover would occur as a result of pipeline construction.

## Methodology and Results

### *Runoff Analysis*

In order to quantify the increase in stormwater runoff volume between existing and proposed conditions, TR-20 was utilized in HydroCAD 10.0. The calculations were based on average curve numbers, hydrologic soil group (HSG) and the delineated pipeline impact areas.

#### Existing Conditions

Existing land cover was obtained from the New Jersey Department of Environmental Protection's (NJDEP) 2012 Land Use/Land Cover (LULC) data set. Quality assurance was performed using 2012 imagery to ensure the mapped land use class was correct. Areas documented as wetlands in the NJDEP LULC data set but are not wetlands according to PennEast work plan's wetland delineation, were reclassified based on aerial imagery interpretation and adjacent land cover classes. Hydrologic soil group were obtained using Natural Resource Conservation Service's (NRCS) Soil Survey Geographic database (SSURGO).

| Table 3 | |
|---|---|
| **Analysis Area** | **Existing Curve Number** |
| **1** | 78 |
| **2** | 79 |
| **3** | 76 |

A runoff curve number is a hydrologic parameter, which combines the effects of soils and land use, and is used in the prediction of infiltration and runoff due to rainfall. Curve numbers vary with land cover class and hydrologic soil group (HSG). A soils HSG is a measure of its runoff potential and is assigned by NRCS. Land cover and HSG were intersected and assigned curve numbers based on Table 2-2 of the SCS/NRCS TR-55 guidance. A single weighted CN was

calculated for each analysis area by taking the sum of each CN value multiplied by its fraction of the total analysis area, as shown below. Based on the HydroCAD model for existing conditions, the following runoff volumes are generated.

| Table 4 | Approximate Existing Runoff Volume per Storm Event | | | |
|---|---|---|---|---|
| **Analysis Area** | **2 YEAR** Volume(Gallon) | **10 YEAR** Volume(Gallon) | **50 YEAR** Volume(Gallon) | **100 YEAR** Volume(Gallon) |
| **1** | 47,900 | 92,542 | 152,172 | 183,128 |
| **2** | 72,339 | 138,161 | 225,163 | 269,805 |
| **3** | 203,657 | 404,381 | 676,793 | 817,886 |

## Proposed Conditions

The proposed pipeline will alter land cover conditions; however, soil and topographic characteristics were assumed to remain the same between existing and proposed conditions. In the proposed conditions analysis, all non-water land cover classes were converted to old field/grassland land cover, which is equivalent to 'old field (<25% brush covered)' in the NJDEP LULC classification scheme, and 'pasture, grassland, or range' in the SCS/NRCS TR-55 guidance for runoff curve numbers cover type.

The following curve numbers were generated for each of the analysis areas under proposed conditions.

| Table 5 | |
|---|---|
| **Analysis Area** | **Proposed Curve Number** |
| **1** | 89 |
| **2** | 89 |
| **3** | 88 |

Additionally, the following runoff volumes were generated from the HydroCAD model for proposed conditions.

| Table 6 | Approximate Proposed Runoff Volume per Storm Event | | | |
|---|---|---|---|---|
| **Analysis Area** | **2 YEAR** Volume(Gallon) | **10 YEAR** Volume(Gallon) | **50 YEAR** Volume(Gallon) | **100 YEAR** Volume(Gallon) |
| **1** | 77,227 | 129,363 | 195,185 | 228,096 |
| **2** | 111,115 | 186,713 | 281,535 | 328,784 |
| **3** | 346,054 | 588,161 | 893,483 | 1,046,633 |

## Total Suspended Solids Loading Analysis

TSS loads were calculated using a unit area loading (UAL) analysis. The UAL model is a quantitative model that employs empirically based nutrient and sediment loading coefficients developed for specific land covers. A loading coefficient reflects the load amount for a land cover class. Existing and proposed land cover delineation methods are detailed in the previous section. The result of the TSS load calculations for each analysis area can be seen below.

| Table 7 | | | |
|---|---|---|---|
| **Analysis Area** | **Existing TSS Load (Tons/Year)** | **Proposed TSS Load (Tons/Year)** | **Percent Change (%)** |
| 1 | 0.17 | 0.43 | 153 |
| 2 | 0.15 | 0.58 | 287 |
| 3 | 0.8 | 1.99 | 149 |

## Soil Erosion Potential

Potential soil loss from erosion was evaluated using the Revised Universal Soil Loss Equation (RUSLE) adapted from 'Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE)', USDA Agriculture Handbook Number 703. The equation is expressed as:

$$A = R \times K \times LS \times C \times P$$

Where;

'A' is the average annual soil loss in tons/acre/year,

'R' is the rainfall runoff erosivity factor,

'K' is the soil erodibility factor,

'LS' is the slope length and degree,

'C' is the land cover management factor, and

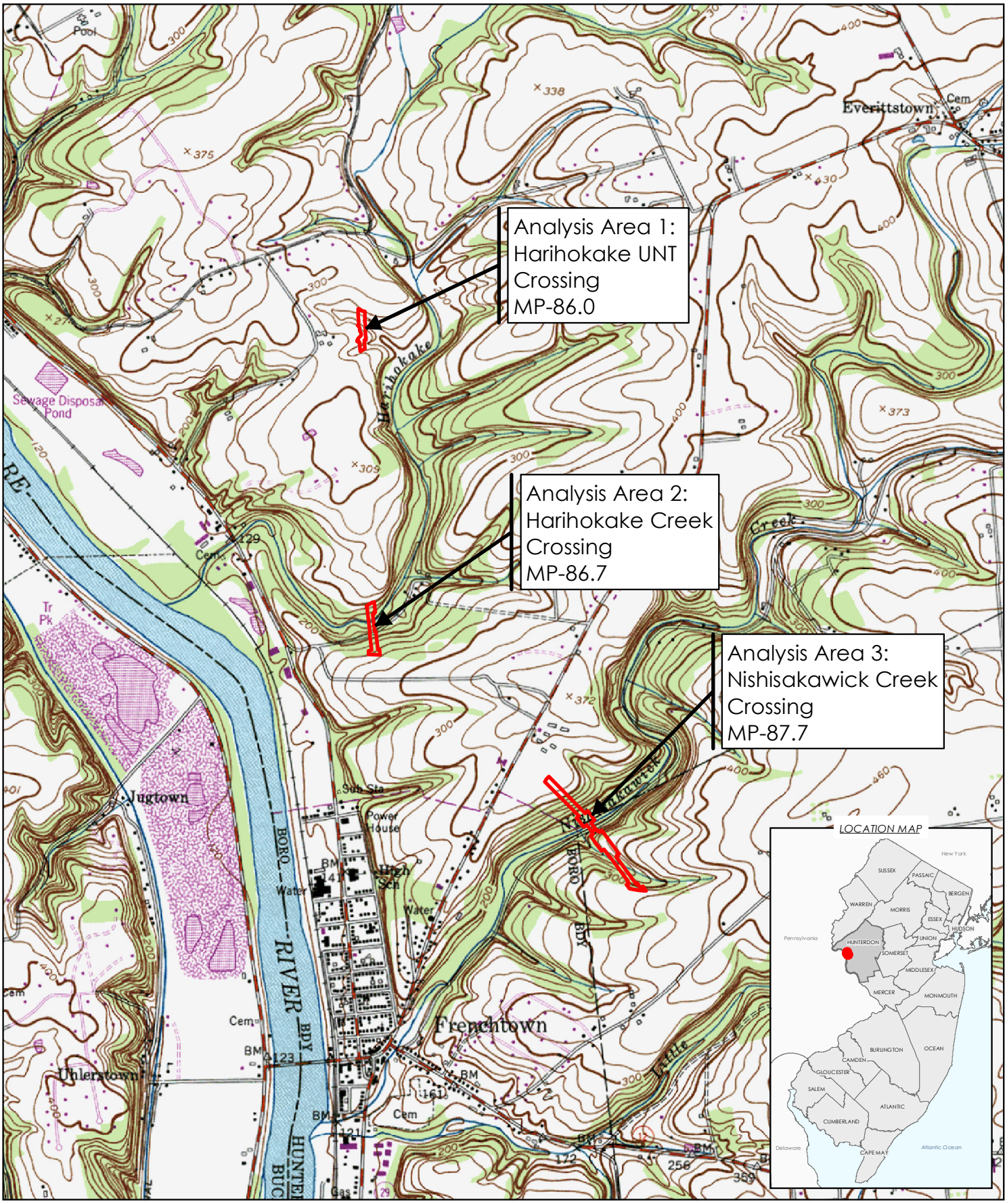
'P' is the conservation practice factor

Only the C-factor will change between existing and proposed conditions; methods for land cover delineations were detailed previously.

The R-Factor was determined using the average rainfall runoff erosivity factor for the northeast as published by USDA. The K-Factor was determined from NRCS SSURGO data; however, the map unit "rough broken land, shale" was not rated for K-factor. This map unit also has minor components of Penn and Linesville soils. In these areas, the K-factor value for Klinesville was used as a surrogate as it is less erodible than Penn soils and would therefore give a more conservative estimate. The LS-Factor was calculated using flow accumulation and slope values as derived from a 10-foot resolution DEM derived from LiDAR. The C-Factor was assigned based on NJDEP LULC codes and proposed conditions. The P-Factor was set to a constant value of 1, as there are no existing or planned soil conservation practices taking place in these

areas. The factors were multiplied and the average potential soil loss from erosion or loading coefficient in tons/acre/year was determined for each analysis area. The results are displayed in the following table.

| Table 8 | | | |
|---|---|---|---|
| **Analysis Area** | **Existing Soil Loss (tons/ac/yr)** | **Proposed Soil Loss (tons/ac/yr)** | **Percent Change (%)** |
| 1 | 8.55 | 32.63 | 282 |
| 2 | 7.31 | 32.14 | 340 |
| 3 | 7.19 | 26.81 | 273 |




# FIGURE 1: USGS SITE LOCATION MAP

PENNEAST PIPELINE
ALEXANDRIA AND KINGWOOD TOWNSHIPS
HUNTERDON COUNTY, NEW JERSEY

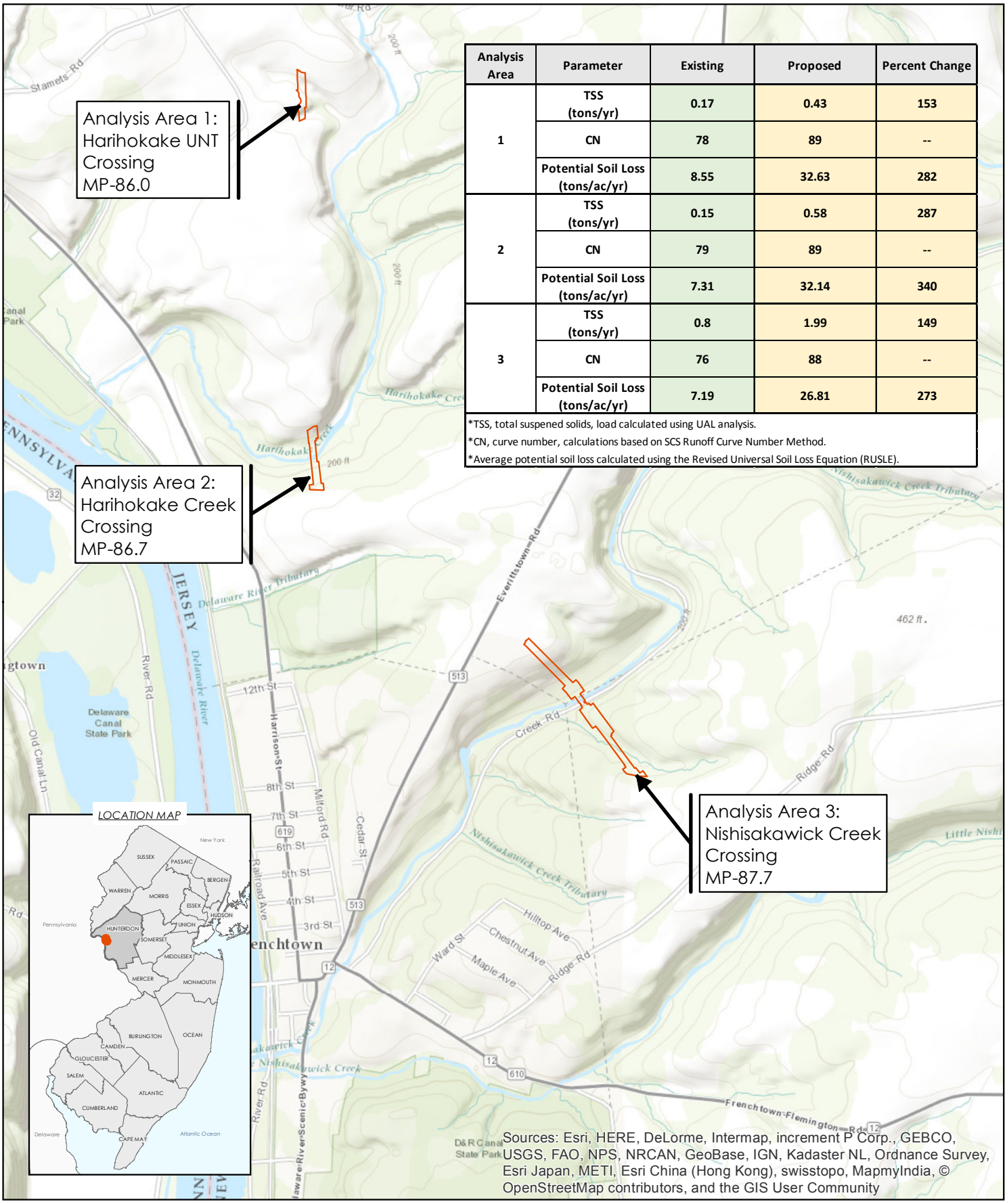

**PRINCETON HYDRO, LLC.**
**1108 OLD YORK ROAD**
**P.O. BOX 720**
**RINGOES, NJ 08551**
*with offices in NJ, PA and CT


NOTES:
1. Analysis areas delineated by Princeton Hydro, LLC.
2. USGS topographic digital raster graphic obtained from Terrain Navigator Pro, Frenchtown NJ quadrangle.

0 1,000 2,000 Feet

Map Projection: NAD 1983 StatePlane New Jersey FIPS 2900 Feet


File: P:\1575\GIS\MXD\USGS.mxd, 9/12/2016, Drawn by cpollack, Copyright Princeton Hydro, LLC.




| Analysis Area | Parameter | Existing | Proposed | Percent Change |
|---|---|---|---|---|
| 1 | TSS (tons/yr) | 0.17 | 0.43 | 153 |
| | CN | 78 | 89 | -- |
| | Potential Soil Loss (tons/ac/yr) | 8.55 | 32.63 | 282 |
| 2 | TSS (tons/yr) | 0.15 | 0.58 | 287 |
| | CN | 79 | 89 | -- |
| | Potential Soil Loss (tons/ac/yr) | 7.31 | 32.14 | 340 |
| 3 | TSS (tons/yr) | 0.8 | 1.99 | 149 |
| | CN | 76 | 88 | -- |
| | Potential Soil Loss (tons/ac/yr) | 7.19 | 26.81 | 273 |

*TSS, total suspened solids, load calculated using UAL analysis.
*CN, curve number, calculations based on SCS Runoff Curve Number Method.
*Average potential soil loss calculated using the Revised Universal Soil Loss Equation (RUSLE).

# FIGURE 2: STREAM CORRIDOR IMPACT ANALYSIS

PENNEAST PIPELINE
ALEXANDRIA AND KINGWOOD TOWNSHIPS
HUNTERDON COUNTY, NEW JERSEY

PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551
*with offices in NJ, PA and CT

NOTES:
1. Analysis areas based on PennEast workplans, 300-foot stream buffer, and the upper extent of steep slopes.
2. Basemap imagery obtained from ArcGIS online maps.

0 1,000 2,000 Feet

Map Projection: NAD 1983 StatePlane New Jersey FIPS 2900 Feet

File: P:\1575\GIS\MXD\Stream_Crossing_Analysis.mxd, 9/12/2016, Drawn by cpollack, Copyright Princeton Hydro, LLC.

# Attachment 2

## New Jersey Conservation Foundation

## Pipeline Mitigation Assessment

BAMBOO BROOK
170 LONGVIEW ROAD
FAR HILLS, NJ 07931
908-234-1225
908-234-1189 (FAX)
www.njconservation.org

New Jersey Conservation
FOUNDATION

Honorable Norman Bay, Chairman
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Re: Docket CP15-558-000 – Proposed PennEast Pipeline Project

Dear Chairman Bay and Members of FERC:

New Jersey Conservation Foundation is an intervener in Docket CP15-558-000 regarding the proposed PennEast pipeline.

In FERC's conclusions and recommendations (section 5.1) in the PennEast Draft Environmental Impact Statement (DEIS), FERC concludes that "….construction and operation of the PennEast Project would result in some adverse environmental impacts." FERC goes on to say that, "if the Project is constructed and operated in accordance with applicable laws and regulations, the mitigating measures discussed in this EIS, and our recommendations, most of the adverse impacts would be reduced to less than significant levels."

Neither PennEast nor FERC present any data or evidence to document that the proposed mitigation measures will be effective in reducing adverse environmental impacts to less than significant levels. This calls into question the foundation of FERC's preliminary, and premature, conclusion that the project can be completed without significant environmental impacts.

To the contrary, there is evidence that the typical mitigation measures required by FERC for interstate pipelines are not effective and don't prevent environmental degradation or restore natural resources to their prior state or healthy ecological conditions.

To document these mitigation failures, I was joined by forest restoration ecologist Leslie Sauer to examine the results of mitigation measures on the Tennessee Gas pipeline as it passes through the Highlands region of New Jersey. Attached is a summary of our observations of the pipeline ROW on August 18, 2016.

Thank you for your attention to this information.

Sincerely,

Emile DeVito, PhD
Senior Manager of Science and Stewardship
New Jersey Conservation Foundation

New Jersey Conservation
FOUNDATION

**Comments on Proposed Mitigation Measures for PennEast Pipeline**
*Review of Tennessee Gas Pipeline Mitigation Failures*

The draft EIS for the PennEast Pipeline provides an assessment of the potential environmental effects of the construction and operation of the project in accordance with the requirements of the National Environmental Policy Act. The DEIS states that "FERC staff concludes that approval of the Project would result in some adverse environmental impacts; however, most of these impacts would be reduced to less-than-significant levels with the implementation of PennEast's proposed mitigation and the additional recommendations in the draft EIS".

Avoidance of significant impacts through mitigation is a common theme throughout the DEIS, as is the frequent reference to the PennEast's Erosion and Sediment Control Plan (E&SCP). For example, the DEIS states that "Based on our analysis, we conclude that the Project is not expected to significantly impact groundwater, surface water, or wetland quality or quantity during construction or operation with implementation of PennEast's proposed mitigation measures as well as our recommendations". These statements are unsupported by any references or examples that would validate the DEIS's assertion that FERC's E&SCP and other stated mitigation measures can achieve the desired goal of reducing impacts to "less-than-significant levels".

The rhetoric of the DEIS is especially troubling when considering the impacts to highly sensitive habitats such as those associated with steep slopes, mature forest, complex wetland systems, endangered species habitat and anti-degradation streams. The mitigation of sensitive, rare or complex habitats may be easy to state, as FERC has done throughout the DEIS, but more often than not it is not possible to successfully mitigate unique or ecologically complex habitats.

The DEIS identifies a number of issues that are all relevant to the identification of adverse impacts and important to both the scale and complexity of the environmental issues that will complicate the successful mitigation of PennEast's impacts. The issues listed below are just some of the many issues that are relevant to mitigation.

1. About 723 acres (67 percent) of the soils along the proposed PennEast Pipeline and laterals are soils with a poor revegetation potential and would be temporarily impacted by construction.
2. 452 acres of forest would be permanently converted to an herbaceous state.
3. 43 category 1 anti-degradation streams will be impacted in New Jersey alone. It is also important to understand that the final number of Category 1 streams impacted in New Jersey has yet to be fully evaluated. These impacts also include the removal of riparian zone vegetation.
4. 30 acres of wetland impact and 104 crossings of wetland areas. The DEIS indicates that through the application of FERC's E&SCP and other Procedures, "we conclude that construction and operation of the Project would result in minor effects on wetlands that would be appropriately mitigated and reduced to less than significant levels".

5. About 406 acres (38 percent) of the soils along the proposed pipeline segments are considered highly erodible by either water or wind and would be temporarily impacted.
6. PennEast would also implement its Invasive Plant Species Control Plan during construction and operation of the Project in order to minimize the risk of invasive plants spreading within the Project rights-of-way and to control existing invasive populations that might prevent successful revegetation of the area. In addition the DEIS indicates that "No herbicides or pesticides would be used for clearing or maintenance within 100 feet of a waterbody".

All of the items listed above indicate either the extent of sensitive lands to be impacted or the rhetoric describing how PennEast can avoid a designation of "significant Impact". It is the unsupported rhetoric regarding the widespread use of mitigation to reduce impacts to less than significant levels that is disconcerting as it serves to form the foundation for FERC's conclusion that the PennEast Pipeline will not result in significant impacts. In the absence of any supporting documentation that illustrates that FERC's mitigation measures can actually minimize project related impacts to the level here suggested, the proposed mitigation measures should be simply considered conjecture and as such should not form the basis for an approval.

Moreover, with regard to regulated resources such as wetlands, nothing in the DEIS was based on the requirements for an individual wetland permit in New Jersey and no basis for believing that the 404(b)(1) guidelines were considered in the selection of the proposed route. Lastly, the regulatory thresholds for impacts to such important natural resources as anti-degradation streams are onerous and would be difficult for a large intrusive construction project such as PennEast to realistically satisfy. The NJDEP defines Category one waters as "those waters designated in the tables in N.J.A.C. 7:9B-1.15(c) through (i), for purposes of implementing the anti-degradation policies set forth at N.J.A.C. 7:9B-1.5(d), for protection from measurable changes in water quality based on exceptional ecological significance, exceptional recreational significance, exceptional water supply significance or exceptional fisheries resource(s) to protect their aesthetic value (color, clarity, scenic setting) and ecological integrity (habitat, water quality and biological functions)." Nothing in the DEIS supports the position that the trenching through these streams will not result in a measurable change in water quality or that the proposed mitigation measures would protect their ecological integrity or aesthetic value of these waters.

Since the DEIS contains no information or evidence regarding the effectiveness of FERC's procedures to successfully mitigate natural resource impacts, we are providing our own investigation which proves that mitigation methods typically recommended by FERC in pipeline construction projects are not successful. An inspection of a section of the recently constructed Tennessee Gas (now Kinder Morgan) Pipeline in the Highlands of northern New Jersey was conducted to evaluate the success of the mitigation performed to reduce adverse impacts to less than significant levels. This pipeline was selected as it has similarities with PennEast regarding steep slopes, mature forest, sensitive wetland resources and anti-degradation streams. The results of the inspection are provided in the following sections.

**A Review of Tennessee Gas Pipeline ROW Stabilization and Mitigation Failures in the Highlands of Northern New Jersey.**

- **On August 18th, Emile DeVito and Leslie Sauer visited three sites along the recently constructed Tennessee Gas Pipeline in the New Jersey Highlands, constructed adjacent to an existing pipeline and completed in 2013.**
    - **where it crosses Canistear Road in the Newark Watershed near Highland Lakes,**
    - **the Clinton Road crossing at Bearfort Mountain Natural Area in Wawayanda State Park, and**
    - **near Union Valley Road primarily on private land.**

---

**General conclusions from the field inspection:**

The three sections of the ROW that we looked at shared many traits in common. All three sites showed signs of severe past erosion. Once they were finally installed and rebuilt, the enhanced stone and soil water bars have been effective. But it is clear that major soil discharges occurred before conditions finally stabilized, and significant impacts to water quality and damage to natural hydrologic conditions in headwater streams occurred through erosion, sedimentation, and increased turbidity. What remains now throughout the steep slopes is a highly mineral soil with few smaller particles and no organic matter (photos 1&2).

East of Canistear Road: Photos 1 & 2

*"fragmented rock subsoil, trees growing poorly"*

West of the Canistear Road crossing, just upstream from Highland Lakes, there appears to be the remains of a serious sedimentation event in the alder swamp. A large, unnatural depression has been excavated, perhaps to remove sediment deposits and to trap future sediment from entering Highland Lakes. Heavy equipment moving from the ROW to work at this sediment trap caused extreme compaction of the forest floor, so much so that even with sunlight streaming in from the south, virtually nothing has started growing on the forest edge (photo 3).

Just upstream from Highland Lakes (Photo 3).

*“virtually no plant colonization due to severe soil compaction in southern exposure at edge of forest”*

In addition, much of the ROW is too compacted for good forest regeneration. Some places were extremely compacted such as at Bearfort Mountain. Some of this compaction may have been a deliberate effort to reduce erosion (photo 4).

Bearfort Mountain Natural Area, east of Clinton road, Photo 4

*"Highly compacted ORV trail over pipeline spreading knotweed, mugwort, stilt grass into nitrogen-enriched soil throughout entire ROW into Bearfort Mountain Natural Area. Seed mix including clover and trefoil and other nitrogen fixing plants will guarantee spread of invasive species, post-agricultural soil conditions, and virtual impossibility of ever establishing forest conditions beneath tree plantings"*

All of the pipeline sections we walked are stabilized against severe erosion at the present time, primarily and unfortunately by mugwort, a mix of mugwort and ragweed, or a mix of mugwort, seeded native and alien herbaceous species, and weedy alien invasives such as stilt grass. Nitrogen-fixing plants like clover, bush honeysuckle and trefoil are abundant and further retard the establishment of native plants. Additional fertilizer was likely added with seeding which further limits native regeneration. The alleged stockpiling of topsoil and site preparation has not served to provide a reasonable growing medium for regenerating the former forest, despite abundant seed sources adjacent to the ROW (photo 5).

East of Canistear Road, Photo 5

*"Japanese stiltgrass has colonized above the new pipeline, and is already invading into the nutrient-enriched soil in the tree planting area. This alien invasion in the altered soil will ensure that a native understory can never be recovered in the tree plantings in the temporary work area which was incorrectly deemed to have temporary, restorable impacts ."*

While the woody plantings, both original and successive replacement plantings, appear to conform to the No Net Loss requirements in terms of survival, the requirements provide absolutely no chance that a native forest can ever recover on the site. The planted species are locally native, including various oak, maple, and other trees and shrubs, although the siting is sometimes inexplicable, e.g. white oak in a ponded wetland. The extensive planting of ash also seems futile, given that it has been assumed that emerald ash borer will invade the region for many years. Arrowwood viburnum plantings off Canistear Road are infested with viburnum leaf-eating beetles. It is likely that the beetles were brought in on nursery stock, aiding in the threat to local viburnum populations. The mature trees lost on state land are being replaced according to the numerical rule requirement, but no trajectory toward the ecological recovery of a forest ecosystem is apparent at all.

None of the sections we examined is on a trajectory to return to forest, much less anything similar to the forest that was lost. Virtually all of the upland tree plantation is likely to become a failed tree plantation underlain with dense mugwort or another set of alien weeds, with just pure mugwort and other invasive species over the actual pipeline (photo 6).

Along eastern edge of Union Valley Road, Photo 6

*"Mugwort abundant throughout entire tree planting area east of union valley road is consuming and out-competing entire tree planting. It is impossible to establish forest conditions with this level of compaction and nutrient-enrichment."*

Giant reed and Japanese knotweed appear to be encroaching toward and replacing tree plantings in forested wetland habitats (photos 7 and 8). Palustrine forest replaced by giant reed represents a serious loss that should be quantified.

(East of Canistear Road, Photo 7)

*"New patch of phragmites (giant reed) invading north edge of temporary work area, where intact forest was cleared and is supposed to return"*

West of Canistear Road above Highland Lakes, Photo 8.

*"Japanese knotweed marching downhill on pipeline corridor will reach wetlands that drain to Highland Lakes in the next growing season (2017). Knotweed has been herbicided, but herbicide failed to control knotweed instead killed only surrounding native plants just exacerbating spread of knotweed toward wetlands. "*

The important hemlock forest and rhododendron bog habitats are not able to reclaim the planted areas adjacent to the pipeline, because those areas were so highly disturbed, compacted, and hydrologically altered that now they support dense populations of invasive giant reed (Phragmites) which inhibits the redevelopment of forest conditions. (photo 9).

East of Canistear Road in wetland, Photo 9.

*"The left side of the photo reveals the original forest condition of dense shade, dense shrubs, dense understory, low nutrients, low pH, uncompacted and undisturbed soil; compare to the pipeline corridor on right side of the photo with high sunlight, high nutrients, high pH, high compaction (post-construction soil similar to post-agricultural soil), and altered hydrology - therefore high degree of alien species, impossible for native species to compete in the long term."*

The lady sipper orchids in the debris next to the ROW will not colonize this landscape; in fact they will be lucky to survive adjacent to vegetation dominated by invasive species. Native regeneration is likely to be compromised for decades. Many areas of mugwort and giant reed elsewhere in the region have remained unchanged for 50 years or more. Sites that undergo soil disturbances such as this, given the ever-increasing abundance of aggressive alien species present throughout the landscape, will not be recovered to native forest.

Even within the 30 years PennEast claims natural regeneration will take place along their pipeline route, they propose no practices in their draft EIS to combat the obstacles to forest regeneration that are widespread across today's landscape.

Much of the giant reed on the Canistear section appears to be the consequence of serious ponding on the ROW due to major drainage modifications to the small stream channel that crosses the pipeline. Winter aerial photos from 2002 clearly show a meandering stream, and this stream configuration has been obliterated by the recent pipeline construction (photos 10 and 11). This may be a result of blasting and/or grading.

Photo 10 : December 2002

Photo 11 : October 2014

Hydrology has been altered significantly; one patch of hemlock/rhododendron forest remaining immediately adjacent to and downstream of the ROW may be deprived of some of its water supply and may suffer in the future. Some of the invasive giant reed has been herbicided, but is rapidly recovering due to ineffective results from the herbicide. (photo 12).

East of Canistear Road, Photo 12.

*"Ineffective herbicide control of phragmites; phragmites spreading throughout pipeline ROW wetlands, especially where stream hydrology was altered, soils were compacted, and ruts had formed"*

In places where Japanese knotweed has been herbicided, the herbicide treatment was ineffective. All native plants around the Japanese knotweed are dead, but the knotweed is alive, has flowered, and is setting seed, and encroaching toward the wetlands. In other areas, control of Japanese knotweed has not even been attempted, setting the stage for disaster in wetlands along the entire corridor (photo 13). Mugwort has been totally ignored, as if it were a beneficial species (photo 14).

East of Canistear Road – Photo 13

*"Japanese knotweed perched on the hilltop, ready to invade wetlands along entire pipeline corridor"*

Edge of Clinton Road, Photo 14

*"Mugwort being ignored, consuming ROW and tree planting in background.*

Other patches of invasive species have been killed, but these areas are now circles of dead vegetation which will be invaded by Japanese knotweed or mugwort, not native plants (photo 15).

East of Canistear Road (Photo 15)

*"herbicide has killed all native plants in addition to the target invasive plant, especially warm season grasses. There is no re-planting of natives, and the area will be invaded by aggressive alien species."*

Successful elimination of these aggressive alien species, including the abundant, invasive and persistent mugwort and Japanese knotweed, would be almost impossible now without extensive herbicide use or complete regrading and planting.

It should be noted that the current restoration specifications for PennEast are even less likely to foster natural recovery than what was implemented on the Tennessee Gas ROW, which at least included some native grasses and herbaceous native wildflowers in the mix.

PennEast claims in the DEIS that no herbicides or pesticides will be used in the ROW, but it is unclear how they will manage invasives. FERC asked for an Invasives Management Plan before construction, but the public should be able to review that plan now.
The DEIS for PennEast repeatedly claims, as does the FERC, that the Additional Temporary Work Space and Temporary Work Space (ATWS and TWS) will all be allowed to return to forest. These areas are treated as temporary impacts when in fact these are permanent impacts that need to be quantified in the EIS. Only the loss of the permanent ROW is acknowledged in the DEIS. The fact is that all cleared forest is a permanent loss, because of the uncontrolled disturbance using wide ROWs, heavy equipment and completely ineffective restoration specifications.

One small section of the Bearfort Mountain mitigation tree planting located immediately east of Clinton Road offers an image of the future, and it is not forest. The planted trees

are quite large in this small area, and underlain by six foot tall mugwort (photos 16 and 17). These losses must be acknowledged and quantified as impacts.

Along Clinton Road, Photos 16 and 17

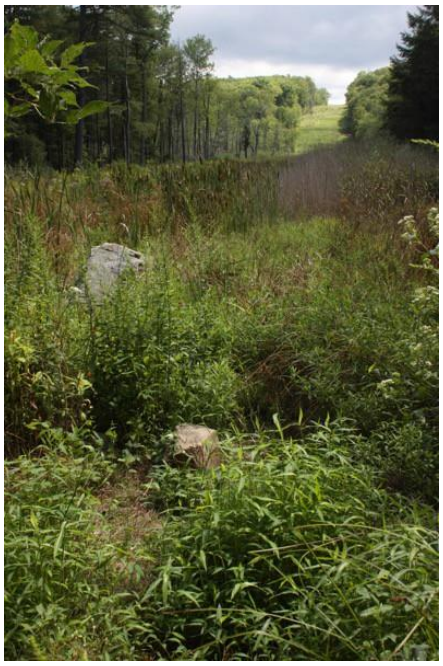
"Bird's foot trefoil enriching soil nitrogen in foreground. Mugwort spreading beneath all planted trees in background, eliminating chance for forest development."

In both directions from the Union Valley Road pipeline crossing, predominantly thick healthy mugwort plants and many other alien species, including black locust trees, are seriously outcompeting all the planted native woody trees and shrubs. The area is also being colonized by invasive Black Locust trees which thrive in these disturbed, compacted soil conditions. The Black Locust trees are growing 10-20x faster than hundreds of native trees that are staked and fenced, while the native plantings are being consumed by the mugwort.

Vast acreages here are on a trajectory to becoming alien invasive weed-dominated corridors, with no chance of ever developing native forest soil types or species assemblages. The best that can be expected are a few scattered trees and shrubs along a wide corridor dominated by aggressive, herbaceous weeds such as mugwort and non-native trees such as Black Locust. The plant communities that will eventually develop in areas that are supposed to return to forest will contain incredibly low species diversity for all native plants and animals, and be composed primarily of alien weeds with little structural diversity or complexity, and be virtually useless for local wildlife and migratory birds and insects (photos 18 and 19).

East of Canistear Road – photo 18

*"Japanese stiltgrass & mugwort in foreground, herbicided phragmites still alive in background, entire pipeline corridor destined to become a linear weed patch due to lack of organic material and nutrient-enrichment of entire corridor."*



East of Union Valley Road – photo 19

*"Mugwort abundant throughout entire tree planting east of Union Valley road, consuming and out-competing entire tree planting. Impossible to establish forest conditions with this level of compaction and Black Locust trees invading.*

ORV use on the Bearfort Mountain Natural Area section has led to serious off site damage as well as trails on the pipeline ROW. A gate was earlier installed at the end of a trail in an attempt to keep ORVs out. Another barricade was required when the ORV riders just created a new trail and now they are on their third trail. The ground was muddy and torn up when we were there. ORV use is simply not controlled here, and subsequent damage enters into the forest adjacent to the ROW.

The wetland sections at the Bearfort Mountain Natural Area crossing were also in better condition, possibly due to the use of a construction mat in that area with reduced soil disturbance.

The most successful sections on the ROW are the few small areas where native grasses, panic grass and goosefoot in particular, have become established. These small patches have a chance of returning to a native forest with enough time. The birch naturally colonizing is also likely to be very successful and may overwhelm some of the planted trees. The native sumac also can compete with mugwort often with its underground rhizomes. The rocky blasted areas with rocky debris also have a chance to return to native forest, albeit slowly, due to the low fertility and lack of established weedy species. PennEast also claims it will conform to FERC s requirement to restore native grasslands designated important to birds, but it will have to use better specifications and site prep than was used here.

PennEast has stated it will plant tree seedlings on all federal, state, county municipal and public conservation areas, but has provided no plan or evidence that any of the tree plantings can possibly mature into any habitat resembling native forest (photos 20-22).

Comparison: photos 20 and 21, taken from exact same location looking opposite directions:

"Original hemlock rhododendron forest compared to nitrogen- enriched tree planting with invasive weeds as mitigation"

Photo 20

Photo 21

**Photo 22**

"Mugwort abundant throughout entire tree planting west of union valley road consuming and out-competing entire tree planting. Impossible to establish forest conditions with this level of compaction and nutrient-enrichment."

FERC requires PennEast to submit a Habitat Restoration Plan before construction, but the public should be able to review it now, especially since the recent pipeline construction ROWs in New Jersey are characterized by weedy disturbance habitats throughout.

In conclusion, a close examination of mitigation measures in a recently constructed interstate pipeline ROW in New Jersey demonstrates that FERC's standard required mitigation measures did not achieve their stated objectives. No evidence has been provided that proposed mitigation measures for PennEast will be successful.

# Attachment 3

## Evaluation of Two Streams Impacted by

## Pipeline Construction

# Evaluation of Two Streams Impacted by Pipeline Construction
# September 12, 2016

## Introduction

Princeton Hydro conducted two stream assessments to evaluate biological, physical or chemical changes to lotic ecosystem caused by habitat modifications resulting from the construction of gas transmission pipelines. Specifically, for this project we evaluated the following ecosystem features: benthic macroinvertebrate assemblage, water quality and morphometric characteristics.

## Site Description and General Features

The two streams assessed for this study were the Big Flat Brook in Sussex County, New Jersey and Rock Brook located in Somerset County, New Jersey.

### *Rock Brook*

Rock Brook, located in Somerset County, NJ, is a tributary of Beden Brook, a tributary of the Millstone River (HUC 14: 02030105110070). The sampled reach is a FW2-Non-trout (NT) waterbody as per the New Jersey Surface Water Quality Classification (N.J.A.C. 7:8B). Located in the piedmont physiographic province of New Jersey, the sampled segment of Rock Brook is a second order stream with a catchment area of approximately 24 $km^2$. The reach originates in a largely forested area of the Sourland Mountains. As it meanders dow gradiest in a southeasterly direction, the watershed changes from one dominated by forested land into a mosaic of agricultural fields and suburban residential development. Surficial geology of the headwater reaches is that of weathered diabase of the Pleistocene, while that of the lower catchment is predominately comprised of weathered shale, mudstone and sandstones of the same era.

The upstream (B1 – Photo 1) and downstream (B3 – Photo 3) area of Rock Brook may be characterized as a deciduous forested reach whereby the dominant trees consisted of various hardwoods, most notably, red maple (*Acer rubrum*), American sycamore (*Platanus occidentalis*), and American beech (*Fagus grandifolia*). Canopy cover upstream (B1) was approximately 95%, while downstream canopy cover was approximately 85%. The vegetative community at the transmission area (B2 – Photo 2) was notably altered with zero percent canopy cover occurring within the utility easement. The predominant vegetation within the riparian area associated with the utility easement consisted primarily of the invasive Japanese stilt-grass (*Microstegium vimineum*), mugwort (*Artemisia vulgaris*), multiflora rose (*Rosa multiflora*), tree of heaven (*Ailanthus altissima*) and to a much lesser extent (~2% coverage) the native partridge pea (*Chamaecrista fasciculata*). Supplemental plantings were observed to the south of the site and continued approximately 100-200 meters upgradient of the right stream bank. These plantings included American basswood (*Tilia americana*) and black tupelo (*Nyssa sylvatica*). Furthermore, small areas of black-eyed-Susan (*Rudbeckia hirta*) were scattered upgradient of the stream to the south.

Approximately 25% of the trees were either dead or suffering from extensive herbivory from Japanese beetle (*Popillia japonica*) as evidenced by extensive leaf damage on the recent plantings. All plantings were along the edge of the pipeline cut with the centerline was characterized by areas of exposed, compacted soil and invasive forbs and various grasses.

**Photo 1: Station B1 (Upstream) – 8/16/16**

**Photo 2: Station B2 (Utility Easement) – 8/16/16 (**

**Photo 3: Station B3 (Downstream) – 8/16/16**

## *Big Flat Brook*

Big Flat Brook, Sussex County, NJ, is a tributary of the Upper Delaware River (HUC 14: 02040104140010). It is located within High Point State Park. The sampled reach is characterized as a FW2-Non Trout, Category-1 (NTC1) waterbody per New Jersey Surface Water Quality Classifications (N.J.A.C. 7:9B). The studied reach, located in the ridge and valley physiographic province of New Jersey, is a second order stream segment with a catchment area of approximately 7.7 $km^2$. The reach begins in a densely (greater than 50% crown closure) forested area, flows through Sawmill Pond, and then flows in a southerly direction through a mixture of forest and wooded and herbaceous wetlands. With the exception of the utility and transportation easements, the watershed in this area is almost entirely undeveloped. Surficial geology of the reach is glacial in origin and is associated with the Kittatinny Mountain till of the late Pleistocene and late Wisconsinian era. Interspersed throughout the catchment area are smaller parcels of swamp and marsh deposits of the late Pleistocene and Holocene which comprise modern day freshwater wetlands.

Upstream (C1 – Photo 4) of the Tennessee Gas Pipeline transmission easement, the lands adjacent to the stream was characterized by a dense cover of woody shrubs, and the riparian vegetation immediately adjacent to the stream consisting of various native forbs and graminoids, including goldenrod (*Solidago* sp.) and several sedges and grasses. Canopy cover in the upper reach was sparse (5%) due to the associated wetland area. Nevertheless, this is a natural condition and not one resulting from land development or any other form of habitat degradation. The transmission easement (C2 – Photo 5) was characterized by zero percent canopy caused by the clear cutting of the adjacent deciduous forest (C2 – Appendix X). For this area, prior to disturbance, a 50% or greater canopy cover would be considered natural. Within the transmission easement a mitigation area was observed along both banksides. It consisted of a mixture of native plantings including black-eyed-susan (*Rudbeckia hirta)*, cardinal flower (*Lobelia cardinalis*), blue vervain (*Verbena hastata*) and goldenrod (*Solidago* sp.). Several small trees had also been planted in this area. Nevertheless, the overall dominance of forbs and graminoids point to a vegetative community that is not consistent with pre-disturbance conditions. Downstream (C3 – Photo 6) showed approximately 45% canopy cover consisting primarily of red maple (*Acer rubrum*) interspersed with various native grasses and forbs.

**Photo 4: Station C1 (Upstream) – 8/16/16**

**Photo 5: Station C2 (Cut) – 8/16/16**

**Photo 6: Station C3 (Downstream) – 8/16/16**

# Methodology

To evaluate the impact of the transmission easement of both Rock Brook and Big Flat Brook, Princeton Hydro implemented a multi-prong sampling approach. The sampling of both streams was conducted on 16 August 2016. At each site, Princeton Hydro collected stream data at the pipeline transmission easement, as well as above and below the easement (Appendix 1). The collected data consisted of the following:

- Benthic Macroinvertebrates – Kick net collection for taxonomy and community metrics
- Water Quality – *In-situ* collection of temperature, specific conductance, dissolved oxygen and pH
- Morphometry – Select measurements of wetted and bankfull width, maximum depth and mean depth

Data specific methodology for the aforementioned areas is presented below.

## *Macroinvertebrate*

Macroinvertebrate samples were collected according to protocol specified in the *Standard Operating Procedures – Ambient Biological Monitoring Using Benthic Macroinvertebrates* manual; Water Monitoring and Standards – Bureau of Freshwater and Biological Monitoring of the New Jersey Department of Environmental Protection (2007).

Sampling at each site was conducted with a consistent effort between stations and according to specifications for Riffle/Run sampling given[SS1] that both stream sampling areas were in higher gradient piedmont (Rock Brook) and valley and ridge (Big Flat Brook) physiographic provinces of New Jersey. At each site the sample run was estimated at approximately 50 meters. Sampling was conducted using a 500 µm D-frame kick-net. At each site, the sampler faced downstream with the bottom of the net facing upstream so that water flowed into the net. At each site the sampler physically disturbed the sediment to manually dislodge epifaunal organisms from the substrate. After collection, the sampler progressed upstream and repeated the process. Over the entire sampled stream segment a total of 20 collections were obtained using this methodology.

Upon collection, all material was transferred into a new, clean polystyrene jar and preserved in the field utilizing 70% laboratory grade ethanol. Each contained was proper labeled noting the sample station, date, time, habitat type (riffle and run) and name of sampler. All labeling was conducted using solvent-resistant ink to prevent subsequent destruction of the label. Samples were subsequently shipped overnight to EcoAnalysts of Moscow, ID for taxonomic analysis to lowest practical taxon (typically species or genus) and the calculation of ecological and pollution based metrics.

## *Water Quality Data*

Water quality data was collected at each sampling station through the use of a calibrated Hach MS5 multimeter. Princeton Hydro is NJDEP certified (Certification Number 10006) for the collection of *in-situ* data. Prior to sampling the meter was calibrated according to manufacturer specifications. Sampling was conducted near the center of each reach and data for temperature, specific conductance, dissolved oxygen, dissolved oxygen percent saturation and pH were collected.

### *Morphometry*

At both sites, various morphometric data were collected at each sampling station. Specifically, Princeton Hydro recorded numerous measurements of the stream channel to establish the width of the wetted and bankfull areas. In addition, mean depth and maximum depth of the wetted and bankfull areas of the stream were collected at Rock Brook. Measurements were taken according to standard fluvial geomorphology protocol.

# Results

## *Rock Brook, Somerset County, New Jersey*

### Benthic Macroinvertebrates

Macroinvertebrates are often utilized as indicators of stream health as they provide longer term insight into the biotic integrity of the stream. Macroinvertebrates are bottom dwelling organisms including the crustaceans, worms, and aquatic insects which serve as the trophic link between primary producers and higher level consumers such as fish. Important in stream health, macroinvertebrates exhibit varying tolerances to a myriad of stressors including changes in water temperature, dissolved oxygen content, epifaunal substrate type, organic carbon inputs and hydrology. As such, macroinvertebrate community composition may be utilized as the basis for the calculation of numerous ecological metrics which can provide crucial insight into stream health and variations amongst sites within a stream.

The dominant benthic organisms collected at B1, B2 and B3 were *Chimarra obscura* (28.05%), *Tanytarsus* sp. (20.00%) and *Caenis latipennis* (27.59%), respectively. Species richness was highest at B3 with a value of 40 and lowest at B1 with a value of 22. B2 fell in the middle with 36 species identified. Of particular importance in the evaluation of this data is not only species richness but more so the composition of the community in relation to pollution tolerant and intolerant organisms; important indicators of stream health.

The percent EPT, which is a metric of the percentage of pollution intolerant Ephemeroptera, Plecoptera and Trichopteran organisms, is commonly utilized in the rapid bioassessment[1] of stream health as these organisms are sensitive to changes in water quality, habitat alteration or cumulative impacts of anthropogenic stressors. The percent EPT for Rock Brook showed variation amongst sampled sites. B1 (upstream) exhibited the highest percent EPT at 46.61%. This value decreased at B2 (pipeline crossing) to 17.92% and then increased at B3 to 31.61%. Chironomids, which are universally regarded as tolerant of impaired conditions, were the dominant grouping at B2 whereby they comprised 64.58% of the total community at this site. These metrics point to a larger community of pollution tolerant organisms at the transmission line cut area and are indicative of an impaired stream reach relative to B1 and B3.

In addition to taxonomic groupings, Princeton Hydro evaluated the functional groups of macroinvertebrates as groupings exhibit a diverse array of morphological and behavioral adaptations for exploiting nutritional resources. A marked number of variables influence functional trophic groups in a

[1] Refer to http://www.epa.gov/watertrain; Rapid Bioassessment Protocols, USEPA Watershed Academy

specific reach including variations in microhabitat, flow regimes, resource availability and respiratory and thermal requirements (Wallace and Webster, 1996). As such, changes in functional groupings between sites may shed additional insight energy transfer and trophic kinetics in a stream system.

Variation in functional groups was noted between sites with filterers being the predominant group at B1 whereby they comprised 50.68% of the community. In contrast, gatherers were the dominant group at B2 whereby they comprised 29.58% of the community while unclassified functional groups were dominant at B3 (31.61%) and gatherers represented the second most dominant group at 22.99%.

The predominance of gatherers at B2 is indicative of altered conditions at this site due to the habitat requirements and morphological adaptations for feeding of these organisms. Gatherers are adapted to feed primarily on fine particles (< 1 mm in diameter) in depositional areas which were noted amongst the bedrock at this site. As such, these organisms may be associated with non-point source sediment loading from the watershed. In contrast, the dominant grouping of filterers at the upstream site (B1) may be associated with a predominance of particle sizes in the <1-50 µm diameter range which dominate the organic seston in most lotic environments (Wallace and Webster, 1996).

## Water Quality Data

*In-situ* water quality data collected at the Rock Brook sampling sites is as follows (Table 1).

Table 1 - Rock Brook - *In-situ* Data

| Station | Date | Time | Temp | SpC | DO | DO% | pH |
|---|---|---|---|---|---|---|---|
| | | | (°C) | (mS/cm) | (mg/L) | (%) | (units) |
| B1 | 8/16/2016 | 18:00 | 23.72 | 0.260 | 9.34 | 111.8 | 7.98 |
| B2 | 8/16/2016 | 16:30 | 22.76 | 0.260 | 9.83 | 115.5 | 7.45 |
| B3 | 8/16/2016 | 19:00 | 24.40 | 0.260 | 8.64 | 104.7 | 7.94 |

[SS2]

Water temperatures varied slightly amongst sites with a 0.96°C decrease from B1 to B2 and then a subsequent increase in temperature at B3 of 1.64°C. Dissolved oxygen was generally similar between B1 and B2 with a slight increase of 0.49 mg/L at B2. DO decreased from B2 to B3 by 1.19 mg/L. pH was similar between B1 and B3 but was lower at B2 which may be indicative of increase metabolic respiration or decomposition of organic matter at this station. Continuous sampling of *in-situ* parameters, with a minimum of temperature and dissolved oxygen, should be conducted to further elucidate diel patterns in these parameters as they relate to primary productivity and relative water quality conditions between sites.

## Fluvial Morphometry

Streams in different physical settings have predictable flow and sediment discharge patterns determined by the climatic, geographic, and geologic characteristics of the valley in which they occur. Different physical settings result in various fluvial processes and stream types, which are identified by their channel form and sediment transport characteristics. Measurement of channel dimensions, therefore, is an important component in fluvial assessments in order to determine whether an existing stream type of the present channel is consistent with its setting.

At Rock Brook, measurements were recorded at each sampling station of the width and depth of the wetted and bankfull channel. These data were collected primarily to elucidate any relative differences in

these morphometric parameters that could provide insight into channel alteration resulting from the transmission easement's disturbance of the stream. Results of the aforementioned metrics are presented in Table 2.

| Table 2: Rock Brook Morphometry | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Site** | **Width (ft)** | | | **Depth (ft)** | | | | **Bankfull W/D** |
| | Wetted | Bankfull | Bankfull/Wetted | Wetted | | Bankfull | | |
| | | | | Max | Mean | Max | Mean | Ratio |
| B1 | 33.0 | 38.0 | 1.15 | 0.80 | 0.34 | 2.30 | 1.62 | 23 |
| **B2** | 31.5 | 34.3 | 1.09 | 0.82 | 0.53 | 2.00 | 1.36 | 25 |
| B3 | 58.9 | 72.0 | 1.22 | 0.65 | 0.30 | 2.90 | 1.73 | 42 |

The ratio of wetted width to bankfull width varied between sites with higher ratios associated with B1 and B3 and the lowest ratio occurring at B2. At B2, the channel was narrower with less distance between the wetted perimeter and that of bankfull. Furthermore, observations of this channel characterized the highest mean depth at B2.

General observation of each site were consistent with these measurements. Sites B1 and B3 were wide and relatively shallow with various epifaunal habitat types including mixtures of riffles, runs and pools and areas of woody debris and softer sediment deposition. In contrast, B2 was generally narrow and deeper with a more homogenous substrate of bedrock interspersed with areas of fine sediment deposition.

In relation to stream hydrology, conditions at site B2 are more prone to increased discharge velocity with resultant impacts including scour and displacement of epifaunal substrate and organisms. Indeed, there were observations of impaired substrate conditions as mentioned above.

## *Big Flat Brook*

### Benthic Macroinvertebrates

The dominant benthic organisms at the three Big Flat Brook sites were *Dubiraphia* sp., which accounted for 12.94% of C1 and 34.06% of C2, while *Promoresia tardella* was dominant at C3 accounting for 29.50% of the benthic community. Species richness was highest at C1 with a measure of 55, declined at the gas transmission easement to 37, but then increased downstream at C3 to 43.

Of particular intereste in this study is the ratio of the EPT pollution intolerant organisms versus the more pollution tolerant species such as those organisms in the orders Chironomidae and Oligochaeta. EPT percentage was similar at C1 and C3, with measures of 21.18% and 25% respectively. However, the EPT percentage was markedly lower at C2 with a value of 4.37%. The decrease in pollution intolerant organisms could be related to degradation at this site due to anthropogenic disturbance related to water quality, hydrology, carbon inputs or a myriad of factors. The displacement of this area from a more densely forested reach to an open system dominated by forbs and graminoids likely affects localized erosion, sediment deposition and carbon inputs to this section of the stream thereby possibly causing a change to poorer-quality macroinvertebrate indicator organisms.

Functional groupings at each site varied with the predominant classification of predators at C1 (35.69%) changing to a less diverse grouping of gatherers at B2 (60.26%). Functional grouping changed yet again at C3 where the scrapers were dominant (38.50%). As previously mentioned, variations in functional feeding

groupings have important impact on energy and particle transport, trophic transfer and higher level biotic assemblages. An increase in gatherers at C2 may be due to increases in fine sediments at this area associated with increased erosion from the pipeline disturbance. Interestingly, similar patterns were observed at the Rock Brook sampling area. It would appear that this may be indicative of an overarching change in macroinvertebrate community composition attributable to development related stressors.

### Water Quality Data

The Flat Brook *In-situ* water quality data measured at the three sites is presented in Table 3.

| Table 3 - Big Flat Brook - *In-situ* Data | | | | | | | |
|---|---|---|---|---|---|---|---|
| Station | Date | Time | Temp | SpC | DO | DO% | pH |
| | | | (°C) | (mS/cm) | (mg/L) | (%) | (units) |
| C1 | 8/18/2016 | 12:17 | 27.37 | 0.034 | 9.67 | 123.7 | 7.06 |
| C2 | 8/18/2016 | 10:07 | 22.39 | 0.041 | 6.98 | 81.4 | 7.04 |
| C3 | 8/18/2016 | 11:05 | 22.35 | 0.040 | 7.79 | 90.8 | 7.22 |

Interestingly, temperature at Big Flat Brook were highest at C1 and then decreased by 4.98°C at C2 to 22.39°C. Temperatures at C3 were similar to those measured at C2; 22.35°C. The markedly higher temperatures at C1 were likely due to a combination of the open canopy at this reach associated with the natural wetland features in conjunction with the very shallow water depth which allows for quicker substrate warming and subsequent thermal transfer. Dissolved oxygen concentrations exhibited change between the disturbed site and C1 and C3 with minimum concentrations of 6.98 mg/L recorded at C2. In contrast, measures were elevated above saturation at C1 (9.67 mg/L) and slightly below 100% saturation at C3 with a concentration of 7.79 mg/L. pH also exhibited variation amongst sites with the minimum value of 7.04 occurring at C2 while the maximum value of 7.22 occurred at C3. The combination of lower DO and pH at C2 may be related to carbon inputs and increased respiration at this site which commonly results in low pH and dissolved oxygen conditions in aquatic systems.

### Fluvial Morphometry

Measurements at Big Flat Brook centered primarily on the measurement of stream width relative to the width of the bankfull area (Table 4).

| **Table 4: Big Flat Brook Morphometry** | | | |
|---|---|---|---|
| **Site** | **Width (ft)** | | |
| | Wetted | Bankfull | Bankfull/Wetted |
| | | | |
| C1 | 11.7 | 15.8 | 1.35 |
| **C2** | 16.9 | 18.5 | 1.09 |
| C3 | 18.0 | 27.0 | 1.50 |

Stream width increased with distance downstream with the ratio of wetted to bankfull width being the greatest at C3 and the smallest at C2. As was similar to Rock Brook, the stream channel was narrower and closer to bankfull width at the gas transmission crossing. As with Rock Brook, there is concern that this morphometric condition may impart increased velocity of flows at this reach which may serve to impair macroinvertebrate communities and trophic condition at this site.

## Summary

Princeton Hydro conducted a single sampling date assessment of Rock Brook (Somerset County, NJ) and Big Flat Brook (Sussex County, NJ) to evaluate physical, chemical and biological conditions of the stream systems as related to disturbances associated with utility easements. This sampling effort was intended to provide a snapshot of documented conditions with the intention of evaluating relative differences in collected parameters between upstream, downstream and impact sites. It is recognized that sampling effort was limited in overall scope. However, the objective of this effort was to evaluate, even at a basic level, the impact of utility crossings on stream ecosystems and the effectiveness of the implemented mitigation measures. The data that we collected refutes the assertions made by the pipeline industry that transmission line easements and associated stream cuts (either with or without mitigation) do not cause a measurable difference in stream quality or ecosystem complexity, services and functions. The findings of this study support the fact that even when assessed on a superficial scale pipeline projects cause significant and unavoidable environmental impacts. Such projects negatively affect the ecological, aesthetic and environmental attributes of each stream crossing. The PennEast pipeline's proposed path transects a number of Category-1 streams. Category-1 streams are protected by the State's anti-degradation standard (N.J.A.C. 7:9B-1.5) from any "measurable or calculable" alteration in quality or services. Our data shows that other pipeline projects have resulted in measurable changes to the ecological integrity of the streams studied. Therefore, the repeated conclusions (unsupported by any data) made by PennEast that their project will not result in adverse impacts to the streams proposed to be crossed due to their mitigation measures is unfounded and certainly not consistent with our findings.

The most telling metric in the evaluation of both sampled stream ecosystems was the BMI data as it relates to the presence, abundance and diversity of pollution tolerant EPT organisms. As previously mentioned, the utility easement sites at both streams were characterized by a notably lower percent EPT compared to both the upstream and downstream sites of the respective stream. Furthermore, functional trophic groups groupings exhibited variation between sites with a commonality of gatherers at the transmission sites at both streams.

Water quality data showed some variation amongst sites with lower dissolved oxygen and pH at C2 which may be associated with increased trophic activity and/or metabolic degradation of built up organics at this station. Additional continual monitoring of temperature and dissolved oxygen, at a minimum, would help elucidate if there are any continuous differences in these parameters between stations.

Morphometric data at both sites pointed towards narrowing of the streams at the transmission easements with lesser distance between wetted and bankfull width at the time of sampling. Such conditions may be associated with increased stream velocity at these reaches which may serve to displace benthic substrate and epifaunal organisms.

The data presented and discussed within this report provide an overall snapshot of degraded lotic conditions at gas line easements as reflected in:

- Reductions in %EPT,
- Channel narrowing and deepening, and
- Vastly altered riparian vegetative conditions.

It is important to note that the mitigation measures implemented at both gas line easements did not restore the temporarily impacted portions of the corridor to original conditions. Based on the data that was collected during what is admittedly a limited sampling effort, it appears that FERC's mitigation measures are insufficient to prevent water quality and biotic degradation associated with the large scale disturbances associated with the major construction effort required to build pipelines.

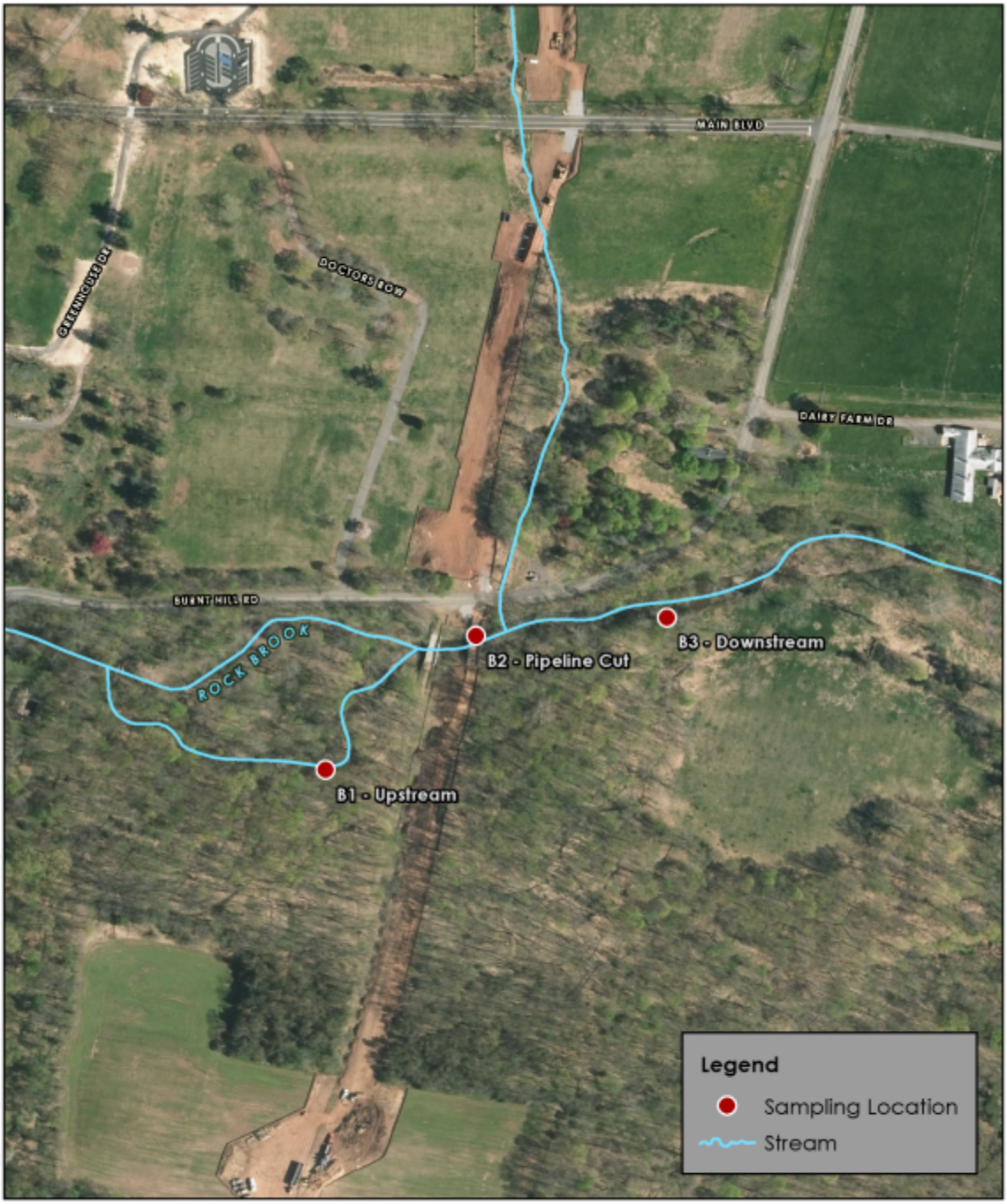
# References

Honachefsky, William (Ed.). 2007. *Standard Operating Procedures – Ambient Biological Monitoring Using Benthic Macroinvertebrates (Field, Lab and Assessment Methods).* New Jersey Department of Environmental Protection, Document No. BMNJ2, 44 pp.

Moultain II, Stephen (et al). 2002. *Revised Protocols for Sampling Algal, Invertebrate, and Fish Communities as Part of the National Water-Quality Assessment Program.* United State Geological Survey. Open-File Report 02-150. 87 pp.

Wallace, J. Bruce and Webster, Jackson R. 1996. *The Role of Macroinvertebrates in Stream Ecosystem Function*. Annual Review Entomology, 41:115-39

# Appendix I - Site Figures




**SAMPLING LOCATION MAP**
**SITE B**

PENNEAST PIPELINE
MONTGOMERY TOWNSHIP
SOMERSET COUNTY, NEW JERSEY

PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551
*with offices in NJ, PA and CT

NOTES:
1. Sampling locations are approximate.
2. Streams obtained from NJDEP GIS website: www.state.nj.us/dep/gis/
3. 2015 orthoimagery obtained from NJGIN Information Warehouse website: https://njgin.state.nj.us/NJ_NJGINExplorer

0 125 250 Feet

Map Projection: NAD 1983 StatePlane New Jersey FIPS 2900 Feet

**SAMPLING LOCATION MAP**
**SITE C**

PENNEAST PIPELINE
MONTAGUE TOWNSHIP
SUSSEX COUNTY, NEW JERSEY

PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551
*with offices in NJ, PA and CT

NOTES:
1. Sampling locations are approximate.
2. Streams obtained from NJDEP GIS website: www.state.nj.us/dep/gis/
3. 2015 orthoimagery obtained from NJGIN Information Warehouse website: https://njgin.state.nj.us/NJ_NJGINExplorer

0 125 250 Feet

Map Projection: NAD 1983 StatePlane New Jersey FIPS 2900 Feet

# EXHIBIT F

# HydroQuest

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September 12, 2016

Nathaniel J. Davis, Sr., Deputy Secretary
Federal Energy Regulatory Commission
888 First Street, NE, Room 1A Washington, DC 20426

**RE: Technical Comments on the PennEast Pipeline Project DEIS (Docket # CP15-558-000)**

## I. Introduction

This report is provided by HydroQuest upon Eastern Environmental Law Center's request to review the above-referenced DEIS. It addresses important geologic, hydrologic and hydrogeologic considerations that have not been adequately addressed in the PennEast Pipeline Project DEIS. Overall, it is clear that release of the DEIS was premature**. Many of the studies that are required for full characterization of geological impacts are only partial completed, while others have not been started or are deferred to others to complete after project approval.** As such, there is neither accurate identification or extant geologic conditions, nor a means to determine actual adverse impacts from the proposed pipeline. All of the issues addressed in this report need to be addressed in a newly revised DEIS which, once complete, should undergo full public review and comment. At a minimum, FERC must include the scientific data and analyses contained herein, and evaluate its DEIS conclusions based on these data.

## II. Karst Concerns

HydroQuest reviewed PennEast's 5-13-16 Karst Mitigation Plan (KMP) revision and related DEIS karst discussions. Along its alignment in Pennsylvania and New Jersey, the Project's preferred alternate route would cross several geologic formations that may exhibit karst features (e.g., sinkholes, conduits, caves). The counties and geologic formations with karst potential that the alignment would cross include the Rickenbach, Epler, Allentown, Jacksonburg, and Leithsville formations in Northampton County, Pennsylvania, as well as the Leithsville formation in Hunterdon County, New Jersey. (KMP, p. 4)

As proposed, the 118.8 mile PennEast pipeline would traverse areas of carbonate bedrock approximately between mile posts 11 and 13, 22 and 23, 42 and 44, 48 and 51, 58 and 81, 92 and 97, 99 and 101, and 104 and 105. While no sinkholes are visible on USGS maps of this area, PASDA has mapped numerous karst features throughout the area (as depicted on PennEast KMP maps) that include closed depressions (i.e., sinkholes). PennEast has initiated geophysical investigations along the length of proposed pipeline to investigate the potential for karst terrain within the path of the HDD and/or cut and fill pipeline installations. Such investigations are

incomplete. The Karst Mitigation Plan details use of using Electrical Resistivity Imaging (ERI) to indicate the presence of numerous anomalies which may represent buried sinkholes or conduits to potentially identify buried karst features (i.e., sinkholes, conduits) that have the potential for ground subsidence that could cause pipeline rupture and release of natural gas. Many long segments of the proposed pipeline route have yet to be surveyed, again pointing out the premature release of the DEIS. After determining karst areas, route changes may need to occur to avoid such terrain; alternately, if no route changes occurred, the adverse impacts from pipeline construction in these areas are likely underrepresented because the scope of work has not adequately been explored.

While PennEast plans to conduct confirmatory borings to document the many anomalies detected, this either has not been done or has not been reported. This is important information that should be incorporated into a revised DEIS provided for public review and comment. The Karst Mitigation Plan was developed to identify areas of karst terrain along the proposed pipeline alignment and to address potential impacts and hazards related to local karst formations crossed by the proposed pipeline. The plan outlines monitoring activities and the corrective measures that PennEast and its Contractor would implement if karst features are encountered during pipeline installation. As described below, those measures are inadequate to address likely adverse impacts from the proposed route.

The stated means of pipeline burial through karst areas is predominantly by conventional cut and cover, with the use of HDD in some segments. The KMP states: "*Although potential exists for unknown karst features to be encountered by this method of construction* (cut and cover), *the likelihood that these features will be large in scale is low as exposed karst features discovered during pipeline installation can be readily identified, evaluated and remediated.*" This statement is not supported by any data. And to the contrary, there is a high likelihood that soil thickness is sufficiently thick such that shallow trench cuts will not expose underlying karst features. Furthermore, unless said Contractors have detailed knowledge and training in karst geology, it is likely that they will not recognize visible karst features or those encountered during excavation.

Section 5 of the Karst Mitigation Plan addresses the potential use of HDD techniques in some karst areas. No details are provided as to exactly where HDD will be used, if anywhere. Without this crossing design information, environmental impact assessment cannot be accurately inventoried. PennEast states that the general risks associated with HDD construction methods in karst areas include difficulties arising from very loose unstable soils and open voids along the drill path. Risks mentioned include loss of drilling fluids into fractures, voids, and conduits; inadvertent drilling fluid returns into wells, springs and rivers; and ground subsidence. PennEast downplays the potential loss of drilling fluids into "*small conduits connected to* ***former*** *karst voids*" which they claim are generally sediment filled and not open. No data or basis is provided for this claim.

Indeed, loss of drilling fluid into karst voids (i.e., solution conduits) has a high potential of mixing with groundwater and adversely impacting the quality of springs situated nearby or many miles away that may be used for water supply purposes. Loss of drilling fluid, inclusive of bentonite and any drilling additives, may degrade down-gradient caves and adversely impact troglodytic fauna. In such instances, tracer testing would be needed to approximate subsurface groundwater pathways and spring receptors - quite likely after aquifer and fauna degradation had occurred. As such, there is no assessment of damage from the possible outcome, and proposed

mitigation would not address it. If aquifer and faunal degradation occur, such impacts are difficult, if not impossible to mitigate.

Furthermore, leakage and/or rupture of HDD pipelines into conduits (e.g., caves) would pose a health and safety risk to cavers, cave fauna and nearby property owners should natural gas excursions occur. Should natural gas enter caves with people in them, the risk of death by asphyxiation, explosion and/or burning would be high. Without full knowledge of subsurface fracture and solution conduit pathways, HDD and other tunneling-based pipeline installation methods should be avoided. Similarly, karst terrain with buried sinkholes pose a health and safety risk should subsidence and pipeline rupture occur. Geophysical investigations documented in the Karst Mitigation Plan accent what appears to be a high degree of karstification along the proposed pipeline route.

Notably, PennEast's desktop review of karst features failed to include the best source of cave-related information - members of the National Speleological Society (NSS) who are very familiar with local karst features as a result of having widely searched the area and explored area caves, mines, major sinkholes and spring resurgences. To be scientifically credible, the Karst Mitigation Plan and DEIS must be upgraded to include input from geologists, karst hydrologists and caver members of the NSS. This will provide a more comprehensive karst feature data base to base potential adverse impact analyses upon. For example, had this level of care been taken, factual errors such as that put forth on pages 4-97 and 4-98 of Volume I of the DEIS would not have occurred:

> "*The FWS has identified three known hibernacula located within 0.25 mile of the Project (Shellenberger 2015), which are identified as Durham Cave 1, Durham Cave 2, and Tunnel 34. Cave 1 and Cave 2 are both located approximately 1,125 feet south of the pipeline route in the vicinity of MP 77.2. ... Based on correspondences with the Pennsylvania Game Commission (Turner 2015) the only connection known to exist between the Cave 1 and Cave 2 is airflow. … the Project would be located within 0.25 mile of other known hibernacula and hibernating colonies at three locations (i.e., at Durham Cave 1 and Durham Cave 2 at MP 77.2, and Tunnel 34 at MP 11.3); and additional unidentified mines and caves may also be present along the Project. As a result, the Project is not consistent with the FWS requirement to avoid bat hibernacula by at least 0.25 mile ...*"

This description places the Durham caves in the wrong state, on the wrong side of the Delaware River, about 2.5 miles from the actual cave location and about 2.6 miles from the nearest pipeline milepost. Furthermore, the "*airflow*" connection has been physically connected by cavers. Notably, Table 5.1-1 (Potential Karst Anomalies Identified by Geophysical Investigations) of the Karst Management Plan identifies possible air-filled cavities and clay-filled sinkholes with estimated diameters of up to 30 feet relatively close to Durham Cave. A direct physical connection may be present between one or more of these features and Durham Cave that may be used as bat hibernacula. The lack of assessment of this hibernacula area along with discussion of risk to a depleted bat population points out the premature nature of the DEIS release. Interestingly, PennEast's Karst Management Plan's Karst Terrain Mapping map set appears to not include the map sheet that includes the Durham Cave area. This brings into question the accuracy, credibility and reliability of karst assessment work presented in the DEIS

and accents the need to complete important field investigation work and necessary analyses prior to release of a DEIS. Otherwise, the DEIS lacks data necessary to make the required scientific assessments. In addition, PennEast refers to two potential bat hibernacula sites in Pennsylvania and 16 in New Jersey that could not be surveyed due to lack of access. This lack of information compromises potential indirect or direct impacts to nearby bat populations. I concur with PennEast's conclusion on page 7 of the Karst Mitigation Plan:

> "*It is indicated that more detailed investigation or evaluation should be carried out by a professional to identify if the concern for karst exists at the mapped locations*."

No reasonable decision maker could conclude that impacts are "less than significant" when the applicant itself identifies significant gaps in the data set upon which such an analysis should be based. These investigations should be conducted prior to issuance of an updated DEIS, so that the agency can make its decision regarding impacts based on sound geologic evidence.

It is critical that the project's design be changed in order to ensure that the project is consistent with the FWS requirement to avoid all bat hibernacula by at least 0.25 mile. The project route should be redesigned to both stay at least 0.25 mile from bat hibernacula and 0.5 mile from voids, located via geophysical assessment, that may be physically connected to hibernacula. Once geologic assessment is completed, an upgraded DEIS should be provided for public review and comment.

Importantly, no sinkholes appear on USGS topographic maps along the proposed pipeline route. Yet, PennEast's geophysical survey work using Electrical Resistivity Imaging (ERI) and soil borings indicates the presence of numerous anomalies which may represent sinkhole or conduit voids (i.e., low resistivity may represent clay-filled voids or heavily weathered bedrock; high resistivity may represent air-filled voids). Significantly, PennEast either does not plan or has not conducted ER imaging over all pipeline segments that have been identified as being underlain by carbonate bedrock. This geologic data gap should be corrected in an upgraded DEIS.

Previously mapped features may represent only a small portion of extensive karst features (e.g., caves). Surface sinkholes indicate active water infiltration and sapping of sediments - many are probably not isolated features. PennEast's incomplete and ongoing Electrical Resistivity Imaging survey has identified numerous subsurface anomalies, many of which are likely to document karst features that integrate with solutional conduits, caves and spring resurgences. Many of the anomalies identified to date are greater than 10 or 20 feet deep below the ground surface with estimated feature diameters of up to 30 feet (see KMP, Table 5.1-1). Confirmatory soil borings have not been conducted or completed. Furthermore, the density of potential karst features identified translates directly to increased risk of ground subsidence, collapse of sinkholes and pipeline rupture. The tight density of potential buried karst features argues against the use of both cut and fill and HDD pipeline installation methods through areas of carbonate bedrock. This constitutes another important geological indicator that would require project redesign, such as rerouting. The speculative nature of all these items confirms that the DEIS lacks data necessary to reasonably predict or assess adverse environmental impacts.

Once PennEast completes geophysical surveys along the length of the pipeline alignment, additional surveys perpendicular to critical Class 1 features will be conducted to further classify the dimensions of the feature and the possible connectivity to other karst features. Subsequently,

PennEast intends to advance geotechnical borings where necessary to calibrate geophysical data. Clearly, PennEast has submitted their DEIS in advance of completing important field work. Once this work is completed, it should be presented to the public for review and comment in an updated DEIS. Moreover, since the results of this work may render the applicant's preferred alternative infeasible, any conclusions set forth in the DEIS regarding project geological impacts were premature and not grounded in science.

Most sinkhole collapse is triggered by rapid changes in groundwater conditions. Subsidence and collapse of sinkholes in Pennsylvania and New Jersey can be stimulated by high groundwater flow during floods when sinkhole fill is undermined by cave streams. Pipeline trenches provide preferentially permeable pathways where shallow groundwater flow may be modified, increased and redirected such that it saps sediments into subsurface solution features, resulting in subsidence or collapse within sinkholes. This may lead to loss of pipeline support and pipeline failure.

Thus, the issue at hand is not simply conducting pipeline installation activities to decrease groundwater recharge and the risk of sinkhole collapse during construction, but also that of increased shallow groundwater flow into sinkholes over time along pipeline trench pathways. These pathways increase future risk of pipeline failure. These risks have not been acknowledged or addressed in the DEIS. Pipeline installation through karstic project areas should be avoided due to high environmental risk to people and cave fauna.

## Considerations Regarding Horizontal Directional Drilling in Karst Terrains

A first look at PennEast karst related HDD documents reveals that they downplay environmental concerns associated with pipeline construction in karst terrains. Section 2-1 states that "*karst is characterized by features such as cavern openings, sinkhole, closed depressions, and gaining and losing streams*." Section 3-5 uses verbiage that seeks to minimize karst features including "*seepage conduits*" and:

> "*It is recognized that small conduits connected to former karst voids could be encountered along the proposed HDD alignment, however these conduits are not typically "open" and are rather infilled with sediment caused by preferential groundwater flow paths. In most instances, the loss of drill fluid to these conduits will minimize over time as the drilling fluid develops a filter cake around the perimeter of the borehole and seals minor conduits from additional flow*."

While it is true that karst terrains can exhibit sinkholes, closed depressions and losing/sinking streams, the singular most important factor that characterizes karst terrains is the rapid, non-Darcian, movement of groundwater within conduit portions of aquifers. The absence of surface features (sinking streams, sinkholes) does not document the absence of a karst terrain. Many karst areas of the world do not exhibit surficial karst features. Key karst features generally include conduits ranging from short lengths to hundreds of miles (vs. seepage conduits) and spring discharge points. Karst aquifers are the most hydrologically vulnerable type of aquifer because groundwater moves rapidly in conduit portions of them with little or no natural cleansing.

Any contaminant that enters a conduit can potentially pose a risk to groundwater and air quality along the pathway of the conduit(s). Because the current application is solely for purposes of transporting natural gas, which is lighter (i.e., less dense) than air, the evaluation of potential adverse environmental impacts must factor in all conduits and caves that might be intersected via horizontal directional drilling. Should pipeline rupture or failure occur within very small to large conduits either directly within or connected to caves, degraded air quality may lead to the death of troglodytic fauna and humans within them due to explosion or asphyxiation. Therefore, it is important to document known conduits (i.e., caves) along pipeline pathways - not just sinkholes or shallow conduits as interpreted from geophysical data.

If caves are documented via geophysical work or from NSS members, these areas should avoid use of HDD methods so as to not introduce the risk of natural gas release into conduits connected to caves used by cave-dwelling fauna and humans. If pipeline routes must cross over areas of known caves, efforts should be made to use open cut pipeline methods so that conduits may be observed and gas excursions would only vent upward vs. laterally in conduits.

## Protection of Karst & Other Species: Environmental Considerations

Pipeline leakage or loss of natural gas resulting in the buildup of methane in caves and mines may pose both an explosive and health risk to cavers, cave scientists, and cave-dwelling fauna. People and bats in caves may potentially be overwhelmed by the buildup of methane where health and safety concerns normally reserved to confined spaces should not be an issue. The potential widespread devastation and far reaching adverse impact to bats and other cave-dwelling species in the project area and elsewhere far overshadow the recent bat population reduction from Geomyces destructans (a.k.a., white-nose syndrome). Now, more than ever, untainted cave and mine habitat is needed for restoration of bat species. Bat conservation organizations such as Bat Conservation International, Organization for Bat Conservation, and the National Speleological Society should be actively incorporated into the decision making/regulatory process within the context of a full environmental impact statement process, complete with public review and comment. Concerns of this nature (i.e., leakage of gas or fluids into cave passages that could kill cave life or cause explosions) have been recognized in other areas (e.g., New Mexico), where gas and oil drilling on BLM lands was coordinated to avoid intersecting and adversely impacting known cave systems, including world-famous Lechuguilla Cave.

## Overall Karst Terrain Conclusions

About 20 percent of the proposed PennEast pipeline route would traverse through karst terrain. Regional field studies conducted by PASDA, members of the National Speleological Society, PennEast consultants and others document the karstic nature of carbonate bedrock formations within the project area. While PennEast has conducted Electrical Resistivity Imaging (ERI) over portions of the pipeline route, long sections have not yet been surveyed with geophysical equipment. Similarly, a confirmatory boring program has either not been initiated or has not been completed to assess ERI results. Completion of this and other karst-related work is necessary to assess karst feature connectivity with at least one bat hibernacula, the presence of undocumented hibernacula beneath the pipeline route, and the risk of ground subsidence and sinkhole collapse that may lead to pipeline failure. Pipeline failure may jeopardize the health and safety of people and cave fauna. Release of the DEIS was premature.

Pipeline installations advanced through carbonate bedrock via HDD may intersect very small to large conduits that are part of a cave serving as habitat for troglodytic fauna and/or as of air-filled conduits used by humans for scientific research and recreation. Release of natural gas into conduits and caves from leaking or ruptured pipelines has the potential to accumulate gas, thereby posing explosive and asphyxiation risk to cave-dwelling fauna and humans.

Groundwater moves rapidly through caves and solution conduits, much like that in surface streams. Because the conduits are open, almost no natural cleansing of contaminants occurs. For this reason, conduit portions of karst aquifers are THE most hydrologically vulnerable aquifers anywhere. The DEIS fails to document the importance of this environmental feature. It therefore de facto fails to address the significance of potential environmental impacts from attempted pipeline installation in these areas.

The potential release of drilling fluids (with bentonite and additives) may adversely impact caves, cave fauna, and down-gradient springs and streams. Contaminated karst streams resurge as springs where their adverse impact to streams, lakes, reservoirs, ecosystems, and wetland species and water quality may be rapid. Furthermore, release of natural gas and contaminants into caves may lead to the loss of threatened and endangered species, including bat species. Overall, the greatest risk posed as a result of installing natural gas pipelines in karst terrains is to the health and safety of people should pipeline failure occur coincident with ground subsidence or collapse into underlying sinkholes or conduits. The project applicant and others have documented the karstic nature of the terrain beneath a significant portion of the proposed pipeline route, while not completing equal assessment throughout all pipeline segments overlying carbonate bedrock (e.g., New Jersey segments). The DEIS implies that it is safe to cross karst terrains, while failing to acknowledge the geologic risks from doing so are extremely high. The DEIS should have an embellished alternate routes analysis that avoids pipeline placement through karst areas where subsidence-induced pipeline leaks, ruptures and explosions pose an unnecessary risk to public health and safety.

## III. Preferential Permeability along Pipelines: Hydrogeologic-Groundwater Implications

PennEast failed to provide adequate characterization of potential adverse hydrogeologic-groundwater resource impacts associated with pipeline construction. The DEIS should be withdrawn and rewritten with extensive analyses of potential, avoidable, and unavoidable hydrologic impacts along the entire proposed pipeline route. At a minimum, agency decision makers must assess the following data and analyses to determine how it will affect their findings with respect to significance of adverse impacts. A partial framework for this work is provided in the discussion below.

Trenches dug to contain pipelines disrupt and significantly increase the natural porosity and permeability of soil, sediment, and bedrock alongside pipelines. The high porosity and permeability of backfilled trench material will result in pipeline trenches functioning as zones of low hydraulic head, effectively acting as interceptor trenches that will preferentially shunt shallow groundwater flow into and then along them. Increased pipeline permeability will promote and increase sinkhole drainage efficiency, thereby increasing the likelihood of subsidence, collapse, and pipeline failure. Depending on the physical, topographic, and hydrogeologic setting, trench construction may cause a number of unnatural changes which

require detailed evaluation prior to public review and comment on an upgraded DEIS. Given the lack of important geological data in the DEIS, it is difficult to evaluate the likelihood of such adverse impacts. In turn, it is impossible to determine that such impacts will be insignificant or capable of mitigation. These potential changes and related impacts include but are not limited to:

- Increased recharge to underlying aquifers;
- Increased recharge within sinkholes leading to increased (i.e., stimulated) drainage efficiency with increased and accelerated subsidence and collapse downward into underlying conduits and caves;
- Decreased shallow groundwater flow downslope of pipelines placed at angles other than perpendicular to topographic contour lines. This may, for example, result in spring and water supply flow reductions;
- Diversion of shallow groundwater flow into and along pipeline trenches which may redirect flow away from areas formerly receiving flow;
- Reduction in watershed area when trenches divert shallow groundwater flow outside natural catchment boundaries (e.g., away from ponds and lakes with low surrounding topography);
- Lowering of the water table in areas with seasonally or perennially high groundwater levels. This may lead to loss of vegetation and ecosystem damage;
- Drainage of wetlands in certain physical settings (e.g., wetlands elevated on hill slopes);
- Sediment influx into waterways, wetlands, ponds, lakes, and reservoirs from non-compacted clay and silt-rich trench backfill; and
- Pipeline trenches as preferential contaminant transport pathways stemming from pollutant influx into trenches from beyond them or from contaminant loss resulting from pipeline rupture (e.g., black powder compounds, corrosion products, hydrocarbon condensate).

Pipeline construction within mapped and unmapped sinkholes poses unnecessary risk of pipeline rupture due to subsidence and collapse. Importantly, the risk of sinkhole collapse would be greatly exacerbated from pipeline trenching through them because increased permeability within trenches will unnaturally shunt water downward into underlying sinkhole drains, thereby increasing infiltration, drainage efficiency, and downward sapping of residuum. The proposed PennEast pipeline route, as characterized through incomplete geophysical survey, may traverse through many sinkholes. This should be avoided and the current route reconsidered.

## IV. Waterbodies Crossed by the Project

Review of DEIS Volume III, Appendix G, Table G-5 (Waterbodies Crossed by the Project) provides a disturbing look at the applicant's **inconsistent** planned means of crossing **many** waterbodies. Some of the major waterbodies along the pipeline route will be crossed via HDD

bore technology, others will not. Additional technical rationale is required to justify why some waterbodies are crossed via HDD and others would be crossed using Dry Crossing methods. [The same issue applies to the proposed 7.38 miles of wetland crossings (6.2% of the pipeline route) where most crossings would be open cut (up to 1,722 ft), yet others would use HDD or bore methods.] For example, the Delaware River crossing would use HDD methods and the Susquehanna River crossing would use dry crossing methods. A footnote on Table G-5 states: "*b/ Susquehanna River crossing includes an additional 23.5 acres of temporary disturbance due to drying of river bed between coffer dams.*" Use of dry crossing methods to cross the Susquehanna River reeks of environmental and ecosystem disturbance and potential water quality degradation, substantially increased due to the risk of pipeline failure from floodwater scour.

The DEIS presents no scientific or technical justification to support the applicant's plan for major disturbance of the Susquehanna River and not the Delaware River. Nor does the limited environmental data contained in this record suggest a reasonable basis for such planned inconsistency. These are not isolated examples of conclusions reached with no apparent scientific underpinning. The applicant plans to use dry crossing open cut methods for most waterbody crossings, including FERC major and intermediate class waterbodies. Why are some FERC major and intermediate class waterbody crossings targeted for HDD methods, while others would be crossed using dry crossing methods? Similarly, why are some minor creeks targeted for either bore or HDD crossings while others are not? Detailed rationale and justification should be provided for not using HDD methods for all waterbodies targeted for dry crossing methods. Importantly, and furthermore, the applicant has not detailed why they plan to use HDD vs. Direct Pipe or other tunneling methodologies that may have a higher degree of likely success with less environmental impact. This should be presented for public review in an upgraded version of the DEIS. And FERC needs this scientific data to make any environmental impacts assessment. An abbreviated listing of waterbodies targeted for dry crossings follows:

| Waterbody Name | Nearest MP | Crossing Method | FERC Class | Width (ft) |
|---|---|---|---|---|
| Susquehanna River, PA | 7.0 | Dry Crossing | Major | > 100 |
| Little Shades Creek | 18.3 | Dry Crossing | Major | > 100 |
| Stony Run | 22.6 | Dry Crossing | Intermediate | > 10&≤100 |
| Lehigh River | 23 | Dry Crossing | Major | > 100 |
| Buckwha Creek | 48.1 | Dry Crossing | Intermediate | > 10&≤100 |
| Indian Creek | 54.3 | Dry Crossing | Intermediate | > 10&≤100 |
| Hokendauqua Creek, PA | 55.9 | Dry Crossing | Intermediate | > 10&≤100 |
| Harihokake Creek, NJ | 85.6; 86.7 | Dry Crossing | Intermediate | > 10&≤100 |
| Nishisakawick Creek | 87.9 | Dry Crossing | Intermediate | > 10&≤100 |
| Litte Nishisakawick Creek | 88.4 | Dry Crossing | Intermediate | > 10&≤100 |
| Copper Creek | 90.0 | Dry Crossing | Intermediate | > 10&≤100 |
| Wickecheoke Creek | 96.8 | Dry Crossing | Intermediate | > 10&≤100 |
| Alexauken Creek | 100.4 | Dry Crossing | Intermediate | > 10&≤100 |
| Swan Creek | 101.3; 102.9 | Dry Crossing | Intermediate | > 10&≤100 |
| Moores Creek | 104.8 | Dry Crossing | Intermediate | > 10&≤100 |
| Jacobs Creek | 109.1 | Dry Crossing | Intermediate | > 10&≤100 |
| Stony Brook, NJ | 112.8 | Dry Crossing | Intermediate | > 10&≤100 |

A more complete listing is found in DEIS Volume III, Appendix G, Table G-5.

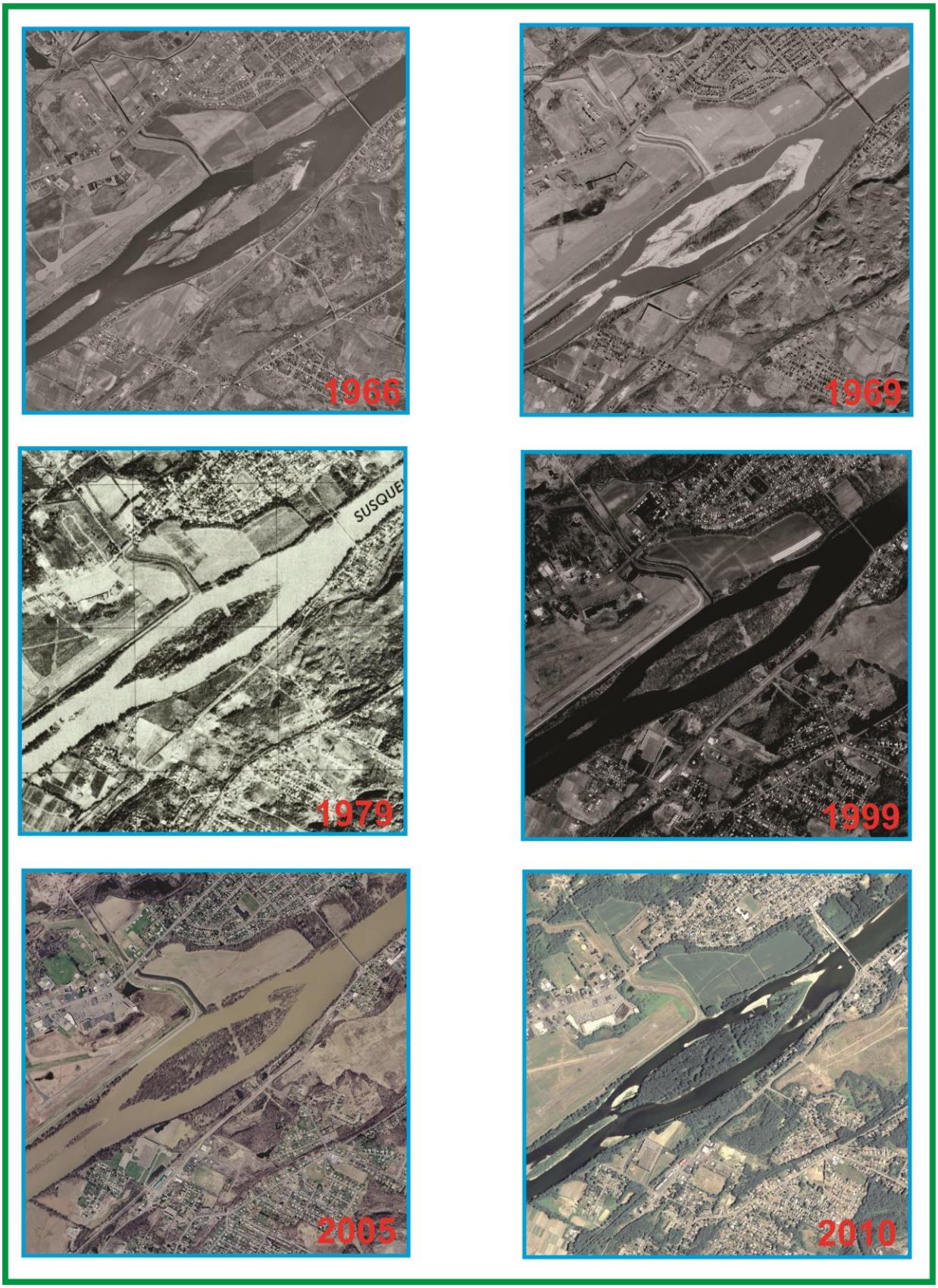
## V. Pipeline Failure in Dry Crossings

Pipes buried beneath creeks and river beds are subject to failure from a number of well-documented mechanisms including corrosion, construction defect and mechanical or material failure (e.g., cracked and ruptured pipes, pipe joint failure) and ground movement (Sklavounos and Rigas, 2006). Scour and exposure of pipelines during flood events presents another documented pipe failure mechanism.

Shrivastava (2009) provides a fluid mechanic basis that explains exposure of buried natural gas pipelines at river crossings:

> "*A buried pipeline at a river crossing can become exposed, due to the scour of the underlying river bed during flood flows, to hydrostatic buoyancy force, hydrodynamic forces of drag and lift as well as flow-induced vibration. The above mentioned hydrostatic and hydrodynamic forces can rupture a buried pipeline at a river crossing during flood flows, and such a rupture has - in the case of a natural gas pipeline – grave social, economic and environmental consequences (NTSB, 1996, Thompson, 2002). Natural gas is a hazardous material, and it is colourless, odourless, tasteless and inflammable. Moreover, it is less dense than the atmospheric air, and therefore a ruptured pipeline creates a buoyant plume. Further, leaking gas from a high pressure pipeline emits noise at a level which is hazardous to human hearing. Understandably, therefore, a ruptured natural gas pipeline has the potential to quickly turn into a public emergency (NTSB, 2000).*"

Shrivastava discusses the many unknowns and uncertainties in the technical literature as related to scour depth that provides recommended scour depths ranging from 2 to 16 meters. Literature also documents river bottom scour depths ranging upward to three times the height of floodwaters above river bottoms. The lack of sufficient empirical data regarding lithology and lateral and vertical sediment continuity across the Susquehanna and other project rivers targeted for dry crossings simply adds risk to the proposed scenario of burying pipelines beneath creeks and rivers that experience flood flows with high stream power. Lack of sufficient geologic data and poor planning have led to failure of many bridge piers subjected similar hydrodynamic forces as PennEast pipelines may be under the current proposal. For example, the 1987 Fort Hunter NYS Thruway bridge collapse into the flooding Schoharie Creek occurred due to scour of unconsolidated sediments. The presence of unconsolidated sediments in the bed of the Susquehanna River proximal to the Monocanock Island crossing can be seen at various river stages on the figure below.




Monocanock Island at proposed pipeline crossing location.

Floodwater scour in Pennsylvania and New Jersey creeks and rivers targeted for dry crossings poses a significant risk. In the absence of detailed empirical lithologic data for each and every proposed dry crossing, collected at very frequent intervals, geotechnical characterization would be wholly incomplete. Lack of lithologic information and hydrologic analysis provides scientific justification to withdraw the DEIS until full characterization has been completed, analyzed, and provided for public review and comment. FERC cannot make decisions grounded in science without these data.

Here, the Susquehanna River is used as an example of the nature of hydrologic data that is important in scientifically justifying decisions to bury highly pressurized pipelines with explosive and flammable gases in flood prone creeks and rivers. Reference to long-term stage and discharge data recorded at USGS gaging station 01536500 (Susquehanna River at Wilkes-Barre, PA; ~ 4.5 miles downriver of the proposed pipeline crossing) reveals that the up-gradient watershed area encompasses 9,960 $mi^2$, a huge drainage area. A look at historic records reveals that flooding has historically been a major problem. In fact, in places levees were built to reduce flood impacts outward into communities. This, of course, unnaturally channelizes river flow and increases potential scour depth. The maximum flood depth of 42.66 feet at the Wilkes-Barre gage occurred on September 9, 2011.

Comparison of Hurricane Agnes in June 1972 and flooding on the Market Street Bridge in Wilkes-Barre, PA, on September 8, 2011 (Courtesy of Tim Bender)

Flooding along Market Street Bridge in Wilkes-Barre, PA, September 8, 2011 (Courtesy of Deirdre Mollahan)

Detailed empirical geologic and hydrologic data should be provided in an upgraded DEIS to justify the scour risk associated with pipeline burial in the invert of the Susquehanna River and all other proposed dry crossings.

In the absence of data submitted by the applicant, HydroQuest reviewed all additional credible scientific data submitted to the administrative record. The record contains data submitted by other sources, which are not considered in the DEIS, documenting the risk associated with HDD at the proposed Susquehanna River crossing, as well as numerous related contaminant concerns. See FERC Docket CP15-558, Accession # 20160909-5171. The excellent work reported to the record is thus referenced here and need not be repeated. Instead, scour-related concerns are raised. Thus, between undocumented coal mines beneath the proposed crossing, contaminant concerns and the risk of pipe exposure and failure from scour it is difficult to conceive why a regulating agency would permit pipeline crossing here. The risk at the planned crossing location is too great. An alternate location should be selected, geotechnically analyzed, and put forth for public review and comment, and agency consideration.

Crossing the Susquehanna River at the target location should be rejected. Furthermore, the applicant should thoroughly document the rationale for not selecting an HDD, direct pipe or microtunneling alternate for all creeks and rivers targeted for dry crossings.

## VI. Pipeline Failure in HDD Crossings

The Delaware River, like the Susquehanna River, is a high consequence area where pipeline leaks or rupture may endanger river water quality, fauna, ecosystems, an underlying aquifer, and the public. It is a navigable waterway where catastrophic pipeline failure would endanger boats, ships and people. A number of environmental concerns and risks associated with placement of a pipeline beneath the Delaware River are discussed below. Here, the Delaware River is used as one example of potential adverse environmental impacts that are not adequately addressed in the DEIS.

### Geotechnical Considerations

Horizontal directional drilling beneath the Delaware River, if conducted, will occur through a highly pervious geological environment. Geotechnical study and engineering design of drilling and pipeline installation are the most important factors for successful crossing of rivers (Williamson and Jameson, 2000). A full geotechnical review of Delaware River and other HDD crossings could not be conducted because PennEast has not filed the results of all outstanding geotechnical investigations and has not filed final planned designs for each HDD crossing. It is thus impossible to evaluate the potential adverse environmental impacts associated with these pipeline crossings.

Bentonite excursions during pipeline installations have not been adequately addressed in the DEIS. Break out of bentonite and fine sediments during the pipeline installation process could blanket river bottoms with resultant degradation of fauna and ecosystems. The technology required for placement of a 24-inch gas transmission line in soft, saturated, river bottom sediments via horizontal directional drilling methods is well established (Hair, 2011). However,

Hair further points out that while HDD operations are routinely successful in placing pipelines in soft sediments, an open hole condition is difficult to achieve in soft cohesionless soils over a long horizontally drilled length. Non-cohesive sediments encountered beneath river bottoms have been the subject of assorted technical papers dealing with tunnels and pipelines (e.g., Guatteri et al., 2000). The lack of sediment cohesiveness in creeks and rivers, including the Susquehanna River, could easily result in the upward release of natural gas and entrained fine-grained sediments to overlying water bodies, even with the use of bentonite in the drilling fluid. This could result in highly turbid river water and the deposition of fine sediments and bentonite on the river bottom (i.e., sedimentation). Howitt et al. (2012) identified these same environmental issues of concern in a shallow coastal shoreline HDD pipeline installation. Their paper details the methods they used to identify and map sediment plumes and deposition of drilling fluids and bentonite associated with HDD. Other microtunneling technologies should be further explored and discussed in the DEIS that may be capable of reducing or eliminating adverse environmental impacts (e.g., direct pipe). Yet, as discussed above, there are other geological risks (such as crossing karst features) with the current pipeline route that could not be mitigated by such measures.

## VII. Pipeline Failure in Developed Areas (with worst case example scenario)

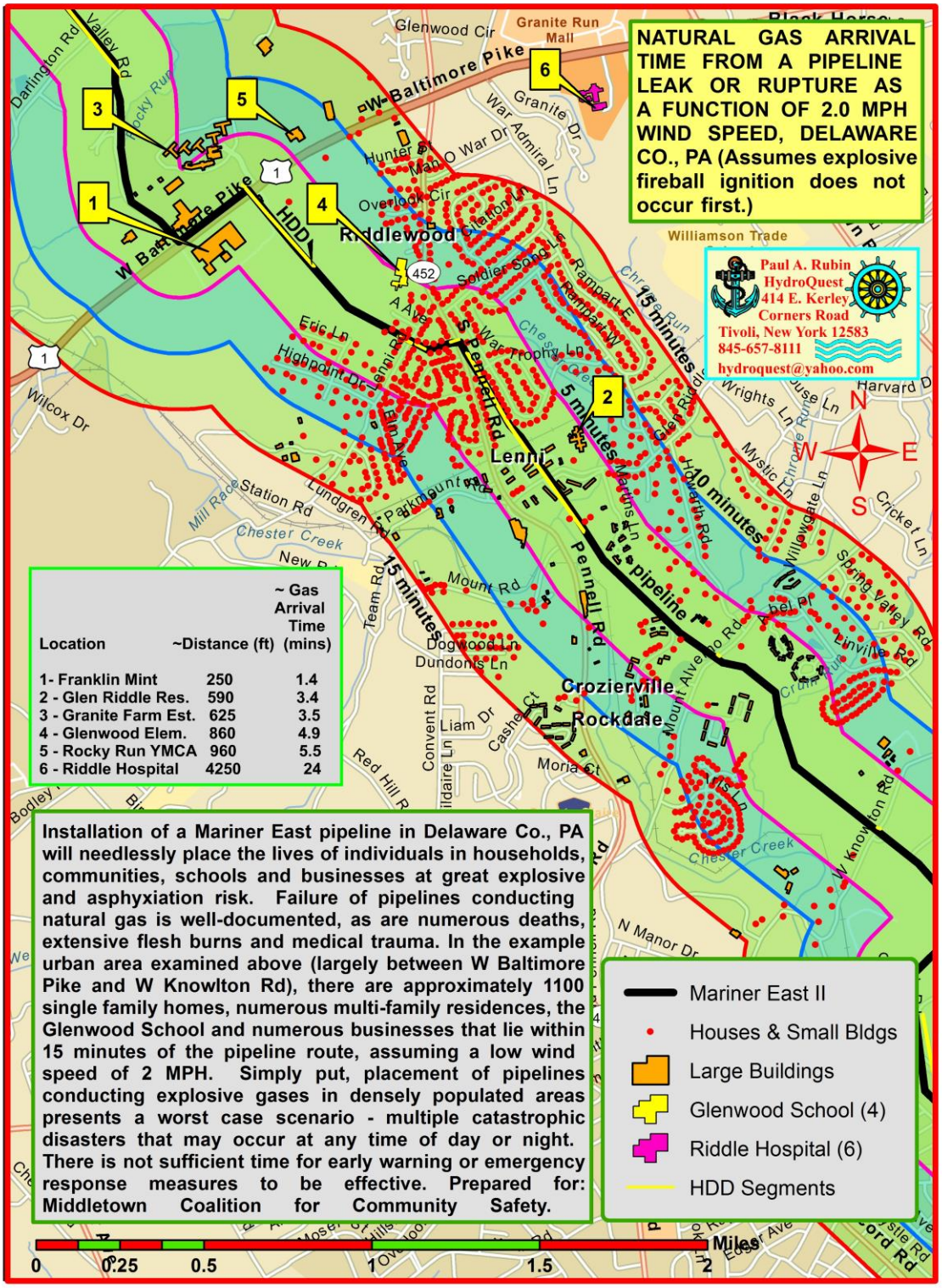
PennEast documents that residential homes would be as close as 40 feet from the pipeline centerline (Table G-16).

> "*Where residences or business establishments are within 50 feet of construction, PennEast would install safety fences along the edge of the right-of-way for a distance of 100 feet to each side of the residence or business establishment*." (DEIS, p. 2-13)

Public health and safety is the singular most important issue relative to the proposed PennEast pipeline project. Regarding reliability and safety of the pipeline and aboveground facilities associated with the Project, PennEast states that they would be designed, constructed, operated, and maintained to meet the U.S. Department of Transportation (DOT)'s Minimum Federal Safety Standards in Title 49 Code of Federal Regulations part 192 and other applicable federal and state regulations. These regulations include specifications for material selection and qualification; minimum design requirements; and protection of the pipeline from internal, external, and atmospheric corrosion. **Nonetheless, pipeline failures continue to occur raising the most important issue as related to pipeline installation directly within feet of parents, their children and the community - public health and safety. A site-specific example is provided below that demonstrates that pipeline failure in developed areas may result in death within minutes. This accents the unjustified risk our communities are forced to bear when safe green alternatives are available. Unless pipeline routes avoid families and children, they should not be permitted. The DEIS should justify "acceptable" risk to the public.** More emphasis needs to be placed on alternative route options. The no-action alternative would clearly avoid these risks. The DEIS's conclusion that compliance with PHMSA requirements and other laws dispose of FERC's obligation to weigh these risks flies in the face of scientific data regarding pipeline failure on lines adhering to these requirements.

The DEIS does not adequately address potential adverse health impacts to families and businesses that may occur as a result of pipe failure. Nor does it adequately detail emergency response plans. In some instances, pipeline placement would be within only tens of feet from family homes, needlessly placing them in jeopardy should pipeline failure occur. Such failures and related injuries, burns and death are well-documented. The proposed 36-inch diameter PennEast pipeline would conduct highly pressurized natural gas (~1,480 psi). Needed safety distances increase when the internal diameter or the operating pressure of pipelines increases. Nevertheless, safety distance is more sensitive with pipe size rather than operating pressure (Sklavounos and Rigas, 2006). Yet, this is not the situation present along portions of the proposed PennEast pipeline where the pipeline would be placed adjacent to homes and businesses. An example is presented in the paragraph and map below.

Installation of the PennEast pipeline would needlessly place the lives of individuals in households, communities, schools and businesses at great explosive and asphyxiation risk. Failure of pipelines conducting natural gas is well-documented, as are numerous deaths, extensive flesh burns and medical trauma. By analogy and way of example, the GIS map below (albeit for another pipeline) documents the urgency and real risk to human health as a function of gas arrival times from a failed pipeline. The scenario presented could easily be anywhere along the PennEast pipeline. In the Delaware County, PA example urban area examined there are approximately 1100 single family homes, numerous multi-family residences, the Glenwood School and numerous businesses that lie within 15 minutes of the pipeline route, assuming a low wind speed of 2 MPH and little gas dispersion. Simply put, placement of pipelines conducting explosive gases in densely populated areas presents a worst case scenario - multiple catastrophic disasters that may occur at any time of day or night. **There is not sufficient time for early warning or emergency response measures to be effective. The DEIS is deficient in its presentation regarding public health and safety. Adequate justification for placing peoples' lives in jeopardy vs. using alternate pipelines, current capacity and/or alternate routes is needed in an updated DEIS.**


NATURAL GAS ARRIVAL TIME FROM A PIPELINE LEAK OR RUPTURE AS A FUNCTION OF 2.0 MPH WIND SPEED, DELAWARE CO., PA (Assumes explosive fireball ignition does not occur first.)
Paul A. Rubin
HydroQuest
414 E. Kerley Corners Road
Tivoli, New York 12583
845-657-8111
hydroquest@yahoo.com
~ Gas Arrival Time
Location ~Distance (ft) (mins)
1- Franklin Mint 250 1.4
2 - Glen Riddle Res. 590 3.4
3 - Granite Farm Est. 625 3.5
4 - Glenwood Elem. 860 4.9
5 - Rocky Run YMCA 960 5.5
6 - Riddle Hospital 4250 24
Installation of a Mariner East pipeline in Delaware Co., PA will needlessly place the lives of individuals in households, communities, schools and businesses at great explosive and asphyxiation risk. Failure of pipelines conducting natural gas is well-documented, as are numerous deaths, extensive flesh burns and medical trauma. In the example urban area examined above (largely between W Baltimore Pike and W Knowlton Rd), there are approximately 1100 single family homes, numerous multi-family residences, the Glenwood School and numerous businesses that lie within 15 minutes of the pipeline route, assuming a low wind speed of 2 MPH. Simply put, placement of pipelines conducting explosive gases in densely populated areas presents a worst case scenario - multiple catastrophic disasters that may occur at any time of day or night. There is not sufficient time for early warning or emergency response measures to be effective. Prepared for: Middletown Coalition for Community Safety.
Mariner East II
Houses & Small Bldgs
Large Buildings
Glenwood School (4)
Riddle Hospital (6)
HDD Segments
0 0.25 0.5 1 1.5 2 Miles
15 minutes
5 minutes
10 minutes
pipeline
HDD
W Baltimore Pike
Pennell Rd
Lenni
Riddlewood
Crozierville
Rockdale
Granite Run Mall
Williamson Trade
Glenwood Cir
Granite Dr
War Admiral Ln
Hunter St
Mah O War Dr
Overlook Cir
Soldier Sand Ln
Rampart E
Rampart W
War Trophy Ln
Eric Ln
Highpoint Dr
Elm Ave
Parkmount Rd
Lundgren Rd
Station Rd
Mill Rd
Chester Creek
Mount Rd
Team Rd
Dogwood Ln
Dundonis Ln
Convent Rd
Liam Dr
Cashel Ct
Moria Ct
Red Hill Rd
Darlington Rd
Valley Rd
Rocky Run
Wilcox Dr
Harvard Dr
Wrights Ln
Mystic Ln
Willowgate Ln
Cricket Ln
Spring Valley Rd
Linville Rd
Mount Alverno Rd
Howarth Rd
Martins Ln
Chrome Run
N Manor Dr
W Knowlton Rd
Bodley
N
S
E
W

Pipeline accidents continue to occur, accenting the wisdom of installing highly pressurized natural gas in close proximity to families and communities. Two recent pipeline accidents document the importance of subjugating the risk of injury and death to families below that of gas distribution. Additionally, they and more other accidents point out modern pipeline installations continue to fail. Two recent accident examples follow.

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## Recent Pipeline Accidents

**Incident 1: Drawn from the PHMSA CAO: On January 26, 2015, an Enterprise Products pipeline that originates in Pennsylvania structurally failed near Follansbee, West Virginia, resulting in the release of over one million gallons of liquid ethane into a wooded area. The explosion and resulting fire burned approximately five acres of woodlands. The fire in the surrounding area wasn't extinguished until 24 hours later. A house 2,000 feet away suffered thermal damage. This pipeline was brand new, having been put into service just about one year prior to the failure. And the failure was both predictable and predicted: in May 2010, PHMSA issued Advisory Bulletin 2010-0078 on Girth Weld Quality Issues Due to Improper Transitioning, Misalignment, and Welding Practices of Large Diameter Line Pipe. The very issues identified in this Advisory Bulletin were factors in the structural failure of this pipeline.**

**Incident 2: On Friday April 29, 2016, A large Texas Eastern transmission line — 30 inches in diameter — burst open around 8:15 a.m. in Salem Township, shooting flames into the sky that could be seen for miles. Residents reported hearing a deafening gush of air. The explosion blew a 12 foot deep, 1500 square foot hole and scorched 40 acres. A 24.5 foot section of 30-inch diameter pipe landed 100 feet away. A 26 year old man was hospitalized with third degree burns over 75 percent of his body. "The preliminary investigation has identified evidence of corrosion along two of the circumferential welds: one at the point of failure and another excavated after PHMSA's response to the Failure Site. The pattern of corrosion indicates a possible flaw in the coating material applied to girth weld joints following construction welding procedures in the field at that time."**

### Pipeline Integrity

Gas pipelines installed below river bottoms present a difficult environment to access and work in should rupture or failure occur. The ability to access horizontal directionally drilled pipelines to correct problems and make failed pipelines functional is far greater in sub-river bottom settings than in shallowly buried subaerial trenched pipeline settings. Furthermore, the downwardly curved pipe cross section presents a physical situation where increased corrosion may occur.

Much documentation exists that establishes that the greatest threats to pipelines are internal and external corrosion and third party damage (e.g., Eguiguren, 2015). Other common pipeline failure mechanisms include seam corrosion, coupling failures, stress cracks, stress corrosion cracking (SCC), over pressurization, and inadequate cathodic protection. According to the U.S. Pipeline and Hazardous Material Safety Administration, Pipeline Safety Trust's analysis of federal data, new pipelines are failing at a rate on par with gas transmission lines installed before the 1940s. Thus, the concept that new pipeline installations are inherently safer than older installations is erroneous. Thus, potential adverse impact to public health and safety is of utmost concern. Existing regulations clearly are not reducing these risks, and even if they are outside of FERC's regulatory purview, the DEIS is supposed to present an assessment of adverse impacts, based on existing data.

### Pipeline Rupture, Explosion and Crater Formation (More Examples of Pipeline Rupture)

Should PennEast's proposed pipeline rupture, gases within it could quickly result in environmental degradation. It is well documented that pipeline ruptures have resulted in massive explosions, walls of fire, fireballs, and the release of gases and liquids into the environment. The great force of some of these explosions is evident in large craters and the distance of ejected pipe sections. Thus, unconsolidated sediments present on creek and river bottoms may not be sufficient to contain an exploding pipeline, as well as gas and chemical excursions. Again, public health and safety are of paramount importance. Pipeline accidents continue to occur. Examples of pipeline explosion craters and pipeline ejection include:

- Energy Transfer Partners, L.P./Panhandle Eastern Pipe Line Company system (ETP/PEPL) Houstonia 200 Line near Mile Post 21.6. The failed section of the pipeline was located in a rural area west of Pilot Grove, Missouri in Cooper County. The longitudinal rupture in the pipe body created a 50-foot by 33-foot by 7-foot deep crater in the ground. Two pipeline sections totaling 28 feet in length and a coupling were ejected from the crater up to a distance of 300 feet from the rupture site (USDOT, 2014).

- San Bruno pipeline explosion in 2010. A 30-inch diameter steel natural gas pipeline exploded into flames, inclusive of a wall of fire more than 1,000 feet high. Eight people died and 35 houses were leveled. The resulting shock wave registered as a magnitude 1.1 earthquake. The explosion excavated an asymmetric crater 167 feet long, 26 feet wide, and 40 feet deep (Wikipedia).

- Arkansas River pipeline blowout on May 31, 2015. A Texas Eastern pipeline owned by Spectra Energy used to transport natural gas across the Arkansas River exploded. Cement debris from the explosion damaged and landed on a passing towboat. See photo below. Source: http://www.arktimes.com/ArkansasBlog/archives.

Disturbed Arkansas River water coincident with the rupture of Spectra Energy natural gas pipeline. Photo was taken by Tony Cassady after the height of the water spout had diminished. This scenario could easily occur beneath the Susquehanna or other creeks and rivers.

Furthermore, multiple pipelines with nearly intersecting pathways or placed in close proximity to each other increase health and safety risk.

## VII. Liquid Content of Natural Gas

The potential loss of liquids from HDD pipeline installations may jeopardize water quality and ecosystems in rivers should pipe rupture occur. These environmental impacts are not analyzed in the DEIS, as FERC avoids safety-related analysis. Natural gas is a mixture of hydrocarbon compounds (e.g., benzene, toluene, xylenes, and ethylbenzene) with quantities of various non hydrocarbons. The composition of natural gas being transmitted in pipelines may include a condensate or liquid fraction (i.e., wet gas; natural gas liquids) containing hydrocarbons. Hanger et al. (2015) discuss this while pointing out that deposits and liquids build up inside pipelines, at low water accumulation points in pipelines (e.g., below the river bottom), and create local

environments that can be more corrosive than the bulk wet gas environment. The liquid volume can vary from very little (dry or non-associated gas) to thousands of gallons depending on numerous factors including gas composition, liquid content, liquid saturation, gas density, pressure, velocity, and pipe orientation. Depending on gas velocity within the pipeline, the U-shaped pipeline curvature beneath the river bottom may result in liquid holdup. In this scenario, pipeline rupture beneath rivers could potentially result in a significant release of hydrocarbon-tainted liquids into the river environment. These environmental impacts should be addressed in a revised DEIS. Examples of liquid releases from natural gas pipelines include:

- A September 3, 2001 rupture in Mid Lousiana Gas Pipeline Company's 22-inch natural gas transmission line (22" T-ML Pipeline) near the Black Bayou in Louisiana resulted in the release of an estimated 8.00 mmcf to 13.00 mmcf of natural gas and an estimated liquids loss of 15,000 gallons (DOT, 2001).

- On June 19, 2014, Energy Transfer Partners, L.P./Panhandle Eastern Pipe Line Company system (ETP/PEPL) released liquid from the Olpe 100 compressor station discharge in preparation to repair a leak that was downstream of the station. The leak was from a 3" crack in a long seam. While there were no local residents evacuated as a result of the liquid released from the natural gas pipeline, media attention occurred and a local golf course five ponds, two small areas with standing water, one small drainage ditch on various properties, five houses, soybean crops, gardens, and pasture land were affected (USDOT, 2014).

## IX. Inventory of Working and Abandoned Mines

Table 4.1.4.1 of the DEIS lists coal mines within ¼ mile of the project. According to the table, 27 abandoned and reclaimed mines are documented as being present in Luzerne County, PA between MP 5.0 and 11.3. Of these, eight are listed as being less than 280 feet from the pipeline centerline, with two listed as being within the pipeline workspace itself. Others are very close. While some people use the terms quarry and mine interchangeably, mines generally refer to underground rock removal operations where rooms and/or tunnels are excavated to remove rock material. Support pillars are left behind in large rooms, thus the term "room and pillar" mines is used. Unless extremely detailed mapping was or is conducted of abandoned mines, assuming they are not flooded and can be entered safely, it is not possible to know whether they do or do not lie directly beneath planned pipeline routes. As mine collapse occurs over time, or catastrophically, ground subsidence and failure may occur - often upwards for thousands of feet. Thus, detailed borings are needed to assess mine locations and the structural integrity of the subsurface along pipeline segments. In the absence of this geotechnical data it is not possible to conclude that proposed pipeline segments are safe or whether alternate pipeline routing is needed.

From a geotechnical standpoint many questions need to be addressed. Some of these include: what is the depth to the mined layer or layers; how high are mined voids; what bedrock formations overlie voids; are there surveyed surface monuments in place that have been used to document land subsidence over time; has ground subsidence/settlement occurred in the area; have pits, sinkholes and/or crevices formed in areas above mine footprints; have streams been pirated underground within mine footprints; are the mines flooded; and have nearby homes or other buildings experienced structural damage due to settlement?

Page 4-3 of the DEIS states:

> "*Where the available information indicates that mines are likely to exist below the pipeline alignment, PennEast would drill borings for confirmation and to determine the length of the pipeline section that would be affected. Mitigation and remedial measures would be implemented, as needed, to minimize the risk of subsidence due to underground mines in accordance with USDOT standards as discussed in the Karst Mitigation Plan.*"

This limited level of actual geotechnical data is not sufficient to allow technical assessment and informed public comment. As such, it is certainly not enough to provide a basis for rational decision making. Page 3-63 of FERC's August 2002 Guidance Manual for Environmental Report Preparation, under the Minimum Requirements to Avoid Rejection states: "*1. Identify the location (by milepost) of mineral resources and any planned or active surface mines crossed by the proposed facilities. ... Describe hazards to the facilities from mining activities, including susbsidence, blasting, slumping or landsliding or other ground failure.*"

While it is not clear why information is not addressed here relative to abandoned or remediated subsurface mines, the number 2 FERC item listed on page 3-63 should solidly require applicants, on mine-by-mine basis, to detail potential mine structural failure based on mine maps and/or boring data under:

> "*2. Identify any geologic hazards to the proposed facilities.*"

Thus, the minimum requirements to avoid rejection have not been met. Clearly, sufficient geotechnical information should be provided for public review and comment before the DEIS is considered complete, and before FERC makes any conclusions about significance of environmental impacts from the applicant's preferred route. Potential pipeline failure due to unstable underlying mines poses serious risk that must be fully addressed upfront, not after approval of the DEIS. Similar considerations apply to karst and landslide prone areas along the proposed pipeline route. Full geotechnical investigation must be conducted prior to issuance of the DEIS, not as an afterthought.

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